

CHAPTER 26

ENVIRONMENTAL STUDIES

Doctoral Theses

01. AHMED (Paritosh)
Behavioural Studies on nesting Painted Storks (*Mycteria leucocephala*): A Videographic approach.
Supervisor: Prof. Abdul Jamil Urfi
Th 28296

Abstract

Understanding animal behaviour is central to behavioural ecology and essential for wildlife management. The use of digital cameras has enabled non-invasive, uninterrupted monitoring of wildlife behaviour. While camera-based studies are largely mammal-focused, recent studies have involved other animals, particularly birds. This thesis focuses on the Painted Stork (*Mycteria leucocephala*), a large, colonial waterbird of South and Southeast Asia, as a model to study thermoregulation, vigilance, and nest-site fidelity during the nesting season, using camera recording approaches. I collected behavioural data from wild Painted Storks at two nesting sites in North India: the National Zoological Park (NZN) and Keoladeo National Park (KNP). Thermoregulatory behaviours such as urohidrosis and wing-spreading were analysed using Generalized Linear Mixed Models (GLMMs) in relation to temperature, humidity, wind speed, and sex. Males exhibited more thermoregulation than females, with behaviours peaking during the hottest periods. Environmental vigilance was examined using GLMMs to assess the effects of visitors, predators, nest proximity, and nestling age. Males were more vigilant than females, and vigilance increased with visitor presence, nestling age, and nest height but declined with increased neighbour density and greater distance from disturbance sources. Site differences were also evident, with higher vigilance observed at NZN. Social vigilance was studied at KNP, focusing on how neighbouring conspecifics influence behaviour in a colony. Vigilance rates were strongly correlated with the number of neighbours. Of 1791 observations, 97% of vigilance events were triggered by neighbouring storks, especially by routine movements. Males and females showed no significant differences in social vigilance. Finally, we documented nest-site fidelity over three years in a male stork identified by a neck scar, highlighting site fidelity in this species. Overall, this research enhances our understanding of stork behavioural ecology and underscores the value of camera-based monitoring in avian studies.

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1. Introduction 2. Literature Review 3. Thermoregulation in Painted Storks 4. Environmental Vigilance in Painted Storks 5. Social Vigilance in Painted Storks 6. Nest-Site Fidelity in Painted Storks 7. Conclusions References and Appendices.

02. FURQAN (Farooqi)
Integrated Assessment of Toxic Organic Pollutants and Enzymatic Strategies for Environmental Remediation.
Supervisor: Prof. Radhey Shyam Sharma
Th 28699

Abstract

Industrial effluents laden with aromatic amines and phenolic compounds represent one of the most persistent threats to aquatic ecosystems and human health. This research presents an integrated framework combining environmental assessment, risk quantification, and enzymatic bioremediation to address toxic organic pollutants in industrially impacted aquatic systems. Comprehensive field investigations across textile-dominated regions revealed that total aromatic amines (Σ_{12} AAs) in water (4.2–19.6 $\mu\text{g L}^{-1}$) and sediments (0.7–8.3 $\mu\text{g g}^{-1}$ dw) exceeded global medians by an order of magnitude, with p-chloroaniline, 2-naphthylamine, and benzidine as dominant species. Site-specific exposure modeling indicated lifetime cancer risks (LCR) up to 9.6×10^{-4} and hazard quotients (HQ) exceeding 3.0, far surpassing USEPA benchmarks. Multivariate analyses attributed ~73 % of pollutant variance to textile effluents, highlighting sediment as both sink and secondary source of contamination. To mitigate these risks, a sustainable enzymatic strategy employing *Prosopis juliflora* peroxidase (MPx) was developed. Under optimized conditions (pH 6–8, 25 °C, 3.6 mM H_2O_2), MPx achieved > 90 % degradation of phenol, 2,4-dichlorophenol, and 4-chlorophenol within 30 minutes, while reducing remediation cost by ~98 % relative to horseradish peroxidase. Microcosm studies using lentic diatom communities demonstrated near-complete ecological recovery (Shannon index ≈ 1.2 ; Simpson ≈ 0.85) within 96 hours post-treatment. The present thesis develops a cost-effective bio-enzymatic remediation paradigm linking pollutant occurrence, toxicological risk, and ecological restoration. It further establishes the necessity of including aromatic amines and phenolics in national water-quality standards and promotes sediment-based monitoring as an essential diagnostic tool for sustainable environmental governance.

