



First record of *Pelmatosilpha villana* Saussure & Zehntner, 1893 (Blattodea: Blattidae) associated with bromeliads in Campo Rupestre in Brazil

Primer registro de *Pelmatosilpha villana* Saussure & Zehntner, 1893 (Blattodea: Blattidae) asociada a bromelias en Campo Rupestre en Brasil

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Abstract

This study provides the first record of the association between the cockroach *Pelmatosilpha villana* Saussure & Zehntner, 1893 (Blattodea: Blattidae) and three bromeliad species (*Billbergia* cf. *vittata*, *Vriesea medusa*, and *Vriesea* sp.) on rocky outcrops of Campo Rupestre in Pico do Itambé State Park, Minas Gerais, Brazil. Cockroaches, both juveniles and adults, were recorded in five bromeliads belonging to three species sheltered within the bromeliad rosettes, close to the phytotelmata. Given the saprophagous habit of cockroaches, it is likely that these insects exploit the organic matter accumulated in the bromeliads, potentially contributing to nutrient cycling. This interaction may benefit the bromeliads through the fragmentation and decomposition of organic material, thus promoting the release of essential nutrients, especially important in nutrient-poor soils such as those of the Campo Rupestre. These findings highlight the need for further research on the ecological interactions between cockroaches and bromeliads to better understand their ecological roles within this biome.

Keywords: Blattaria, Bromeliaceae, cockroach, ecological interaction, phytotelmata

Resumen

Este estudio registra, por primera vez, la asociación de la cucaracha *Pelmatosilpha villana* Saussure & Zehntner, 1893 (Blattodea: Blattidae) con tres especies de bromelias (*Billbergia* cf. *vittata*, *Vriesea medusa* y *Vriesea* sp.) en afloramientos de Campo Rupestre en el Parque Estatal Pico do Itambé, Minas Gerais. Los individuos se encontraron refugiándose en las rosetas de las bromelias, cerca de los fitotelmos. Considerando el hábito saprófago de las cucarachas, es probable que estos insectos exploren la materia orgánica acumulada en las bromelias, lo que podría contribuir al ciclo de nutrientes. Esta interacción podría ser beneficiosa para las bromelias, debido a la fragmentación y descomposición de la materia orgánica y, consecuentemente, a la liberación de nutrientes esenciales, especialmente en ambientes con suelos pobres, como los de Campo Rupestre. Los resultados refuerzan la necesidad de realizar más estudios sobre las relaciones ecológicas entre cucarachas y bromelias para comprender mejor esta relación en este bioma.

Palabras clave: Blattaria, Bromeliaceae, cucaracha, fitotelmata, interacción ecológica

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Campo Rupestre is one of Brazil's most threatened ecosystems, characterized by nutrient-poor soils, quartzite and ferruginous outcrops, high solar exposure, altitudes above 1,000 meters, and considerable environmental heterogeneity (Giulietti et al., 2000). These features explain the high rates of endemism found in this environment (Conceição & Pirani, 2007; Echternacht et al., 2011), including bromeliads (Versieux, 2008). Bromeliads play a fundamental ecological role in this habitat by functioning as microhabitats that collect water and organic matter, providing shelter, food, and breeding sites for various organisms, especially arthropods (Benzing, 2000; Dézerald et al., 2017; Frank & Lounibos, 2009; Jorge et al., 2021).

The relationship between bromeliads and their associated arthropods is complex and involves different ecological interactions, such as commensalism and mutualism (Frank & Lounibos, 2009). A wide variety of arthropods interact with bromeliads, including ants (Rosumek et al., 2008), bees (Zillikens et al., 2001), social wasps (Souza et al., 2014), termites (Viana-Junior et al., 2014), and cockroaches (Jorge et al., 2024).

Cockroaches are poorly studied from an ecological perspective (Grandcolas et al., 2024), despite their important roles in ecosystems, particularly as decomposers (Prabakaran & Senraj, 2024). Traditionally associated with subterranean habitats, decaying logs, or areas rich in organic matter, many cockroach species are saprophagous and contribute to the fragmentation of plant debris and nutrient cycling (Bell et al., 2007). Some species have occasionally been reported in association with bromeliads (Albuquerque & Lopes, 1976), suggesting that these insects may benefit from the humid microclimatic conditions and organic resources found in phytotelmata, as observed in studies conducted in Brazil's semi-arid region (Jorge et al., 2024). However, such records remain sparse, and there is a lack of studies exploring these associations in the context of Campo Rupestre.

