

Rapid sampling of social wasps (Hymenoptera: Vespidae) in an ecotone zone between the Atlantic Forest and Cerrado adjacent to a mining area

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Abstract

There are few studies on the richness of social wasps in ecotones, particularly in mining regions. These transitional environments exhibit specific geophysical conditions, host species from both biomes, and can act as barriers to evolutionary processes and gene flow. In view of this, this study aimed to document the occurrence of social wasps by a rapid sampling method in a transition region between the Atlantic Forest and Cerrado in the vicinity of a mining area in Itatiaiuçu, Minas Gerais, Brazil. The sampling effort was 24 h, distributed over three field days in December 2022. A total of 18 species were sampled. One noteworthy record is that of *Parachartergus smithii* (de Saussure, 1854), a rare species in the state, previously documented in an ecotone region between the Caatinga and Cerrado. These findings demonstrate the importance of ecotone systems in supporting the diversity of social wasps.

Keywords: Endemism; Fragmentation; Itatiaiuçu; Vespids.

Amostragem rápida da fauna de vespas sociais (Hymenoptera: Vespidae) em ecótono de Mata Atlântica e Cerrado, associado a área de mineração

Resumo

Existem poucos estudos sobre a riqueza de vespas sociais em ecótonos, principalmente em regiões associadas à mineração. Estes ambientes de transição possuem condições geofísicas específicas, compartilham espécies de ambos os biomas e podem atuar como barreiras em processos evolucionários e fluxos genéticos. Neste sentido, o objetivo deste estudo é registrar a ocorrência de vespas sociais, por amostragem rápida, em uma região de transição entre Floresta Estacional de Mata Atlântica e Cerrado, no entorno de uma área de mineração, no município de Itatiaiuçu, Minas Gerais. O esforço amostral foi de 24 horas, distribuídas em três dias de campo, no mês de dezembro de 2022. Foram amostradas 18 espécies com destaque para *Parachartergus smithii* (de Saussure, 1854), considerada rara no estado, e também registrada em região de ecótono (Caatinga e Cerrado), demonstrando a importância destes ecossistemas para a diversidade de vespas sociais.

Palavras-chave: Endemismo; Fragmentação; Itatiaiuçu; Vespídeos.

Mining is one of the primary economic activities in Minas Gerais State, Southeast Brazil (IBRAM, 2023). However, this extractive activity has led to the elimination or alteration of millions of hectares of native vegetation, either through ore extraction (Diniz, Reis, Acerbi Junior, & Gomide, 2014) or due to the failure of tailings dams, as occurred in the municipalities of Mariana in 2015 and Brumadinho in 2019 (Espindola, Campos, Lamounier, & Silva, 2016; Pereira, Cruz, & Guimarães, 2019). Environmental changes caused by mining play a determining role in biodiversity loss (Pereira et al., 2019).

Since the beginning of the 21st century, increasing efforts have been made to survey the social wasp fauna of Minas Gerais State (Barbosa, Detoni, Maciel, & Prezoto, 2016) in the Cerrado (Simões, Cuozzo, & Friero-Costa, 2012), Atlantic Forest (Albuquerque, Souza, & Clemente, 2015), Rupestrian Grasslands and High-Altitude Grasslands (Oliveira, Souza, Clemente & Vieira, 2021), transition regions between the Cerrado and Caatinga (Brunismann, Souza, Pires, Coelho, & Milani, 2016), and even in agricultural and urbanized areas (Aud, Carvalho, Clemente, & Prezoto, 2010; Milani, Jacques, Clemente, Coelho, &

Souza, 2020). However, there is no information on the social wasp fauna inhabiting forest fragments in an ecotone zone between the Atlantic Forest and Cerrado, located in proximity to a mining area.

As generalist foragers, wasps provide biological control and pollination services (Brock, Cini, & Sumner, 2021). These insects are favored by environmental heterogeneity, which promotes increased nesting opportunities and population persistence (Ferreira et al., 2020; Szczepko, Kruk, & Wiśniowski, 2020). Consequently, ecotones may play a fundamental role in sustaining wasp communities.

The purpose of this study was to record the occurrence of social wasps by a rapid sampling method in a transition region between a semideciduous seasonal forest fragment and the

Cerrado, close to a mining area in Itatiaiuçu, Minas Gerais, Brazil.