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 4. Aromatic Amines in Textile Effluent-Affected Environments: Sources, Environmental Partitioning, and Risk Assessment
 5. Summary and Conclusions. References.
03. GOSWAMI (Vikrant Kumar)
Arbuscular Mycorrhizal Fungi in Recycling of Selected Circular Economy Materials from Industrial Wastes.
 Supervisor: Prof. David Kothama Si
Th 28431

Abstract

Rapid industrialization has generated large quantities of nutrient-rich by-products such as distillery spent wash (DSW), fly ash, and steel slag. These materials, when appropriately reused, can support circular economy goals by substituting synthetic fertilizers. However, their safe agricultural use requires scientific evaluation of their interactions with plants and soil microbes. Arbuscular mycorrhizal fungi (AMF), key symbionts in plant roots, play a crucial role in nutrient acquisition and stress mitigation and may influence the fate of pollutants from such wastes. This research investigates the role of AMF in promoting plant growth and environmental remediation under these industrial by-products representing the circular economy materials. A series of controlled microcosm experiments with *Sorghum bicolor* and *Hordeum vulgare* were conducted to evaluate AMF-mediated effects on plant physiology, nutrient cycling, pollutant degradation and soil chemical dynamics.

Under DSW treatments, AMF enhanced bioremediation efficiency, reducing nutrient leaching and degrading melanoidins from mycorrhizal system leachates. Gas chromatography–mass spectrometry (GC-MS) confirmed the absence of complex organic compounds in the final leachate collected from mycorrhizal systems. With fly ash amendments, AMF improved plant biomass and nutrient acquisition but simultaneously increased translocation of heavy metals (Ni, Co, Pb, and Cr) to grains, highlighting a potential human food chain risk. In contrast, steel slag addition enhanced overall plant yield, yet suppressed AMF root colonisation and extraradical hyphal growth, suggesting reduced long-term symbiotic efficiency under high-nutrient conditions. Across all treatments, AMF consistently lowered nutrient losses, enhanced soil nutrient retention, and modulated pollutant degradation pathways. The findings collectively demonstrate that AMF enhance plant productivity and facilitating bioremediation though their benefits are influenced by the physico-chemical nature of the substrate. The research underscores AMF’s potential as a biological tool for integrating waste recycling into sustainable agriculture, while emphasising the need to balance productivity and ecological safety when using industrial by-products as soil amendments.

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04. PORIA (Pankaj)
Evaluation of Naturally Adapted Microalgae and Bacteria for Efficient Detoxification of Real Textile Effluent.
 Supervisor: Prof. Vandana Mishra
Th 28700

Abstract

The discharge of untreated or partially treated textile effluents, especially in rapidly industrializing nations like India, poses a significant threat to freshwater ecosystems and public health. These effluents are often laden with synthetic azo dyes and their toxic metabolites, such as 4-nitroaniline (4-NA), compounds recognized for their environmental persistence, carcinogenicity, and genotoxicity. Despite ongoing advances in bioremediation, most studies remain constrained to controlled laboratory conditions, focusing predominantly on decolorization while overlooking the detoxification of hazardous by-products and the complex matrix of real effluents. This study addresses this critical gap by evaluating the detoxification potential of indigenous microbial communities naturally adapted to textile-contaminated environments. The research employs real textile effluent containing Acid Black 1 (AB1) and its metabolite 4-NA as the primary contaminants. Two biologically distinct systems were developed: a microalgal monoculture of *Chlorella sorokiniana* and a bacterial consortium comprising *Bacillus firmus* and *Serratia* sp., both isolated from textile wastewater sites. Experimental optimization of key environmental parameters—pH, temperature, photoperiod, mixing regime, and nutrient load—was undertaken to enhance degradation efficiency. Results revealed that both systems achieved substantial removal of AB1 and 4-NA, with the bacterial consortium demonstrating robust scalability and operational stability in a pilot-scale setup. Toxicity assays confirmed a marked reduction in effluent toxicity, validating the