In this context, the present study aims to report the occurrence of cockroaches (Blattodea) associated with different bromeliad species in a remnant of Campo Rupestre in the state of Minas Gerais, Brazil.

Five observations were made opportunistically on February 22, 2025, during an insect and arachnid biodiversity survey in Pico do Itambé State Park (PEPI) (18°26'37.7"S 43°20'20.4"W), located in the Espinhaço Range, Minas Gerais, Brazil. The park contains patches of Atlantic Forest, with quartzitic outcrops and shallow rocky soils at higher elevations, where Campo Rupestre predominates (Chaves et al., 2012).

Around 8 p.m., cockroaches, both juveniles and adults, were recorded in five bromeliads belonging to three species. These bromeliads occurred on rocky outcrops within the same area, at an altitude of nearly 2,000 m. The number of cockroaches colonizing each bromeliad was counted; however, not all individuals were collected, as some hid or escaped. In total, seven specimens were collected, preserved in 70% ethanol, and sent to researcher Edivar Heeren de Oliveira (Museu Nacional, Universidade Federal do Rio de Janeiro - UFRJ) for identification and deposition (MNRJ-ENT2-004740). The bromeliads were identified by photographs by Dr. Leonardo M. Versieux (Universidade Federal do Rio Grande do Norte - UFRN).

The cockroach *Pelmatosilpha villana* Saussure & Zehntner, 1893 (Blattodea: Blattidae) was recorded in association with three bromeliad species at PEPI: *Billbergia* cf. *vittata* (Bromelioideae), *Vriesea medusa* Versieux, and *Vriesea* sp. (Tillandsioideae) (Figure 1). The genus *Pelmatosilpha* comprises 24 species, eight of which occur in Brazil (Beccaloni, 2019). Among them, only *P. villana* has been reported from Minas Gerais, as well as from Panama (Albuquerque & Lopes, 1976; Hollier et al., 2023), with scarce information available on its ecology and biology.

The first observation occurred in three individuals of *B. cf. vittata*, where an average of eight cockroaches were found. Four were collected, including two males and two females of *P. villana* (Figures 2A and 2B). Subsequently, four individuals were recorded in *V. medusa* (Figure 2C), from which two were collected, a female and a male. Finally, a single adult male was observed in *Vriesea* sp. In all cases, the cockroaches were located within the rosettes, approximately 1–5 cm from the phytotelmata. Behavioral observations were limited due to the evasive nature of the

