



First occurrence of Blattodea and their association with ants (Hymenoptera: Formicidae) in abandoned social wasp nests (Hymenoptera: Vespidae: Polistinae)

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Abstract. Abandoned nests of social wasps are used by various arthropods, however, there are no records of cockroaches. Therefore, the objective of this study is to report the occurrence of cockroaches in abandoned social wasp nests. The first record occurred in a Cerrado area, Brazil, where a nymph (Ectobiidae) of a cockroach (*Cahita* Hebard, 1922) was found in an abandoned social wasp nest. The second record involved three cockroach nymphs (Blattodea: Ectobiidae), found alongside an ant *Camponotus* sp. (Hymenoptera: Formicidae) in an abandoned nest located in a transition area between the Atlantic Forest and Cerrado biomes. Although the exact reason for their presence cannot be defined, it is possible that the cockroaches were foraging for food or shelter from the rain. This is the first record of cockroaches occupying abandoned social wasp nests and the first record of another insect species occupying an abandoned social wasp nest alongside ants. Given the presence of Blattaria in more than one nest and in different locations and biomes, it can be suggested that this occupation is not merely incidental. However, further studies are necessary to determine the frequency of cockroach use of abandoned nests and to better understand the importance of these nests as microhabitats for these insects.

Keywords: ant; *Cahita*; *Camponotus*; cockroach; Ectobiidae.

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Social wasps (Hymenoptera: Vespidae: Polistinae) primarily construct their nests using plant materials, exhibiting diverse architectural designs (Wenzel 1998; Carpenter & Marques 2001). Nests belonging to the tribes Polistini and Mischocyttarini are typically small, consisting of a single comb with only a few dozen cells and lacking a protective envelope. In contrast, nests of the tribe Epiponini are generally larger, containing a greater number of cells and combs; furthermore, most genera in this tribe possess a protective envelope (Carpenter & Marques 2001).

Colonies of social wasps are subject to attacks by various insects, including parasites (Cervo 2006), parasitoid wasps and flies (Jacques *et al.* 2022a; Francisco *et al.* 2022), ants (Souza *et al.* 2022a), and vertebrates such as birds (Rossetto 2021) and mammals (Virgínio *et al.* 2015). Once social wasps abandon their nests, these structures can be occupied by a variety of organisms, including ants (Souza *et al.* 2022b), spiders (Simões-Silva *et al.* 2024), termites (Jacques *et al.* 2023), beetles (Jacques *et al.* 2024a), bees (Pinto 2005), and solitary wasps (Jacques *et al.* 2022b, 2024b). Due to their durability, these abandoned nests provide protection against predators (Wenzel 1998; Somavilla *et al.* 2012; Milani *et al.* 2020) and serve as mechanical barriers against environmental factors such as rain, owing to the hydrophobic composition of the nest's building material (Schmolz *et al.* 2000).

Although abandoned social wasp nests offer advantageous characteristics for various species, little is known about the taxa that occupy these structures. Thus, this study aims to report the occurrence of Blattaria in abandoned social wasp nests located in the Cerrado, specifically within the Grande Sertão Veredas National Park, and in a transition area between the Cerrado and Atlantic Forest in the municipality of Luminárias. Such studies are justified as they contribute valuable information regarding the ecological importance of abandoned wasp nests.

Records were made during studies aimed at investigating the diversity of social wasps and the use of their abandoned nests by other animals in various areas of Minas Gerais, Brazil. The first study was conducted in the Cerrado biome within Grande Sertão Veredas National Park (-15.1000000, -45.816389), located in the municipality of Chapada Gaúcha, northern Minas Gerais, Brazil, between September 2022 and April 2023, totaling 24 field days. The second study took place in a transition area between the Cerrado and Atlantic Forest in the municipality of Luminárias (-21.383333, -44.866667), Minas Gerais, Brazil, from May 2023 to March 2024, encompassing a total of 21 field days.

Collections were conducted between 9:00 a.m. and 1:00 p.m., and between 4:00 p.m. and 6:00 p.m. by a team of four researchers who actively searched for abandoned social wasp

1C, D). nests (Souza & Prezoto 2005), aiming to document their use by other animals. Once nests were located, they were collected and examined in the field for other animals that might occupy them. Cockroaches (Blattodea) and ants found in the nests were sacrificed and preserved in 70% alcohol. The cockroach specimens were sent to researcher Edivar Heeren de Oliveira at the National Museum of the Universidade Federal do Rio de Janeiro (UFRJ) for identification. Ant identification was performed by Prof. Dr. Ricardo Ribeiro de Castro Solar at the Universidade Federal de Minas Gerais (UFMG).

