



## RESEARCH ARTICLE - WASPS

## Nesting habits of social wasps (Hymenoptera: Vespidae) in forest fragments associated with anthropic areas in southeastern Brazil

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### Abstract

Social wasp communities and nesting habits were evaluated in forest environments associated with areas of human disturbance from March to September 2015. Three hundred forty-seven (347) colonies belonging to eighteen (18) species distributed in six genera were recorded. The species with the highest number of colonies were *Mischocyttarus cassununga* (R. Von Ihering, 1903) (194 colonies), *Mischocyttarus cerberus* Richards, 1940 (50 colonies) and *Polybia paulista* (H. von Ihering, 1896) (23 colonies). Other species colony numbers ranged from one to eighteen.

### Introduction

Social wasps belong to the subfamily Polistinae (Hymenoptera: Vespidae) and comprise more than 950 described species; they are most diverse in the Neotropical region (Pickett & Carpenter, 2010). Social wasps interact with the various fauna and flora. Some species acting as floral visitors, constituting a significant portion of the foraging guild (Heithaus, 1979; Aguiar & Santos, 2007; Clemente et al., 2013); they are also predaceous, impacting population dynamics in various prey taxa (Richter, 2000; Souza & Zanuncio, 2012).

The survival of social wasps depends both on successful colony foundation and strong foraging ability (Dejean et al., 1998; Richter, 2000; Oliveira et al., 2010). These insects can establish nests at various sites in urban or natural environments, and the nesting substrates used are extremely diverse, including the abaxial or adaxial surface of

leaves, plant stems, abandoned termite mounds, rocks, and human-made structures (Lima et al., 2000; Alvarenga et al., 2010; López et al., 2012; Souza et al., 2014).

Social wasps colonies can be classified as stelocytarus, gymnodomous, astelocytarus, or phragmocytarus (Richards & Richards, 1951; Richards, 1978; Carpenter & Marques, 2001). Stelocytarus nests are formed by one or more combs attached to the substrate by a peduncle, which may or may not contain a protective involucre. Gymnodomous nests have no involucre (characteristic of *Mischocyttarus* spp. Saussure, 1853, *Polistes* spp. Latreille, 1802, *Agelais* spp. Lepeletier, 1836 and *Apoica* spp. Lepeletier 1836), while calyptodome nests have involucre (*Pseudopolybia* spp. Saussure, 1863 and *Parachartergus* spp. R. von Ihering 1904). Astelocytarus nests present a single comb with protective involucre and cells built directly on the substrate (*Synoeca* spp. Saussure, 1852 and *Metapolybia* spp. Ducke, 1905). In phragmocytarus-



type nests, the initial comb is broadly attached to the protective casing and the subsequent combs are constructed in contact with the sides of the previous combs (*Polybia* spp. Lepeletier, 1836 and *Brachygastra* spp. Perty, 1833).

Colony foundation can occur via swarming or independently (Jeanne, 1991; Wenzel, 1998; Carpenter & Marques, 2001). Swarm founding consists of one or more queens and several workers leaving the original colony to seek a suitable place to build the new colony. For independent-founding species, one or more queens (reproductive females) build a nest, oviposit, and feed larvae (Jeanne, 1991; Wenzel, 1998; Carpenter & Marques, 2001).

Several studies have pointed out that some social wasp species prefer nesting in human-made structures. These sites provide protection from weather, and reduce the threat of predation and competition for nesting substrates (Marques & Carvalho, 1993; Lima et al., 2000). In contrast, species that nest only in natural environments prefer specific features and environmental conditions (Dejean et al., 1998; Souza et al., 2010; Souza et al., 2014).

Studies of social wasps nesting habits in urban sites surrounded by natural vegetation are still scarce. The claim that the social wasps prefer urban environments may be misleading, as association with urban areas could be due to invasion and subsequent reduction of natural areas. Studies on the nesting behavior of these insects in the associated environments may provide important information on the ecological characteristics of organisms and their interactions with the environment (Dejean et al., 1998; Souza et al., 2010; Souza et al., 2014).

