



## SHORT NOTE

### Nesting Behaviour of a Neotropical Social Wasp *Mischocyttarus saussurei* Zikán, 1949 (Hymenoptera, Vespidae)

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#### Abstract

*Mischocyttarus saussurei* nests show a curious architectural pattern which could be related to colony camouflage. Since information on that species is scarce in literature, this study aimed to record ecological data on *M. saussurei*, as well as morphometric data on its nests. Data was collected at the Parque Estadual do Ibitipoca state park and at the municipalities of Barroso and Inconfidentes, Minas Gerais state, Southeastern Brazil. Seven colonies were located, exclusively in conserved environments. Five nests were dissected for morphometric analysis and for the assessment of the vegetal matter incorporated to comb walls. Nests showed comb cells opening towards the substrate and covered by vegetal layers, in which three families of mosses and three of liverworts could be identified. We deduct that the nests' morphometry and the incorporation of vegetal layers to the combs are related to the camouflaging of colonies amidst their substrate.

#### Introduction

Mischocyttarini is the most diverse tribe within the Polistinae paper wasps, despite containing a single genus, *Mischocyttarus*. These taxa encompass around 250 species and are widely distributed throughout South America and other tropical regions (Silveira et al., 2008; Barbosa et al., 2016a). New species are frequently recorded for the genus in Brazil (Cooper, 1998ab; Silveira, 1998; Silveira & Felizardo, 2015; Souza et al., 2015; Borges & Silveira, 2019), which holds the highest known species richness for *Mischocyttarus* (Carpenter & Andena, 2013).

Studies on *Mischocyttarus* have focused on the genus' phylogeny, behavioural aspects, geographical distribution and

species ecology (Raposo-Filho & Rodrigues, 1984; Gianotti, 1998; O'Donnell & Joyce, 2001; Silveira, 2008; Barbosa et al., 2016b; Souza et al., 2017; Oliveira et al., 2017). Despite the number of species sampled in diversity studies throughout Brazil (Barbosa et al., 2016), the ecological niches most of them fill are still poorly understood, which includes *Mischocyttarus saussurei* Zikán, 1949. For this species, the only data currently available on biology, geographical distribution, morphology and colony aspects are included in the works of Zikán (1949) and Richards (1978).

*Mischocyttarus* nests consist in a single comb attached to the substrate through a peduncle, without the presence of a protective envelope (Jeanne, 1972; Wenzel, 1991, 1998). Some less-studied species show deviating architecture patterns;



members of the *Artifex* subgenus *M. mirificus* Zikán, 1935, *M. artifex* Ducke, 1914 and *M. ypiranguensis* da Fonseca, 1926, for instance, build long, one cell-wide string-shaped combs. A similar pattern can be seen in species of the *Mischocyttarus iheringi* Zikán, 1935 group, which includes *M. saussurei*, with the additional deposition of vegetal matter on the comb's external walls. This study aimed to present novel information on the nesting behaviour of *M. saussurei*, as well as ecological data for the species in different ecosystems in Southeastern Brazil.

## Material and Methods

Ecological data was collected during a study on social wasp species richness carried out between 2016 and 2017 in *campos rupestres* ("rupestrian grasslands") environments within the of Ibitipoca state park (21°43' S 43°54' W) and seasonal semideciduous montane Atlantic forests in Barroso (21°12' S 43°55' W) and Inconfidentes (22°19' S 46°19' W) cities in the Minas Gerais state, Southeastern Brazil.

When a colony was located, it was photographed and two wasp specimens were captured, killed, and stored for identification purposes. Species confirmation was carried out on these individuals by the specialist Dr. Orlando Tobias da Silveira from the Emílio Goeldi museum, where samples were deposited. Additionally, duplicates were deposited in the IFSULMINAS collection (Inconfidentes campus) under voucher specimen numbers 03472-2017 - 03477-2017 (IFSULMINAS, 2018). After colonies were naturally abandoned, five nests were collected and analysed at the Laboratório de Ecologia Comportamental e Bioacústica (LABEC) and the Botany Department of the Universidade Federal de Juiz de Fora (UFJF).

Nest analysis was divided in two stages. The first stage consisted in the description of nest morphometry. For each nest we recorded the number of cells, cell width, cell length, peduncle width, and peduncle length. The second stage consisted in the identification of the vegetal matter found in each nest's surface, carried out by specialist Dr. Andrea Pereira Luiz Ponzio by comparing samples to items indexed in the herbarium collection of Herbário Prof. Leopoldo Krieger (CESJ) of the Universidade Federal de Juiz de Fora. Specialized literature was also used for reference during identification (Gradstein et al., 2001; Gradstein & Costa, 2003).