detoxification process rather than mere decolorization. This study contributes to the field by proposing an ecologically informed, scalable, and site-specific microbial strategy for the detoxification of complex textile effluents. The outcomes underscore the utility of employing native microbial consortia for sustainable industrial wastewater treatment and lay the groundwork for future studies integrating omics-based microbial profiling, real-time monitoring, and process modeling for field-scale bioremediation systems.

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1. Integrating Microalgae into Textile Wastewater Treatment Processes: Advancements and Opportunities 2. Advancements and Perspectives on Microalgae-Based Treatment of Real Textile Effluents. 3. Microalgae-Mediated Degradation and Detoxification of Real Textile Effluent 4. Redesigning Effluent Treatment: Simultaneous Iodegradation of Azo Dyes and Aromatic Metabolites in a Single-Step System 5. Scaled-Up Assessment of Microbial Consortia for Textile Dye Bioremediation in Real Industrial Effluent 6. Textile Dye-Environment-Human Interactions: Emerging Risks to Environmental Health. Summary and Conclusions. References.

05. SARMAH (A N Dikshit Akalabya)
Integrative Taxonomy and Systematic Revision of the Subfamily Leptobrachiinae in Northeast India.
 Supervisor: Prof. Sathyabhama Das Biju
Th 28701

Abstract

Amphibians, one of the most threatened vertebrate groups globally, have seen an unprecedented rise in species discovery over the past two decades in India, especially from the Western Ghats and Northeastern regions. However, many of the species described from or found in Northeast India are poorly studied even after decades of their original descriptions or first sightings. The subfamily Leptobrachiinae, belonging to the family Megophryidae, remains particularly understudied despite being known for its high diversity outside the region. This study focuses on investigating the diversity and distribution of Leptobrachiinae in Northeast India through integrative taxonomy and providing a systematic revision based on extensive field surveys, morphological descriptions and comparative analyses, multigene phylogenetics, and bioacoustics. The first two chapters focus on the genus *Leptobrachium*, first addressing the taxonomic status, phylogenetics position, and distribution of *Leptobrachium bompu*, consequently leading to descriptions of two new species in the newly recognised *L. bompu* group, and subsequently resolving long-standing confusions surrounding the identities of *Leptobrachium smithi* populations in India, thereby yielding new records for two other closely related species in the *L. smithi* group. Chapter three reassesses species in the genus *Leptobrachella*, demonstrating that three existing names represent a single taxon, *Leptobrachella khasiorum*, and validating the status of the poorly-known *Leptobrachella lateralis* with additional locality records. Chapter four reviews known and new Indian populations of the high-altitude genus *Scutigiger*, revealing previous misidentifications and two new species. Overall, this comprehensive study resolves taxonomic ambiguities and provides nomenclatural stability within the Leptobrachiinae of Northeast India, reveals four species new to science, clarifies distributions with new records, yields systematic insights among congeners at large, and contributes to filling of knowledge gaps in larval biology, bioacoustics, and conservation. These outcomes will also advance future research and effective conservation planning for this enigmatic and threatened group of frogs.

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1. Introduction 2. An integrative reassessment of *Leptobrachium bompou* (Anura: Megophryidae) with new insights on phylogenetic position, male calls and larval morphology 3. Abundance in secret: A review of the genus *Leptobrachium* (Anura, Megophryidae) in India, with descriptions of two new species 4. A review of the genus *Leptobrachella* Smith, 1925 (Anura: Megophryidae) in India using integrative approaches 5. Hidden up the icy Himalaya: Taxonomy and phylogenetic position of frogs of the genus *Scutigera* (Anura: Megophryidae) in India, with description of a new Species. Future Perspectives. Publications.