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Cicada (Cicadoidea: Hemiptera) Research in Meghalaya, Northeast India: Historical Perspectives and Current Status

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Abstract

Meghalaya, a state within the Indo-Burma biodiversity hotspot, harbors a diverse cicada assemblage (superfamily: Cicadoidea); however, its cicada fauna has remained historically underdocumented. Early taxonomic efforts provided foundational classifications but lacked precise locality data, while mid-20th-century surveys largely overlooked cicadas. The late 20th and early 21st centuries witnessed the emergence of targeted studies, including descriptions of new taxa and the application of bioacoustics and molecular taxonomy. Recent discoveries, such as Chremistica ribhoi, Mata meghalayana, and Becquartina bicolor, indicate Meghalaya's significance as a cicada biodiversity hotspot. Despite these advancements, research gaps persist, particularly in underexplored regions like the Jaiñtia Hills, and taxonomic ambiguities remain due to historical misidentifications. Habitat loss and climate change further threaten cicada populations, emphasizing the need for systematic surveys, molecular phylogenetics, and conservation initiatives to ensure comprehensive documentation and biodiversity preservation.

Keywords: Biodiversity, Cicadoidea, conservation, habitat loss, taxonomy, Jaiñtia Hills.

Introduction

Cicadas (superfamily: *Cicadoidea*) represent a morphologically and behaviorally specialized group of hemipteran insects characterized by their prolonged subterranean nymphal development, species-specific acoustic communication and distinct emergence patterns (Karban 1986). The state of Meghalaya, situated within the Indo-Burma biodiversity hotspot, supports a diverse assemblage of cicadas; however, scientific documentation of this diversity has historically been limited (Lyngdoh *et al.* 2019).

This review synthesizes the progression of cicada research in Meghalaya, spanning early entomological records, mid-20th-century taxonomic ambiguities, late 20th-century developments, and contemporary advances integrating bioacoustics and molecular methodologies

Early records and initial observations (19th to mid-20th century)

The documentation of Meghalaya's cicada fauna can be traced indirectly to colonial-era zoological surveys of Northeast India, although specific references to the state remain scarce. Distant (1906) established the genus *Mata* within *Cicadidae* based on morphological characteristics such as wing venation and body structure, describing taxa from broader Asian regions, some of which likely extended into the forests of Meghalaya. However, his taxonomic assessments lacked precise locality data for the state (Distant 1906). Similarly, Boulard (2007) conducted cicada taxonomic research in Southeast Asia, identifying genera such as *Becquartina*, which were later confirmed within Meghalaya, although no direct records from India existed at the time.

Early 20th-century entomological surveys, such as the Zoological Survey of India's 1922 study of the Siju Cave ecosystem in the Garo Hills, predominantly focused on cave fauna, documenting insect orders such as *Coleoptera* and *Diptera*, yet cicadas were not explicitly recorded (Harries *et al.* 2008). Comprehensive taxonomic catalogs, such as Metcalf's (1963) global cicada compendium, incorporated specimens from "British India," which likely included Meghalaya; however, the absence of specific attributions precluded precise geographic documentation. The reliance on morphology-based identification, coupled with a lack of targeted surveys, resulted in significant gaps in the taxonomic resolution of Meghalaya's cicada fauna.

Mid-20th century: sparse documentation and regional context

During the mid-20th century, cicada research in Meghalaya remained peripheral within broader entomological surveys. Retrospective analyses by Price *et al.* (2016) emphasized the scarcity of taxonomic studies focused on Northeast India's cicadas during this period, attributing the deficit to logistical challenges and the inherent difficulties of taxonomic delineation within the group.

For instance, Chopra and Kemp's 1922 biospeleological study of the Siju Cave complex, while significant for troglobitic insect research, did not record cicadas, either due to their absence from cave ecosystems or inadvertent omission (Harries *et al.* 2008).

Regional taxonomic checklists, such as Sanborn's (2013) compilation of Indian cicadas, provided species distributions at a national scale but lacked granularity for Meghalaya due to their reliance on historical datasets from British India (Sanborn 2013). Furthermore, although indigenous Khasi and Garo communities likely possessed ecological knowledge of cicadas, the absence of ethnobiological documentation in entomological literature resulted in an incomplete understanding of the state's cicada diversity.

Late 20th century to early 2000s: Emergence of targeted studies

The late 20th and early 21st centuries marked the initiation of targeted cicada studies within Meghalaya. Hajong and Yaakop (2013) provided a significant taxonomic breakthrough with the description of *Chremistica ribhoi*, a periodical cicada endemic to the Ri Bhoi district. This species remains the sole known periodical cicada in India exhibiting synchronized emergence cycles. The study employed morphological diagnostics, such as wing venation and tymbal structure, in conjunction with bioacoustics analyses of call patterns, to validate species identity. The discovery of *C. ribhoi* underscored Meghalaya's potential as a cicada biodiversity hotspot and emphasized the importance of acoustic characterization in taxonomic assessments (Hajong and Yaakop 2013).

