



Scientific Note

Nest camouflage records on five social wasp species (Vespidae, Polistinae) from southeastern Brazil

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Abstract: Social insects adopt different strategies to defend their colonies, including camouflage. Aiming to increase the knowledge about this strategy on social wasps, in this study we present records of nest camouflage for *Parachartergus smithii* (de Saussure), *Parachartergus wagneri* du Buysson, *Chartergellus communis* Richards, *Metapolybia cingulata* (Fabricius) and *Mischocyttarus anthracinus* Richards, being is last, *P. smithii* and *P. wagneri* are poorly discussed within the specialized literature regarding their nesting behavior. Therefore, we made records in different conservation units, between 2011 and 2019, in Minas Gerais state, southeastern Brazil. We point out that, due to their docile behavior, the camouflage appears to be the main defense strategy for these species, as demonstrated by the color and shape of the nests within the substrate. The exception is *M. cingulata*, which presents both camouflage and aggressive behavior in some situations.

Keywords: *Chartergellus*; Colony Defense; *Metapolybia*; *Parachartergus*.

Social insects present different evolutionary adaptations to protect their colonies, such as chemical defense (JEANNE 1970), aggressive behavior (BRITO *et al.* 2018), associations with other animals (MENEZES *et al.* 2014; LE GUEN *et al.* 2015; SOUZA *et al.* 2017) and strategies related to the nest architecture (CHAVARRÍA-PIZARRO & WEST-EBERHARD 2010). Colony architecture studies allow obtain information about nest building and repair, social organization and ecological relations, as seen for *Charterginus*, *Pseudopolybia*, *Polistes*, *Mischocyttarus* and other genera (e.g. JEANNE 1975; RICHARDS 1978; O'DONNELL & JEANNE 1990; LONDON & JEANNE 1998, 2000, 2003; MONTAGNA *et al.* 2010; FELIZARDO *et al.* 2018).

Since maintaining the colony is vital for the survival of social wasps, an important ecological strategy for colony defense is nest camouflage (RICHARDS 1978; WENZEL 1998; MATEUS *et al.* 1997), which in some species presents a high elaboration degree, so that the colonies become undetectable against the substrate (HERMANN & BLUM 1981).

Considering behavioral aspects for more aggressive species, the stinger appears to be sufficient; however, docile species usually adopt other strategies, such as *Parachartergus colobopteris* (Lichtenstein), which uses camouflage to defend its colonies (STRASSMANN *et al.* 1990). This is also true for *Mischocyttarus* species (RICHARDS 1978; GIANNOTTI 1999; SILVEIRA *et al.* 2015), and other genera such as *Nectarinella* (WENZEL 1998) and *Leipomeles* according to (STARR, 1991).

In order to contribute to the current knowledge on social wasps nesting and colony defense behavior, we present nest camouflage records for *Parachartergus smithii* (de Saussure), *Parachartergus wagneri* du Buysson, *Chartergellus communis* Richards, *Metapolybia cingulata* (Fabricius) and *Mischocyttarus*

anthracinus Richards.

We recorded the nests in five conservation units in Minas Gerais state, southeastern Brazil: in the Atlantic forest areas such as Environmental Protection Area of Machado River (21°47'21.49"S; 46°07'26.13"W) in November 2018, Serra do Papagaio State Park (22°02'55.30"S; 44°38'36.67"W) in January 2017, and Rio Doce State Park (19°39'59.66"S; 42°32'57.09"W) January 2011 and in the Cerrado areas such as Pandeiros River Wildlife Refuge (15°30'19.90"S; 44°45'25.71"W) in October 2014, and Sempre Vivas National Park (43°46'3712"S; 17°48'22.17"W) between October 2018 and March 2019.

Active searches for colonies were carried out between 9 am and 4 pm. Once the colony was found, a photographic record was made, alongside notes regarding the different characteristics of the number of colonies, substrate, ground height (m), camouflage, behavior and locality (Table 01). Additionally, we caused disturbances to the colony, by touching it and registering the behavior of the individuals for the next 25 to 30 minutes using the *ad libitum* method (DELL-CLARO 2010), considering its docile behavior when individuals remain inside the nest and / or dispersed in flight, and aggressive, when they fly around the source of disturbance and try to sting (STRASSMANN *et al.* 1990). Then, we collected around three to five individuals for species identification and prepared them for dry preservation. Finally, we integrated the specimens into the IFSULDEMINAS Campus Inconfidentes and Emílio Goeldi Paraense Museum social wasps biological collections within the SPECIESLINK NETWORK (2020). The specimens were identified by Dr. Orlando Tobias da Silveira, from Emílio Goeldi Museum.