In this study we characterize the social wasp fauna and describe the various nesting substrates in forest fragments associated with anthropogenically impacted areas in southeastern Brazil.

## Material and Methods

### Study area

The study was conducted in Atlantic forest fragments with high human disturbance. The forest area has an elevation of 864 m and contains 215.62 hectares, and is located in IF-SULDEMINAS (22°19'2" S, 46°19'42" W) in Inconfidentes Campus, Minas Gerais. Regional vegetation landscape is characterized by fragments of Semideciduous Montane Seasonal Forest and Riparian Forest, which are undergoing constant human interventions in association with economic cycles for agriculture and livestock production. The climate is classified as Cwb (mesothermal with well-defined seasons), with an annual average temperature ranging from 13.1 to 23.7°C and average annual rainfall of 1,800 mm (Sarmiento et al., 2013).

### Methodology

The survey was conducted from March to September of 2015, with a total sampling effort of 30 days. Nest searching

and specimen collection was carried out by means of active search (Souza & Prezoto, 2006). Buildings on the campus and in forest areas were inspected. When colonies were discovered we recorded the species, the number of colonies, and types of substrates used. The types of substrates used by different species were grouped into the following categories: man-made structures (windows, metals, aluminum structures, concrete masonry units, poles, pipes, water tanks, wooden slats, and roofs), barranco, and plant substrate (all plants in which nests were found).

Specimens were collected for species confirmation. Species identities were determined using a taxonomic keys by Richards (1978), Carpenter and Marques (2001) and Carpenter (2004). Species identities were confirmed by professor Dr. Orlando Tobias Silveira of the Pará Emilio Goeldi Museum in Belém, Pará.

## Results and Discussion

A total of 347 social wasps colonies were found, belonging to 18 species distributed among six genera. Of this total, 73% belonged to the genus *Mischocyttarus*, 15% to *Polybia*, 8% to *Polistes*, 2% to *Synoeca* and 1% each to *Parachartergus* and *Brachygastra* (Table 1). The greatest proportion of colonies (87%) occurred in man-made structures (Table 1), however diversity and species richness was higher in plant substrates (Table 1). The species with the greatest numbers of colonies were *Mischocyttarus cassununga* (R. von Ihering, 1903) (194 colonies), *Mischocyttarus cerberus* Richards, 1940 (50 colonies) and *Polybia paulista* (H. von Ihering, 1896) (23 colonies). Other species had between one and 18 colonies each (Table 1).

Many studies conducted in urban environments have revealed high diversity in social wasps, with higher incidence of species in the genera *Mischocyttarus*, *Polybia*, *Polistes* and *Protopolybia* (Lima et al., 2000; Alvarenga et al., 2010; López et al., 2012).

Colonies of *M. cassununga*, *Polistes simillimus* (Zikán, 1951), *Polistes versicolor* (Olivier, 1791) and *Mischocyttarus drewseni* (Saussure, 1857) occurred only in man-made structures, suggesting synanthropism in these species (Jeanne, 1972; Raposo-Filho & Rodrigues, 1984; Marques & Carvalho, 1993; Lima et al., 2000; Torres et al., 2011; Castro et al., 2014).

*Mischocyttarus rotundicollis* (Cameron, 1912), *Polybia scutellaris* (White, 1841), *P. paulista*, *M. cerberus*, and *Polybia fastidiosuscula* (Saussure, 1854) were recorded in both natural and man-made substrates. In contrast, *Polybia platycephala slyventris* (Richards, 1978), *Synoeca cyanea* (Fabricius, 1775), *Polybia jurinei* (Saussure, 1854), *Parachartergus fraternus* (Griboldo, 1892), *Polybia occidentalis* (Olivier, 1971), *Polybia sericea* (Olivier, 1971), *Polybia chrysothorax* (Lichtenstein, 1796), *Brachygastra lecheguana* (Latreille, 1824) and *Polybia minarum* (Ducke, 1906) were found only in plant substrates (Table 1).