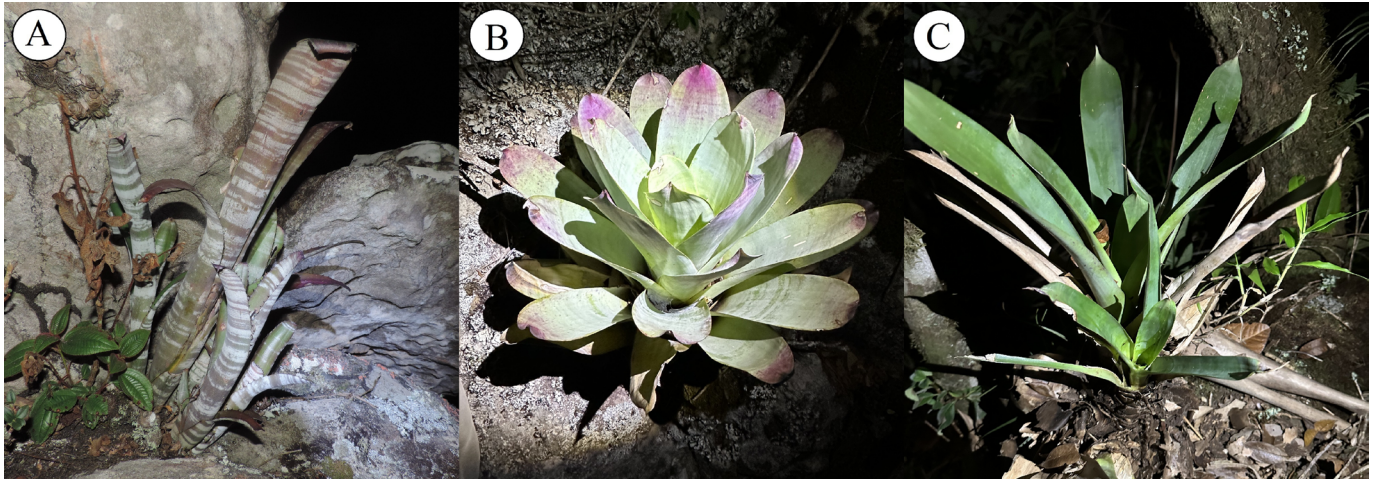


Figure 1. Bromeliad species occupied by *Pelmatosilpha villana*: *Billbergia* cf. *vittata* (A), *Vriesea medusa* (B), and *Vriesea* sp. (C) in Pico do Itambé State Park, Minas Gerais, Brazil.

cockroaches, which quickly retreated deeper into the rosettes when disturbed.

Although feeding behavior was not directly observed, the proximity of the cockroaches to the phytotelmata and their known saprophagous habits (Bell et al., 2007; Grandcolas et al., 2024) suggest that they likely exploit the organic detritus accumulated in the bromeliad phytotelmata, a structure like a cistern that collects rainwater and organic debris (Benzing, 2000). Jorge et al. (2024) observed cockroaches feeding on bromeliad tissues and available resources such as nectar, pollen, and animal remains, revealing a generalist and opportunistic diet.

Another key aspect is the context of this interaction. The rocky outcrops where the bromeliads grow are highly exposed to sunlight (Giulietti et al., 2000), and the bromeliad rosettes may offer protection from direct radiation. In addition to providing shade, the interior of bromeliads maintains higher relative humidity compared to the surrounding environment (Jorge et al., 2021). In environments characterized by shallow or absent soils, limited water retention and groundwater formation, and intense solar radiation like Campo Rupestre (Giulietti et al., 2000; Vasconcelos, 2011), microhabitats with increased humidity and reduced exposure, like bromeliads, may be recurrently used by cockroaches. Nevertheless, further research is

