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EDITED AND REVIEWED BY
Mark A Elgar,
The University of Melbourne, Australia

*CORRESPONDENCE
Mario E. Favila
✉ mario.favila@inecol.mx

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Editorial: Neotropical dung beetle diversity: ecological, historical, and anthropogenic perspectives

Mario E. Favila^{1*}, Jorge Ari Noriega², Pedro Giovâni da Silva³
and Vanesca Korasaki⁴

¹Red de Ecoetología, Instituto de Ecología (INECOL), Xalapa, Mexico, ²Grupo Agua, Salud y Ambiente, Faculty of Engineering, Universidad El Bosque, Bogotá, Colombia, ³Departamento de Ecología, Programa de Pós-Graduação em Ecologia, Instituto de Ciências Biológicas, Universidade de Brasília, Brasília, Brazil, ⁴Departamento de Ciências Agrárias e Biológicas, Universidade do Estado de Minas Gerais, Frutal, Brazil

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Editorial on the Research Topic

Neotropical dung beetle diversity: ecological, historical, and anthropogenic perspectives

The Neotropical region hosts the highest diversity of dung beetles worldwide, linked to the diversity of mammals that thrive in the ecosystems of this region, particularly in its extensive tropical forests. The large amount of feces produced by herbivorous and omnivorous mammals in the natural and modified ecosystems of the Neotropical region is used by dung beetles for feeding and reproduction, but many species consume carrion and decomposed fruits including mushrooms, and even are predators of insects. Therefore, Neotropical dung beetles provide one of the most critical ecosystem services: organic waste recycling. However, our understanding of their behavior, biology, ecology, and taxonomy in this region still needs to be improved. We invite researchers from different countries of Latin America who are investigating various aspects of the biology, behavior, ecology, evolution, and taxonomy of Neotropical dung beetles to participate in our Research Topic.

In the Neotropical region, forests are being converted to grasslands. As a result, the species composition of dung beetles is also changing, and the dung deposited by cattle in pastures is consumed and recycled into the soil by these new dung beetle communities. The ecological roles of dung beetles that contribute to human ecosystem services in these transformed ecosystems encompass improved soil nutrient cycling, bioturbation, plant growth promotion, secondary seed dispersal, control of fly populations, and parasite suppression. [Arellano et al.](#) have reviewed the available literature on taxonomic diversity, functional diversity, and ecological functions of dung beetles in Neotropical grazing lands. They highlight the current knowledge gaps regarding the impact of livestock management practices, forms, and the historical context on dung beetle diversity. To enhance ecological studies in these lands, they have proposed a standardized data collection format that distinguishes among the diverse tropical grazing lands documented in the literature.

Andresen and Urrea-Galeano have reviewed one of the most studied ecosystem services of dung beetles in the Neotropical region: secondary seed dispersal. These authors have analyzed the current knowledge on the influence of dung beetles on the structure and dynamics of seed banks and their impact on tropical forest plants through the dispersal of defecated seeds. They have also explored the crucial role of secondary seed dispersal in the performance of understory seedlings. They believe that this comprehensive review will inspire further investigation into the fascinating interactions between dung beetles and plants in tropical ecosystems.

The methodology used for collecting and monitoring dung beetles to evaluate their communities has recently been questioned, as the conclusions drawn can change depending on the methods used. Mora-Aguilar et al. analyzed the various methodologies employed in dung beetle biodiversity studies in the Neotropical region, ranging from pitfall traps to supplementary techniques. They have proposed a standardized protocol for dung beetle sampling tailored to specific research objectives, including a fundamental methodology for generating comprehensive local inventories. In their review, Rivera and Favila explored the interaction between sampling intensity, sampling coverage, habitat type, and the journal-impact factor in peer-reviewed research in the Neotropical region. From this review, they have suggested sampling guidelines to ensure robust dung-beetle diversity assessments while preventing oversampling.

Studies of dung beetle diversity have been carried out primarily in natural and modified tropical forests. The research by Simões-Clivatti and Hernández addressed the complex dynamics influencing dung beetle metacommunities in native subtropical forests and *Pinus* monocultures. Their analysis evaluated factors such as habitat type, vegetation, mammalian presence as a food resource, and temperature, shedding light on the drivers shaping these assemblages. The metrics they used did not reflect the difference in the environmental quality of the areas with respect to species richness and diversity in different habitats. They suggest supplementing the assessment with composition analysis methods.

Villamarin-Cortez et al. examined diversity and distribution patterns of dung beetles in Ecuador. Their research underscores the crucial role of elevation and precipitation in shaping the distribution of dung beetle assemblages in the country, providing a framework for assessing dung beetle habitats and diversity at various scales within the broader Neotropical region.

The association between mammals and dung beetles in the Neotropical region has been consistently recognized, but needs a more in-depth analysis. Halffter and Favila addressed the intricate relationship between dung beetles and primates in Neotropical forests. In South America, the diversity of arboreal dung beetles associated with monkeys exceeds that observed in tropical forests in Mexico and Central America. These authors suggested a systematic and comparative methodology to shed light on the foraging behaviors of arboreal beetles and their role in recycling arboreal dung.

Dung, carrion, and other wastes consumed by dung beetles are recycled into the soil via the reproductive behaviors of dung beetles. Huerta et al. outlined a comprehensive summary of field and laboratory studies on the reproductive behavior of Neotropical dung

beetles. Their review identified geographic and habitat gaps in the current knowledge on the nesting behavior of these beetles. To address these gaps, they have proposed future research objectives and suggested alternative methodologies for analyzing the behavioral responses of Neotropical dung beetles facing the impact of human activities.

Dung beetles are a suitable model for examining the historical and contemporary factors associated with the speciation process in the Mexican Transition Zone (MTZ), where the Nearctic and Neotropical regions converge. Within the MTZ, dung beetles inhabit diverse environments that promote *in-situ* and vicariant allopatric differentiation of their populations. Nolasco-Soto et al. analyzed the most well-studied dung beetle species of the Neotropical region, *Canthon cyanellus*, which is actually a species complex, focusing on its ecological and evolutionary aspects. They examined the current understanding of divergent patterns that have defined the speciation process within this species complex. Their conclusion underscores the significance of merging traditional morphological taxonomy with phylogeography to gain insight into the speciation dynamics of *C. cyanellus* and other dung beetle species.

Finally, Cupello et al. have highlighted a pivotal period in dung beetle research in the Neotropical region. The “Taxonomic Revolution of New World Dung Beetles” began in 1988 and marked a significant surge in taxonomic studies of Scarabaeinae dung beetles in the New World. Simultaneously, an “Ecological Revolution of Dung Beetles” is characterized by the expansion of ecological studies on these organisms. These authors have stressed the importance of collaboration between ecologists and taxonomists in advancing the scientific understanding of the natural history of Neotropical dung beetles.

As a continued effort to summarize and expand the understanding of the natural history of dung beetles, we are pleased to dedicate this Research Topic to Prof. Gonzalo Halffter, a pioneer in investigating the natural history of dung beetles.

These contributions will catalyze new research and inspire young students and researchers to investigate dung beetles in the Neotropical region and tropical regions worldwide.

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