Concerning *P. smithii* (Figure 1A and 1B), at the time of

registration, there were no individuals on the outside of the colony. However, the disturbance of the observed structure confirmed that it was a colony, as it prompted the exit of the individuals, which demonstrated docile behavior, remaining over the nest wrapper. The shape and gray color of the nest allows it to disappear into the substrate, which demonstrates homochromy or homotype camouflage (Table 1). MATEUS *et al.* (1997), for instance, reported a case of a *P. smithii* nest with a light gray colored envelope, striated with brown and dark gray, which produced a camouflage for the nest.

Parachartergus wagneri (Figure 1C and 1D) did not present individuals on the colony surface, at the time of registration. However, disturbances in the nest prompted the exit of individuals through the opening in the posterior portion of the nest, also cryptic due to its adherence to the tree trunk. Outside the nest, the individuals remained immobile, not attacking, then flying around due to the disturbance persistence. Such docile behavior seen in *P. wagneri* suggests the adoption of alternative strategies of colony defense. Also, the gray color similarity between the nest and the vegetal substrate reinforces the hypothesis of camouflage (Table 1).

Metapolybia cingulata nests presented a gray color similar to the trunk or the wood used in nesting, which suggests homochromic camouflage. However, when the nest is similar to the shape of the trunk bark, a camouflage of the homotype kind is suggested (Figure 1E), as reported by SOMAVILLA *et al.* (2012). Therefore, camouflage in this species is based on two simultaneous strategies, homotype and homochromia. In addition, the nests of this genus are of the astelocytarus type (RICHARDS & RICHARDS 1951), where the single honeycomb is firmly adhered to the substrate, making its distinction difficult. Differently from the species of *Parachartergus* and *Chartergellus*, the individuals of *M. cingulata* presented aggressiveness when the intentional disturbances, by dispersing and investing in attempts to sting. This suggests camouflage and aggressiveness as joint defense mechanisms (Table 1) (CHAVARRÍA-PIZARRO & WEST-EBERHARD 2010).

In the case of *C. communis* (Figure 1F) the shape of the nests combined with their coloring made them difficult to distinguish in the environment (Table 1). Their behavior was similar to that shown by *P. smithii* (MATEUS *et al.* 1997), *P. colobopterus* (STRASSMANN *et al.* 1990), *Chartergellus punctatior* Richards, and *Chartergellus golfitensis* West-Eberhard (CHAVARRÍA-PIZARRO & WEST-EBERHARD 2010).

Similar reports were made for *Metapolybia* and for *Synoeca* species, which, although building camouflaged nests, show aggressive behavior when there are disturbances external to the colony (CHAVARRÍA-PIZARRO & WEST-EBERHARD 2010). In this

sense, it must be mentioned that the alternation between aggressiveness and docile behavior is directly associated with the stage of the colony, being docile in nests with low productivity and aggressive when increasing the production of eggs and pupae, as described for *Metapolybia aztecoides* Richards (FORSYTH 1978).

Regarding color and shape of *M. anthracinus* colonies, there is considerable similarity with the capitulum type inflorescence of the Asteraceae (Figure 1G). This makes the identification of the nest hard within the environment. Therefore, we infer, once again, nest camouflage based on shape and color. When there was an approach to the colony, the individuals flew away or remained in it, moving to the opposite side of the nest, without any aggressiveness. Due to the susceptibility of some species of the *Mischocyttarus* genus to predators in colonies with few individuals and lacking a protective wrapper due to factors such as stunted stingers (JEANNE 1975; RAPOSO-FILHO & RODRIGUES 1984), direct and indirect defense strategies can be observed. In this regard, camouflage is a relevant strategy for the genus, as demonstrated by recent studies (e.g. BARBOSA *et al.* 2016, MILANI *et al.* 2020).

We conclude that camouflage is the main defense strategy in colonies of *P. smithii*, *P. wagneri*, *C. communis* and *M. anthracinus*, while for *M. cingulata* it is adopted in combination with aggressive behavior.

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Table 1. Number of colonies, substrate used for nesting, height of the nest in relation to the ground, camouflage strategy used (regarding color and shape), behavior (docile or aggressive) and place of registration (RVS = Pandeiros River Wildlife Refuge; PN = Sempre Vivas National Park; PE = Rio Doce State Park and Serra do Papagaio State Park; APA = Environmental Protection Area of Machado River) of different species of social wasps in the state of Minas Gerais, southeastern Brazil.