Based on the results, the availability of specific substrates for nesting seems to be a limiting factor for the species occurrence in certain environments. This is especially true

**Table 1.** List of social wasp species and number of colonies recorded in urban fragments in the municipality of Inconfidentes, Minas Gerais, Brazil, in the period from March to September of 2015.

| Species   | Number of colonies |       |          | Total |
|---|--------------------|-------|----------|-------|
|   | Buildings*         | Plant | Barranco |       |
| <i>Brachygastra lecheguana</i> (Latreille, 1824)        | 0                  | 1     | 0        | 1     |
| <i>Mischocyttarus cassununga</i> (R. von Ihering, 1903) | 191                | 3     | 0        | 194   |
| <i>Mischocyttarus cerberus</i> Richards, 1940           | 49                 | 1     | 0        | 50    |
| <i>Mischocyttarus drewseni</i> Saussure, 1857           | 3                  | 0     | 0        | 3     |
| <i>Mischocyttarus rotundicollis</i> (Cameron, 1912)     | 8                  | 0     | 1        | 9     |
| <i>Parachartergus fraternus</i> (Griboldo, 1892)        | 0                  | 1     | 0        | 1     |
| <i>Polistes simillimus</i> (Zikán, 1951)                | 18                 | 0     | 0        | 18    |
| <i>Polistes versicolor</i> (Olivier, 1791)              | 10                 | 0     | 0        | 10    |
| <i>Polybia chrysothorax</i> (Lichtenstein, 1796)        | 0                  | 2     | 0        | 2     |
| <i>Polybia fastidiosuscula</i> (Saussure, 1854)         | 2                  | 1     | 0        | 3     |
| <i>Polybia jurinei</i> (Saussure, 1854)                 | 0                  | 1     | 0        | 1     |
| <i>Polybia minarum</i> (Ducke, 1906)                    | 0                  | 1     | 0        | 1     |
| <i>Polybia occidentalis</i> (Olivier, 1971)             | 0                  | 9     | 0        | 9     |
| <i>Polybia paulista</i> (H. von Ihering, 1896)          | 14                 | 9     | 0        | 23    |
| <i>Polybia platycephala sylventris</i> (Richards, 1978) | 0                  | 4     | 0        | 4     |
| <i>Polybia scutellaris</i> (White, 1841)                | 7                  | 2     | 0        | 9     |
| <i>Polybia sericea</i> (Olivier, 1971)                  | 0                  | 1     | 0        | 1     |
| <i>Synoeca cyanea</i> (Fabricius, 1775)                 | 0                  | 8     | 0        | 8     |
| Number of colonies                                      | 302                | 44    | 1        | 347   |
| Richness of species (S')                                | 9                  | 14    | 1        | 18    |

\* Windows, metals, aluminum structures, walls, poles, pipes, cisterns water, wood slat and roof.

for species that construct astelocytarus-type nests, such as *Synoeca* and *Metapolybia* which build a single comb with a protective involucrum with cells attached directly to the substrate (Richards & Richards, 1951); this partially explains the absence of species in these genera in several studies in urban areas (Dejean et al., 1998; Souza et al., 2010).

The results from this study provide a better understanding of social wasp communities associated with human-modified environments. It is clear that although most species have generalist habits with respect to substrate choice for nest-building, others seem to prefer specific characteristics for colony construction. Areas of vegetation in forest fragments associated with urban environments are vital for the maintenance of social wasp populations, and consequently play a role in maintaining environmental services provided by these insects such as biological control, pollination, and maintenance of trophic webs (Alvarenga et al., 2010). Further studies are needed in these environments that evaluate the potential use for social wasps as indicators of environmental quality, as well as to ensure species conservation, especially for those which require specific features for nesting.

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