## Results and Discussion

Six colonies were found nesting in rocky substrates and one in vegetal substrate. Every site in which a colony was located was part of either a Conservation Unit or a highly conserved forest area (Souza & Prezoto, 2006; Souza et al., 2017). This may indicate a relationship between the species and this ecological setting, since many species of social wasps are restricted to conserved environments or specific

ecosystems (Souza et al., 2017; Detoni et al., 2018), as reported for the genus *Pseudopolybia* (Souza et al., 2010).

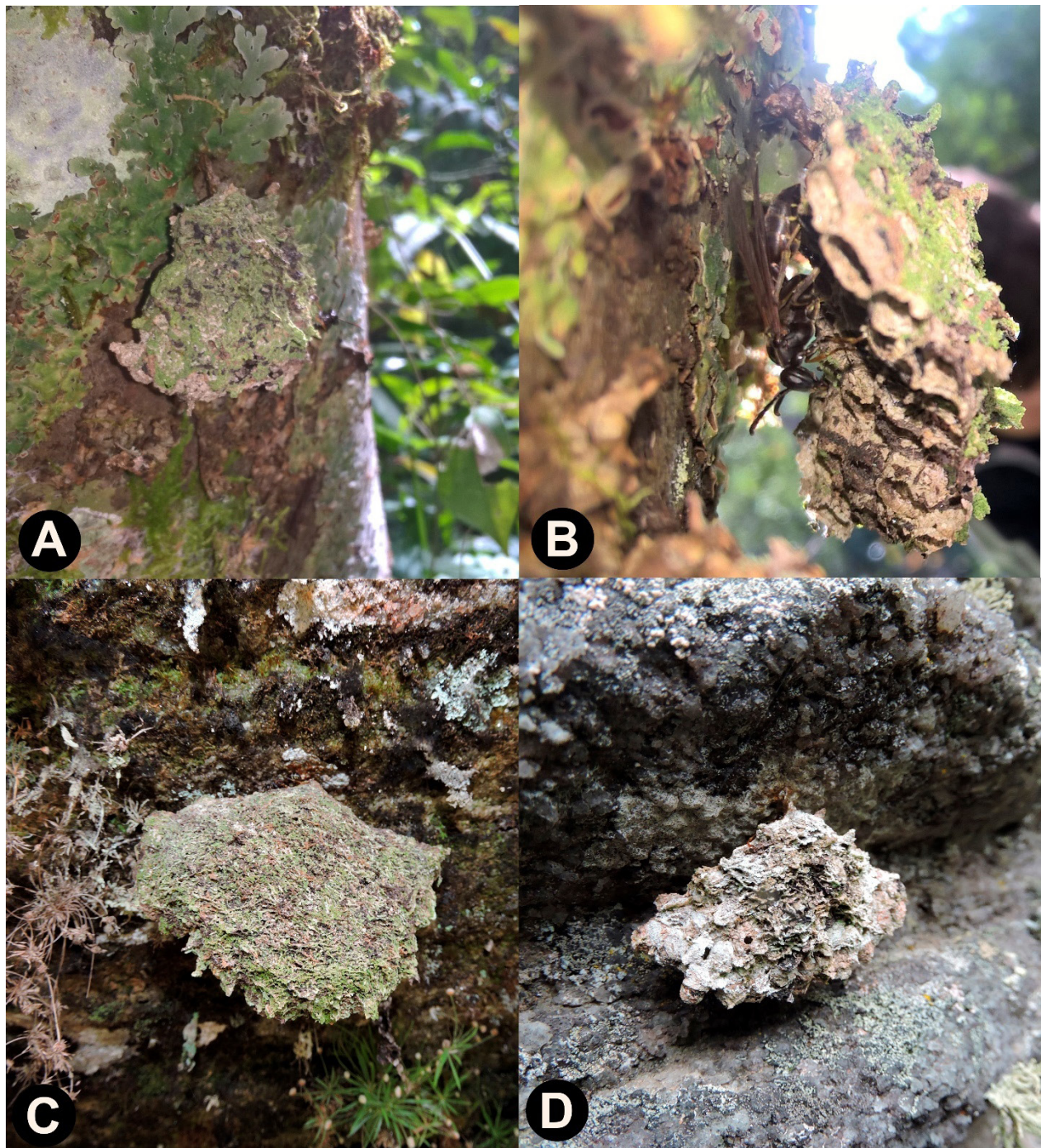
The five dissected nests had, respectively, 15, 16, 26, 48 and 190 cells. The latter was atypically large, considering that *Mischocyttarus* nests rarely present more than 100 cells (Jeanne, 1975; Castro et al., 2014). The finding of a nest with 190 cells may be evidence that the architecture pattern and nest camouflage are acting significantly to ensure colony success. By concealing themselves in the environment, nests may grow to reach high dimensions, which indicate a possible advantage of camouflage behaviour; however, further investigations are required to prove this hypothesis. Cells had an average length of  $1.16 \text{ mm} \pm 0.05$  ( $1.1 - 1.2 \text{ n}=5$ ) and an average width of  $3.2 \text{ mm} \pm 0.24$  ( $3 - 3.5 \text{ n}=5$ ), which are comparable to those found in other studies on *Mischocyttarus* (Giannotti, 1999; Montagna et al., 2010; Downing, 2012).