Cockroaches were found in two abandoned social wasp nests: one in Grande Sertão Veredas National Park on April 18, 2023, and the second in the municipality of Luminárias on November 22, 2023.

The first nest was located on an unidentified plant, 1.5 m above the ground, near the Córrego da Onça stream. This nest had a protective envelope and three layers of cells, with some dead pupae and larvae present. A single nymphal-stage cockroach of the genus *Cahita* (Hebard, 1922) (Blattodea: Ectobiidae: Blattellinae) (Figure 1A, B), measuring 6 mm in length, was found in the last layer of cells within the nest.

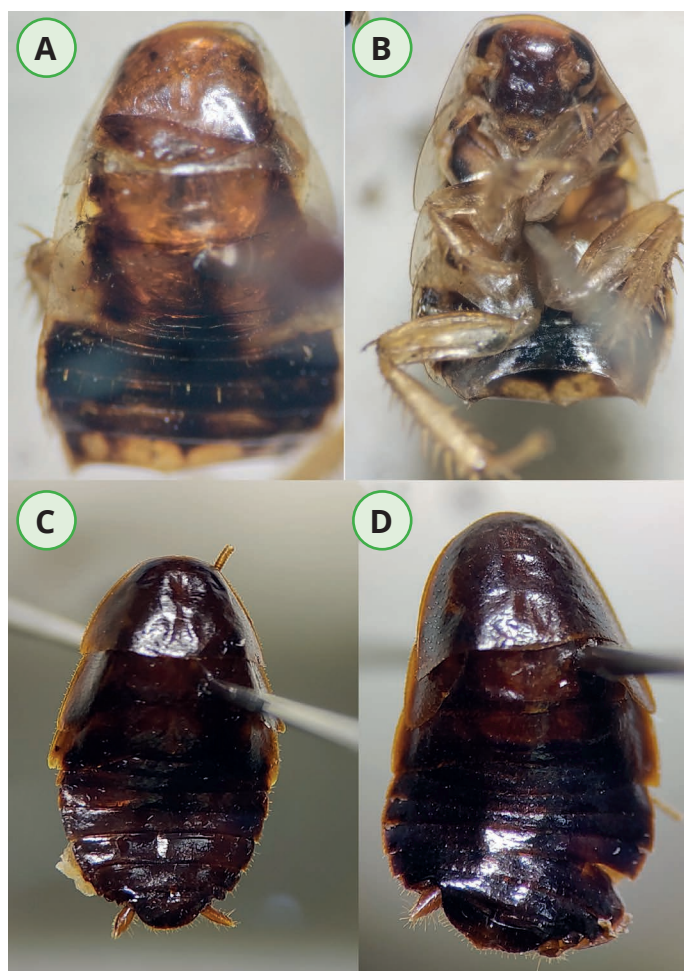


Figure 1. Dorsal view (A) and ventral view (B) of *Cahita* sp. collected from an abandoned social wasp nest in the Grande Sertão Veredas National Park; two nymphs of cockroaches (C, D) collected from an abandoned social wasp nest in the municipality of Luminárias.

In the second record, the nest was located under a rock (Figure 2A), 2.5 m above the ground on the banks of the Cachoeira do Mamomo. This nest had previously been found active during an earlier collection, with the wasp identified as *Polybia fastidiosuscula* (Saussure, 1854) (Hymenoptera: Vespidae: Polistinae). The nest, which had an envelope and four layers of cells, was collected, revealing the presence of both live and dead wasp pupae and larvae, as well as three first-instar nymphs of cockroaches, also from the family Ectobiidae, measuring between 5 and 6 mm in length (Figure

1C, D).