Records were made during a rapid assessment of the insect fauna, undertaken at the request of the municipality. Collections were performed 8 h a day on three field days between December 14 and 16, 2022, totaling 24 h of sampling effort. The active search method was used (Souza & Prezoto, 2005). Social wasps were caught in flight by using entomological nets, and colonies were searched along pre-existing trails. The study area comprises the inside and edges of a forest fragment measuring 19,000 m². The area possesses mixed characteristics of semideciduous seasonal forest and Cerrado and is located about 4 km from a local mining company (USIMINAS S.A.) (Figure 1).

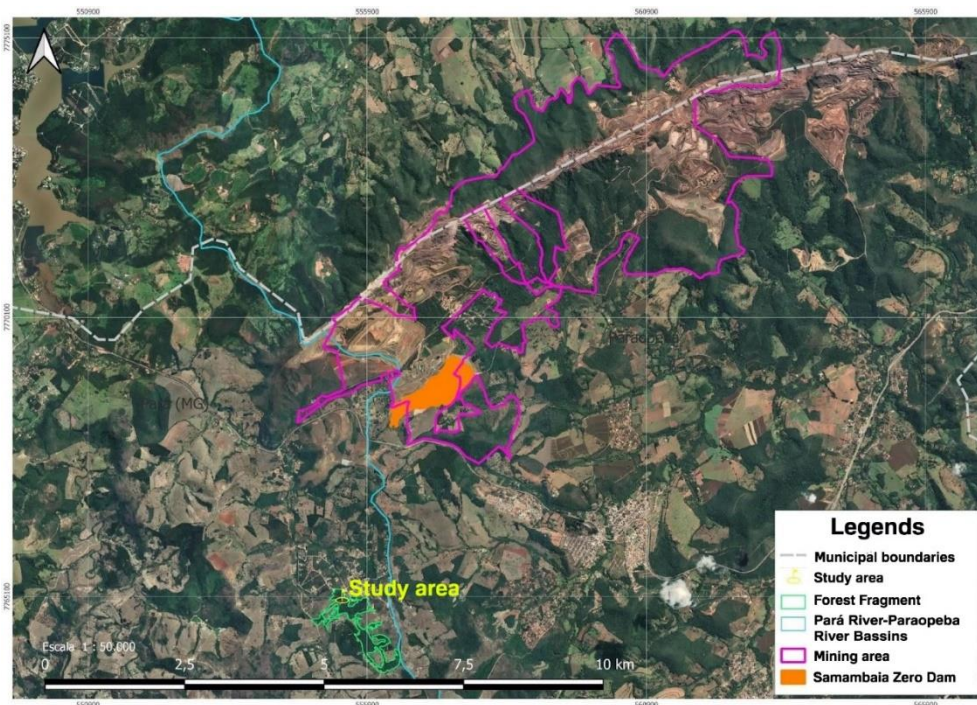


Figure 1. Location map showing the study area and regional landscape. **Source:** prepared by the authors with data from the National Environmental Registry of Rural Properties.

Although the study area has no environmental restrictions in terms of speleological heritage, indigenous and/or quilombola lands, or conservation units, it is located in a transition region between the Atlantic Forest and Cerrado, a buffer zone of the Serra do Espinhaço Biosphere Reserve. Thus, the study area is considered a priority zone for conservation (IDE-SISEMA, 2023).

Collected specimens were stored under wet conditions, transported, and deposited in the Biological Collection of Social Wasps (CBVS) of the Federal Institute of Education, Science, and Technology of Southern Minas Gerais (IFSULDEMINAS). Species identification was carried out using dichotomous keys (Richards, 1978; Carpenter & Marques, 2001) with the help of Dr. Orlando Tobias da Silveira, Museu Paraense Emílio Goeldi, Pará.

A total of 14 colonies belonging to 18 species and 8 genera

were recorded (Table 1). One particularly noteworthy record was that of *Parachartergus smithii* (de Saussure, 1854) (Figure 2), whose colony was found in the trunk of the tree *Ceiba speciosa* (A.St.-Hill.) Ravenna (Malvaceae).

Although the sampled area is inserted in a mining environment, being therefore subjected to a strong anthropogenic pressure, the wasp richness was expressive compared with that observed in other studies in a similar vegetation physiognomy (Souza, Pires, Silva-Filho, & Ladeira, 2015; Silva et al., 2021). This finding demonstrates the importance of conserving remnant forest fragments for the maintenance of these insect populations, as discussed by other authors (Graça & Somavilla, 2018)

Alteration of the area can negatively affect social wasp communities, in particular that of *P. smithii* (Figure 2), which is considered rare. There is only one record of the

species in the state, in the Pandeiros River Wildlife Refuge, a dry forest area within a transition zone between Cerrado and Caatinga, northern Minas Gerais State (Brunismann et al., 2016; Francisco, Souza, Clemente, & Brunismann, 2018).

