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ABSTRACT BOOK

Editors

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Editors

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Mesozoic cicada evolution: Morphological development, sound communication, subterranean lifestyle, and root-feeding behaviours

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Modern Cicadoidea (Hemiptera) includes the widespread Cicadidae and Tettigarctidae, which is thought to be more relictual and only distributed in Australia. Traditional classifications have placed Mesozoic cicadoid fossils within these two groups based on distinct, yet minimally varying, morphological features similar to those of their modern counterparts. This way, however, may ignore some evolutionary nuances and transitional characteristics that fossils offer, potentially obscuring our understanding of Cicadoidea lineage relationships and their early ecological roles. In our research, we utilize new findings of adult and nymphal cicadoids from the mid-Cretaceous Kachin amber of northern Myanmar, alongside a review of previously published data, to assess the phylogenetic relationships and morphological disparities within Cicadoidea, incorporating both fossil and extant taxa. Morphological phylogenetic analyses reveal that the 'Tettigarctidae' group, encompassing Mesozoic fossils, is paraphyletic. This suggests certain Mesozoic cicadoids, previously classified as Tettigarctidae, may actually belong to stem cicadids, indicating a divergence between Cicadidae and Tettigarctidae by at least the Middle Jurassic, based on analyses including fossils from Daohugou, Inner Mongolia, China. Morphological disparity analysis across developmental stages and body parts shows changes in homologous structures between fossil and extant groups, revealing transitional variations that highlight the impact of spatial and temporal factors on morphological macroevolution. What's more, we discovered tymbals in some mid-Cretaceous cicadas. The presence of these structures in both sexes across all phylogenetically reconstructed cicadoid stem groups suggests that possessing tymbals is an ancestral trait of Cicadoidea. The absence of sophisticated sound-producing and hearing structures in most complete fossils implies that mid-Cretaceous cicadoids likely lacked the capability to produce and perceive high-decibel songs like modern singing cicadas (Cicadidae). Our reserach also reported on the known cicadoid final-instar nymphs and exuviae, notably characterized by fossorial forelegs and elongated piercing-sucking mouthparts. This suggests that by the mid-Cretaceous, these ancient nymphal cicadas had already adopted a subterranean lifestyle and specialized in feeding on root sap. In sum, our study traces the morphological evolution of Cicadoidea since the Mesozoic and tries to illuminate their ecological niches, behaviors and survival strategies. We are trying to provide a broader understanding of adaptive trait variations among fossil cicadas and their environmental interactions, offering new insights into the evolutionary history of this fascinating group.