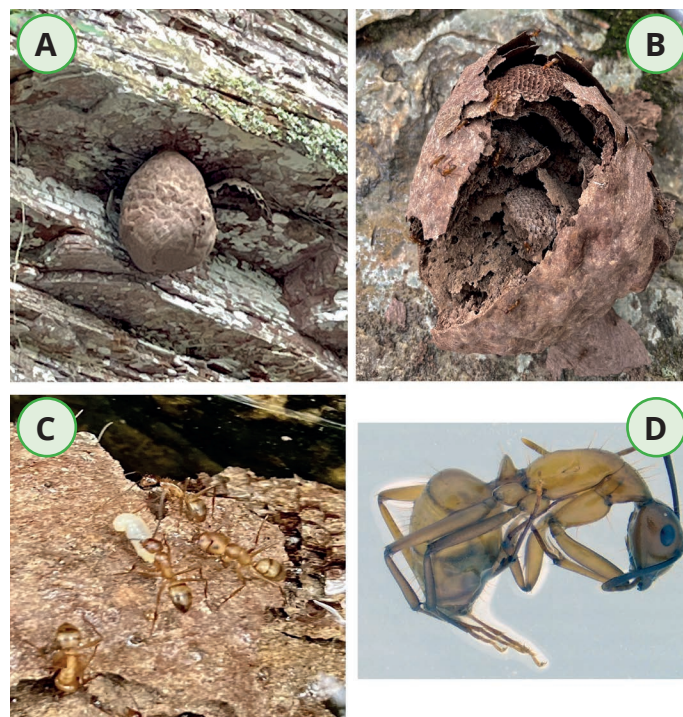


Figure 2. Abandoned *Polybia fastidiosuscula* nest (A), occupied (B), and predated (C) by *Camponotus* sp. (D).

In addition to the cockroaches, ants were observed occupying the nest (Figure 2B) and preying on the wasp larvae and pupae (Figure 2C). The ant was identified as *Camponotus* sp. (Hymenoptera: Formicidae) (Figure 2D).

The family Ectobiidae is the most diverse group of cockroaches in Brazil, encompassing approximately 488 species and 62 genera (Grandcolas et al. 2024), including the genus *Cahita*. Despite this diversity, the biology and ecology of cockroaches within this genus remain poorly understood. In Brazil, four species of *Cahita* have been documented: *Cahita borero* Rehn, 1937, *Cahita hystrix* Rehn, 1937, *Cahita insignis* (Hebard, 1926), and *Cahita linguata* Rehn, 1937 (Pelless & Grandcolas 2024), with *C. borero* being the only species recorded in Minas Gerais (Pelless & Grandcolas 2024).

This study presents the first recorded instance of cockroaches occupying abandoned social wasp nests. While the exact reason for their presence remains unclear, several hypotheses can be proposed. One possibility is that the cockroaches were foraging for food, as both nests contained dead wasp larvae and pupae. Cockroaches are known scavengers, often feeding on decomposing organic matter (Pelless & Grandcolas 2002; Tarli et al. 2014). However, direct feeding behavior was not observed, as the cockroaches quickly hid or left the nests when they were disturbed.

Another plausible explanation is that the cockroaches sought protection from environmental factors such as rain. Both occurrences took place in rainy conditions, with the first after a 20 min downpour and the second during the rainy season. Social wasp nests, constructed from a mixture of saliva and cellulose (Wenzel 1998), form a corneous, water-repellent substance when dry, providing an effective shelter from the rain (Schmolz et al. 2000).

A wide variety of arthropods inhabit environments associated with ants (Hölldobler & Wilson 1990; Allan & Elgar 2001), including cockroaches (Bohn et al. 2021; Ospina-Jara et al. 2022). This association, known as myrmecophily, occurs because ant nests represent well-protected and stable environments rich in various resources, especially stored food and waste (Maurizi et al. 2012). However, this is the first

documented association between cockroaches and ants in an abandoned social wasp nest.

Arboreal ants, such as those of the genus *Camponotus* Mayr, 1861 (Hymenoptera: Formicidae), typically exhibit territorial behavior, aggressively defending their foraging areas (Hölldobler & Wilson 1990). However, this behavior was not observed in the present case regarding the cockroaches cohabited the same nest. Myrmecophilous arthropods exhibit various adaptations, including morphological and chemical mimicry, behavioral mimicry, specialized feeding behaviors, and body modifications that allow them to evade ant attacks and gain acceptance by the ants (Di Giulio *et al.* 2011; Maurizi *et al.* 2012). The coexistence of these species may be possible through resource partitioning, such as differing food sources (Hölldobler & Wilson 1990; Gotelli & Ellison 2002), with ants feeding on live larvae/pupae and cockroaches probably scavenging dead larvae/pupae or other organic matter.

While the documentation of ants attacking and occupying social wasp nests is well-established, this study presents the first record of another insect cohabiting these nests with ants. Moreover, there is no known relationship between Polistinae and Blattodea in the literature, making this the first documented instance of cockroaches inhabiting social wasp nests. The presence of Blattodea in multiple nests across different localities and biomes suggests that this occupation may not be accidental. These observations provide new insights into the potential ecological roles of abandoned wasp nests and highlight the need for further research on the interactions between cockroaches, ants, and other arthropods within these structures.

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AUTHORS CONTRIBUTION

LCSA: Investigation, Writing - Preparation of original draft; DGSR: Investigation, Writing - Preparation of original draft; EHO: Methodology, Writing - Review & Editing; GCJ: Conceptualization, Supervision, Visualization; MMS: Conceptualization, Supervision; Writing - Review & Editing.

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CONFLICT OF INTEREST STATEMENT

The authors declare that they have no conflict of interest.

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