Table 1. Species and number of colonies of social wasps (Hymenoptera: Vespidae) sampled in a forest fragment near a mining area in Itatiaiuçu, Minas Gerais State, Brazil.

Species	No. of colonies		No. of colonies
<i>Agelaia centralis</i> (Cameron, 1907)	0	<i>Polybia fastidiosuscula</i> de Saussure, 1854	1
<i>Agelaia multipicta</i> (Haliday, 1836)	0	<i>Polybia jurinei</i> de Saussure, 1854	0
<i>Agelaia vicina</i> (de Saussure, 1854)	0	<i>Polybia occidentalis</i> (Olivier, 1791)	0
<i>Brachygastra lecheguana</i> (Latreille, 1824)	0	<i>Polybia paulista</i> Ihering, 1896	1
<i>Mischocyttarus cassununga</i> (R. von Ihering, 1903)	2	<i>Polybia platycephala</i> Richards, 1951	1
<i>Mischocyttarus drewseni</i> (de Saussure, 1857)	1	<i>Polybia sericea</i> (Olivier, 1792)	0
<i>Mischocyttarus socialis</i> (de Saussure, 1854)	2	<i>Protonectarina sylveirae</i> (de Saussure, 1854)	0
<i>Parachartergus pseudapicalis</i> Willink, 1959	1	<i>Protopolybia exigua</i> (Saussure, 1854)	2
<i>Parachartergus smithii</i> (de Saussure, 1854)	1	<i>Synoeca cyanea</i> (Fabricius, 1775)	1

Several authors, such as Cabacinha, Pereira, Cordeiro, Fonseca, and Araújo Júnior, (2021), have shown that transition regions between the Cerrado and the Atlantic Forest harbor a unique plant community. For vespids, these plant communities may act as a coevolutionary and/or adaptive pressure. Because transition zones and/or ecotones have specific geophysical conditions and often share elements of two biomes, they can act as barriers to evolutionary processes and gene flow (Kark,

2013). If this is the case, *P. smithii* may be an indicator of transitional environments such as ecotones, which have deterministic environmental gradients for this specificity and to which several other species are endemic, as previously demonstrated (Ferreira et al., 2020; Szczepko et al., 2020). Future studies should further explore the wasp community of these transition regions, conducting molecular and phylogenetic analyses.



Figure 2. Aerial image of the location of the *Parachartergus smithii* nest in a *Ceiba speciosa* tree (Malvaceae) within a seasonal semideciduous forest fragment, a vegetation physiognomy of the Atlantic Forest domain, in Itatiaiuçu, Minas Gerais State, Brazil. **Source:** photographic records taken by the authors.

Bueno, Souza, and Clemente, (2019) and Coelho, Gouvêa, Clemente, and Souza (2021) demonstrated that even fragmented areas can sustain high social wasp richness,

underscoring the importance of maintaining fragments for invertebrate conservation. This is even more relevant if forest fragments are inserted in transition/ecotone regions, as

in this study. Habitats undergoing fragmentation or with a certain degree of environmental impact are often neglected in studies of faunal inventories (Cardoso, Erwin, Borges, & New, 2011) or prioritized as alternatives for the implementation of various enterprises, including mining. Environmental licensing studies commonly and more intensively assess vertebrate fauna. However, the ecosystem services provided by invertebrates, in particular insects, are vital for the maintenance of trophic chains, soil fertility, nutrient cycling, pollination, and seed dispersion, among others (Sühs, Somavilla, Köhler, & Putzke, 2009; Ortega-Martínez, Moreno, Sánchez-Rojas, & Barragán, 2014; Gama, Oliveira, Garcia, & Nascimento Junior, 2019; Pinheiro et al., 2023).

It is also important to highlight that the sampled area comprises botanical features (field observations) of the two most threatened biomes in Brazil, namely the Cerrado and Atlantic Forest, which respectively house 40% and 48% of Brazil's wasp fauna (Souza, Teófilo-Guedes, Milani, Souza, & Gomes, 2020; Souza, Teófilo-Guedes, Bueno, Milani, & Souza, 2020). Thus, we underscore the relevance of ecotones for sustaining social wasp diversity and recommend more comprehensive studies in these regions, particularly in the study area, aiming to create an inventory of wasp fauna. We also highlight the importance of conserving these environments, even if they are fragmented and close to mining areas, as they may constitute refuges for regional fauna and flora.

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