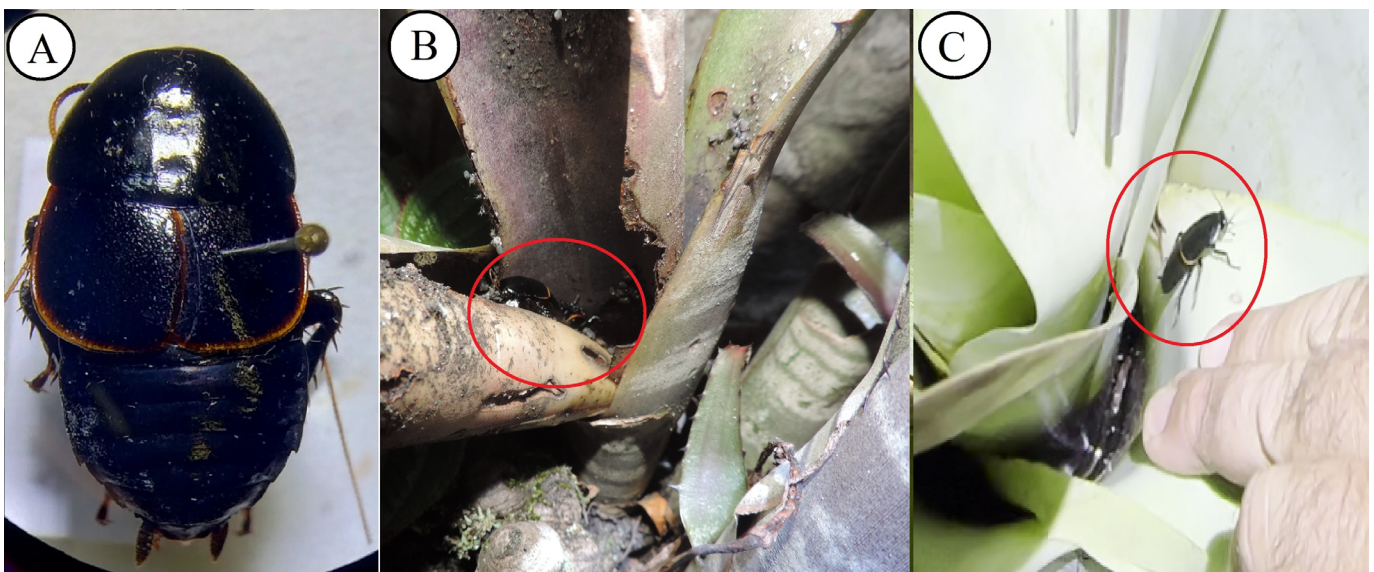


Figure 2. Individuals of *Pelmatosilpha villana* (A) within the rosettes of *Billbergia* cf. *vittata* (B) and *Vriesea medusa* (C) in Pico do Itambé State Park, Minas Gerais, Brazil.

required to clarify the ecological implications of cockroach use of Bromeliaceae in Campo Rupestre.

The simultaneous presence of nymphs and adults suggests that bromeliads may serve as reproductive sites. Their rosettes create moist, sheltered microhabitats with organic accumulation and stable temperatures (Dézerald et al., 2017; Frank & Lounibos, 2009; Jorge et al., 2021), favorable conditions for oviposition and nymphal development. These features make bromeliad rosettes potential breeding sites, especially in harsh environments where suitable shelters are scarce (Giulietti et al., 2000).

This interaction may also benefit bromeliads, as saprophagous cockroaches, by fragmenting and decomposing accumulated organic material, can promote the release of essential nutrients such as nitrogen and phosphorus (Irmeler & Furch, 1979; Tarli et al., 2018), which can be absorbed through the leaves via phytotelmata water (Benzing, 2000; Frank & Lounibos, 2009). This contribution is particularly important in the nutrient-poor soils of Campo Rupestre (Giulietti et al., 2000), where bromeliads rely on alternative nutrient sources. Nonetheless, this hypothesis requires further investigation.

The higher abundance of cockroaches in *B. cf. vittata* compared to the other bromeliads may be related to morphological differences, such as rosette width, water retention capacity, and organic matter accumulation, factors known to influence the selection of bromeliad microhabitats by arthropods (Frank & Lounibos, 2009).

Vriesea medusa is a species endemic to PEPI (Versieux, 2008) and the nearby Rio Preto State Park (Versieux et al., 2010), both in the Espinhaço Range. Its restricted geographic distribution makes it particularly vulnerable to environmental disturbances and habitat loss. Understanding its ecological interactions is essential to conservation efforts targeting the associated microecosystems and biodiversity.

In this context, a micro-endemic frog species in PEPI, *Crossodactylodes itambe* (Anura: Leptodactylidae), with an average body size of 15.7 mm, are known to use *V. medusa* exclusively (Barata et al., 2013; Santos et al., 2017). Although

no direct association was observed between the cockroaches and this anuran, the shared use of the same bromeliad species may indicate niche and habitat overlap, potentially leading to competition for food or reproductive sites, as well as other indirect trophic interactions. Given the endemism and vulnerability of *C. itambe*, understanding and monitoring these interactions is essential for the conservation of both the species and the ecological processes tied to the bromeliads of the park.

The record of *P. villana* associated with different bromeliad species in Campo Rupestre demonstrates that these plants offer favorable shelter and microclimatic conditions for saprophagous cockroaches. Furthermore, by exploring organic matter within phytotelmata, these insects may contribute to nutrient cycling and indirectly benefit bromeliad health in nutrient-poor environments.

It is important to note that the conclusions of this study should be interpreted with caution, as they are based on a relatively limited sample and aim primarily to document this first record. Future investigations should encompass systematic surveys across different seasons and localities, complemented by experimental approaches, to elucidate more precisely the ecological role of cockroaches in nutrient cycling and in the dynamics of bromeliad-associated communities.

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AUTHOR CONTRIBUTIONS

G CJ: Project coordination; writing and final review of the article; photo editing; L C S A: Research; initial writing of the article; A I B: Research; initial writing of the article; E H O: Cockroach

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CONFLICT OF INTEREST

The authors declare no competing interests.

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