Nest peduncles were always eccentrically fixed on the comb. They showed an average width of  $1.46 \text{ mm} \pm 0.55$  ( $0.9 - 2.2 \text{ n}=5$ ), which was negatively correlated to number of cells per nest according to a Spearman's correlation coefficient ( $p=0.1 \text{ r}=0.73$ ) (R Development Core Team, 2017). Conversely, a positive correlation has been found in other studies (Montagna et al., 2010). Wasp workers typically reinforce the peduncle as colonies increase in size and weight, but this was not verified in this study. Peduncles had an average length of  $4.48 \text{ mm} \pm 0.64$  ( $3.7 - 5.3 \text{ n}=5$ ), which is comparable to studies on *Mischocyttarus drewseni* (Jeanne, 1972) and *Mischocyttarus cerberus styx* (Giannotti, 1999).

Every colony collected in this study was found nesting in moss-covered substrates, which made finding them challenging (Figure 1) and reinforces the camouflage hypothesis, as discussed in Barbosa et al. (2016b). The choice of nesting site is decisive for colony success and is an evolutionary response of social wasps to predation pressure (Jeanne, 1975). Colony camouflaging is more common in *Mischocyttarus* than in other social wasp genera, acting as an indirect defensive behaviour (Wenzel & Carpenter, 1994; Barbosa et al., 2016b). This is probably due to their morphological inability to use their stingers for defence, in conjunction to the absence of a protective envelope in their nests and their overall low aggressiveness (Raposo-Filho & Rodrigues, 1984).

Another characteristic found in species of the *Mischocyttarus iheringi* group is the presence of vegetal cover in the exterior of nests, avoiding contrast with the background and providing further visual camouflage. Richards (1978) described colonies of the *M. iheringi* group with special emphasis to the substrate/colony relationship. Richards cites the outward-facing comb's bottom and sides being covered in moss, lichen and other vegetal materials as the group's general feature. A curved peduncle, such as the ones found in this study, is necessary to ensure that cell openings are facing the substrate. This differs from the general architectural pattern in *Mischocyttarus* nests. The





**Fig 1.** (A) Dorsal face of a *Mischocyttarus saussurei* colony which was fixed on a vegetable substrate covered with moss. (B) Detail of the curvature presented by the nest peduncle of *Mischocyttarus saussurei*, so that the cell opening faces the nesting substrate, allowing the wasps to hide behind. (C) and (D) Abandoned nests found on rocks covered by moss.