Subsequently, Price *et al.* (2016) compiled an annotated catalog of cicadas spanning South Asia, recognizing Meghalaya as a region of significant but understudied cicada diversity. The study included *Chremistica ribhoi* and hypothesized the presence of additional genera such as *Mata* and *Salvazana*, based on biogeographic affinities with adjacent regions. However, the assessment was primarily reliant on literature-based analyses and museum collections rather than extensive field-based research within Meghalaya (Price *et al.* 2016). These studies established the foundation for further investigations by highlighting the necessity for detailed regional surveys.

Modern era: taxonomic refinement and new discoveries (2010s–present)

The 2010s and early 2020s witnessed a resurgence in cicada research in Meghalaya, facilitated by advancements in molecular phylogenetics, bioacoustic profiling, and targeted field expeditions. Sarkar *et al.* (2021) described three novel species of *Mata*—*Mata meghalayana*, *Mata lenonia*, and *Mata ruffordii*—collected from the Khasi and Garo Hills. The taxonomic delineation was based on morphological characters (e.g., tymbal and wing structural attributes) and detailed acoustic analyses, refining the taxonomic framework for the tribe *Oncotympanini*.

A landmark discovery followed with the documentation of *Becquartina bicolor* by Sarkar *et al.* (2024), marking the first confirmed record of the genus *Becquartina* in India. Specimens were collected from Balpakram National Park (South Garo Hills) in 2017 and the Nongkhrah community forest (Ri Bhoi) in 2020. The species, informally referred to as the "Butterfly Cicada" due to its striking saffron-and-black wing coloration, was characterized through morphological assessments, photographic documentation, and bioacoustics profiling. Notably, its call exhibited geographical variation, with distinct diurnal and crepuscular calling patterns observed across different populations. This discovery extended the known distribution of *Becquartina* from Southeast Asia into Northeast India, increasing the documented species count within the genus to seven (Sarkar *et al.* 2024).

Hajong's extensive fieldwork further contributed to the documentation of Meghalaya's cicada diversity. His research on *Salvazana mirabilis mirabilis*, first reported from Ri Bhoi in 2016, expanded the species' known biogeographic range, which was previously restricted to Southeast Asia. The identification was substantiated through call recordings and morphological analyses (Hajong and Thangkhiew 2018). His long-term studies reinforced Meghalaya's status as a cicada biodiversity hotspot, emphasizing the critical role of its forested landscapes in fostering endemic species (Shillong Times 2024).

Current understanding and challenges

Recent documented cicada species in Meghalaya encompass taxa from the genera *Chremistica*, *Mata*, *Becquartina*, and *Salvazana*, with *Chremistica ribhoi* remaining India's only known periodical cicada. The region's cicadas inhabit diverse ecological niches, including primary forests and community-protected landscapes such as Balpakram National Park and the Nongkhrah forest. The application of bioacoustic methodologies has significantly enhanced taxonomic precision, enabling the identification of species-specific call patterns and facilitating behavioral studies (Sarkar *et al.* 2021, 2024).

However, research gaps persist. Incomplete historical records, underexplored habitats (e.g., the Jaiñtia Hills), taxonomic inconsistencies due to misidentifications in early literature (Price *et al.* 2016), and anthropogenic threats such as deforestation and climate change pose significant challenges (Sarkar *et al.* 2024). The reliance on opportunistic discoveries rather than systematic surveys further constrains comprehensive documentation, and molecular phylogenetic studies remain in their nascent stages.

Conclusion

The trajectory of cicada research in Meghalaya has transitioned from sparse colonial-era records to a dynamic field integrating morphological, bioacoustic and molecular methodologies. While early entomological surveys offered limited insights due to taxonomic ambiguities and geographic omissions, recent advancements have significantly refined species identification and expanded knowledge of regional cicada diversity. The discovery of new taxa, such as *Chremistica ribhoi*, *Mata meghalayana*, and *Becquartina bicolor*, has underscored Meghalaya's importance as a biodiversity hotspot.

Despite these advancements, considerable gaps remain. Several regions, such as the Jaiñtia Hills and lesser-explored forested landscapes, require targeted field studies to uncover undocumented species. Additionally, molecular phylogenetic analyses remain in their early stages, limiting our understanding of evolutionary relationships within the regional cicada assemblage. Bioacoustic profiling has proven instrumental in species delineation, yet further studies on acoustic variations across microhabitats and populations are necessary.

Future research should prioritize systematic surveys to ensure comprehensive species documentation including ecology and molecular phylogenetics to resolve taxonomic uncertainties and evolutionary lineages, and conservation initiatives to mitigate the impact of habitat loss and climate change. Strengthening collaborations between taxonomists, ecologists, and local communities will be essential for long-term preservation of Meghalaya's cicada fauna. As anthropogenic pressures intensify, a proactive research-driven approach will be crucial in safeguarding these ecologically significant yet understudied insects.

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