Species	<i>Parachartergus smithii</i> (de Saussure)	<i>Parachartergus wagneri</i> du Buysson	<i>Chartergellus communis</i> Richards	<i>Metapolybia cingulata</i> (Fabricius)	<i>Mischocyttarus anthracinus</i> Richards
N° of colonies	2	1	4	12	1
Substrate	Trunk	Trunk	Trunk and light post	Trunk and roofing woods	Inflorescence
Ground height (m)	Raging from 8 to 10	4	Raging from 0,5 to 8	Raging from 1 to 9	1
Camouflage	Color and shape	Color and shape	Color and shape	Color and shape	Color and shape
Behavior	Docile	Docile	Docile	Docile /aggressive	Docile
Locality	RVS Rio Pandeiros	APA Rio Machado	RVS Rio Pandeiros	RVS Rio Pandeiros	PE da Serra do Papagaio
			PN das sempre vivas	PE do Rio Doce	

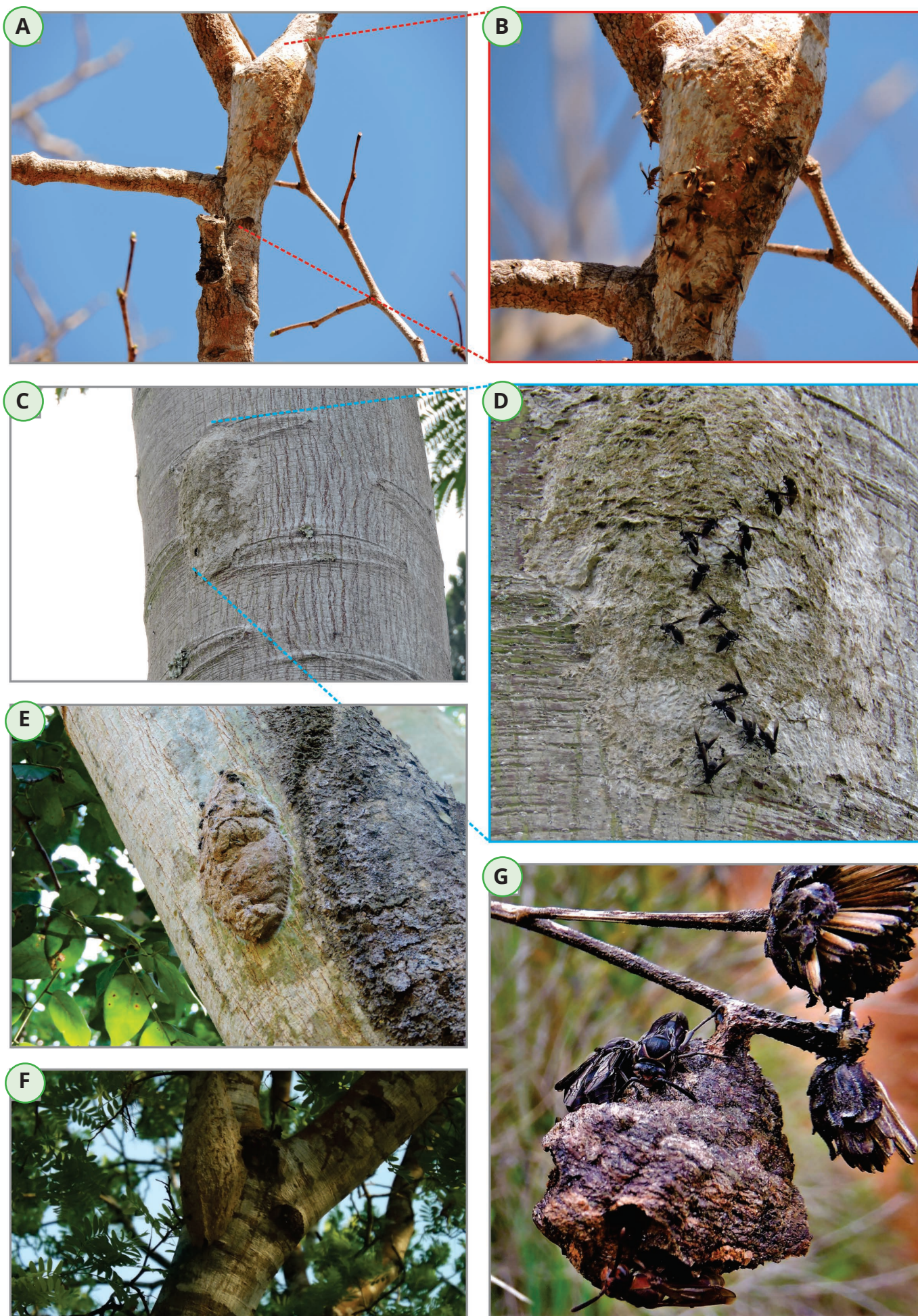


Figure 1. Camouflaged nests of social wasp species, Minas Gerais state, southeastern Brazil. A and B - *Parachartergus smithii* recorded at Pandeiros River Wildlife Refuge (RVS); C and D - *Parachartergus wagneri* recorded in the Environmental Protection Area of the Machado River; E - *Metapolybia cingulata* also from RVS; F - *Chartergellus communis* in RVS; G - *Mischocyttarus anthracinus* in Serra do Papagaio State Park.

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