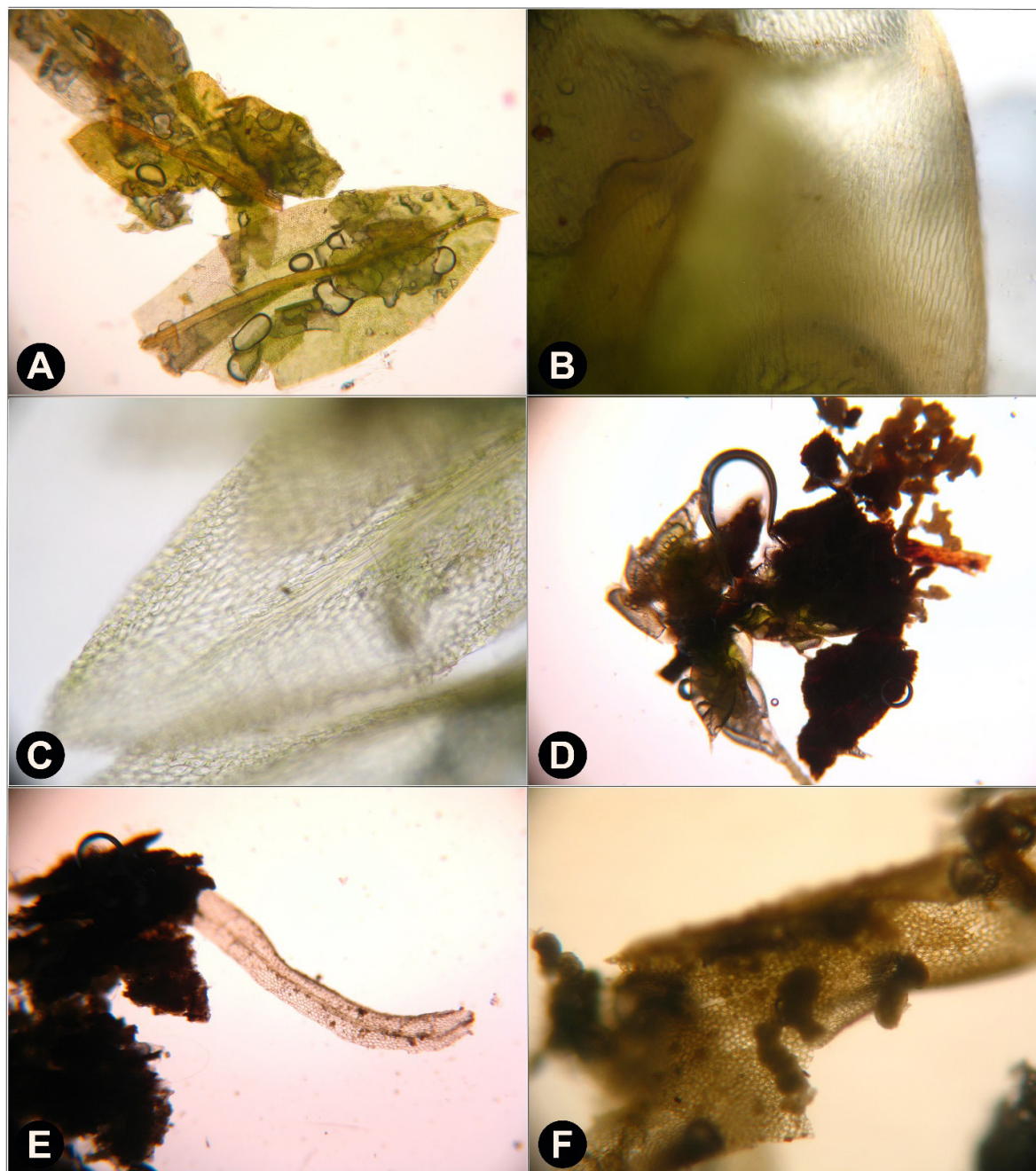
nest's vegetal cover could even be further added and kept by the wasps in the colony due to this feature being idiosyncratic to this species group.

All collected colonies showed vegetal fragments. From these, we could identify three families of mosses (Orthotrichaceae, Sematophyllaceae and Stereophyllaceae) and three of liverworts (Frullaniaceae, Metzgeriaceae and Plagiochilaceae) (Figure 2). Three of these species were also found in nests of *M. iheringi* (Barbosa et al., 2016b), whose

nests are similar in architecture to *M. saussurei*'s, and whose vegetal cover was also discussed by authors as having a possible role in camouflage.

*M. saussurei* nests show a morphometry particular to its group which, when associated to the incorporation of moss in the dorsal part of combs, make their visualisation extremely difficult amidst its substrate. This is likely to provide camouflage and have a positive effect on the colony's success. Future studies are necessary to prove this hypothesis.





**Fig 2.** Plant fragments belonging to Mosses and liverworts found on the surface of the nests of *Mischocyttarus saussurei*. (A) Orthotrichaceae, (B) Sematophyllaceae, (C) Stereophyllaceae (D) Frullaniaceae, (E) Metzgeriaceae e (F) Plagiochilaceae.

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