



Social wasps (Vespidae: Polistinae) in Cerrado and Caatinga conservation units, Minas Gerais, Brazil

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Abstract: The Parque Nacional Grande Sertão Veredas, northern Minas Gerais, is located in the Cerrado, a global hotspot, and the literature lacks information about its communities of social wasps, insects that perform numerous services for the functioning of ecosystems. Therefore, this study aimed to conduct an inventory of social wasps (Vespidae: Polistinae) in the Parque Nacional Grande Sertão Veredas, and compare its richness and composition with three other fully protected conservation units in northern Minas Gerais and Vale do Jequitinhonha, Minas Gerais. A total of 41 species of 14 genera of social wasps were recorded, including a new occurrence in the state: *Mischocyttarus campestris* Raw, 1985. The presence of distinct social wasp communities in the Cerrado and Caatinga conservation units analyzed in this study, reinforces and justifies the creation of these fully protected areas, which ensure the conservation of this biological heritage and the environmental services provided by these taxa, besides providing subsidies for the management and sustainable use of the natural resources of these conservation units.

Keywords: Biodiversity; Dry Forest; Hymenoptera; *Mischocyttarus*; Veredas.

Vespas sociais (Vespidae: Polistinae) em unidades de conservação do Cerrado e da Caatinga, Minas Gerais, Brasil

Resumo: O Parque Nacional Grande Sertão Veredas, norte de Minas Gerais, inserido no Cerrado, *hotspot* mundial, carece de informações sobre a comunidade de vespas sociais, insetos que desempenham inúmeros serviços para o funcionamento dos ecossistemas. Portanto, o objetivo deste estudo foi realizar um inventário de vespas sociais (Vespidae: Polistinae) no Parque Nacional Grande Sertão Veredas, além de comparar sua riqueza e composição com à de outras três Unidades de Conservação de proteção integral no Norte e no Vale do Jequitinhonha no estado de Minas Gerais. Foram registradas 41 espécies de 14 gêneros de vespas sociais, com um novo registro de ocorrência para o estado, *Mischocyttarus campestris* Raw, 1985. A presença de comunidades distintas de vespas sociais nas Unidades de Conservação no Cerrado e Caatinga, analisadas no presente estudo, reforça e justifica a criação dessas áreas de proteção integral, que assegura a conservação desse patrimônio biológico, bem como os serviços ambientais prestados por esses táxons, além de fornecer subsídios para o manejo e uso sustentável dos recursos naturais dessas Unidades de Conservação.

Palavras-chave: Biodiversidade; Mata Seca; Hymenoptera; *Mischocyttarus*; Veredas.

Introduction

The Cerrado is one of the world's biodiversity hotspots (Myers et al. 2000; Klink & Machado 2005; Mittemeier et al. 2011), as it is home to a great diversity of species, including endemic (Myers et al. 2000; Silva & Bates 2002; ICMBio 2018) and endangered species (Aquino & Oliveira 2006; ICMBio 2018). Although considered the richest savanna on the planet, covering about 23.9% of the Brazilian territory (MMA 2023), studies show that 55% of its original area was deforested or transformed by human action. In contrast, only 8.21% of its estimated area is protected by conservation units (CUs) (MMA 2023). The state of Minas Gerais has 23 state parks, 12 national parks, nine natural monuments, four ecological stations, and three wildlife refuges, which represent 1.53% of the state's territory and ensure the full protection of about 2.69% of the Cerrado in Minas Gerais (Drummond 2005; MMA 2023).

The Caatinga, a semi-arid climate, occupies 11% of the Brazilian territory, which encompasses the northeastern states and part of the north of Minas Gerais (EMBRAPA 2022). Although not being a hotspot, it shelters a relevant insect biodiversity (Andena & Carpenter 2003), and a high rate of vegetal endemism (Taylor & Zappi 2002; Fernandes et al. 2020). Despite its relevance, only 1.2% of the Caatinga territory is under protection of CUs (Brasil 2016), an alarming fact due to the several anthropic pressures that are causing a growing desertification process (Santos et al. 2022).

CUs are essential for biota conservation in Brazil (Salvio 2017) by ensuring the preservation of natural habitats and providing abiotic and biotic conditions for maintaining viable populations. This preserves different ecosystem services provided by insects such as social wasps (Vespidae: Polistinae), which perform biological control (Prezoto et al. 2019; Lourido et al. 2019) and pollination (Suhs et al. 2009; Bergamo et al. 2021).

The CUs in Minas Gerais meet the objective of conserving these insects, since they are home to more than 90% of the species sampled in the state, including 34 recorded only in CUs (Oliveira et al. 2021). This information comes from inventory studies, which also contribute to the management of CUs, with the assessment of the carrying capacity of the area, for example, which is important for the implementation of ecotourism (Jesus & Selva 2009) and justifies studies to know the occurrence and distribution of species in ecosystems.

The number of studies on the diversity and distribution of social wasps in Brazil increased in the first two decades of the 21st century (Barbosa et al. 2016; Souza et al. 2020a, b), northern Minas Gerais and Vale do Jequitinhonha, Minas Gerais, still have undersampled ecosystems, such as areas of Cerrado and transition to Caatinga (Brunismann et al. 2016; Souza et al. 2020a; Jacques et al. 2023), due to the greater sampling effort in areas of Atlantic Forest (Barbosa et al. 2016; Souza et al. 2017; Souza et al. 2020b), which shows the need to obtain more information about the occurrence and distribution of these insects in these ecosystems, especially in CUs (Oliveira et al. 2021).

Therefore, this study aimed to conduct an inventory of social wasps (Hymenoptera, Vespidae) in the Parque Nacional Grande Sertão Veredas, and compare its richness and composition with three other fully protected conservation units in northern Minas Gerais and Vale do Jequitinhonha.

Material and Methods

This study was performed in the Parque Nacional Grande Sertão Veredas (15°6'S and 45°48'W), in the municipality of Chapada Gaúcha, Minas Gerais, Brazil. The total area of the park is about 230,671 hectares, with an altitude of 600 to 900 m, characterized by sandstone plateaus covered by vegetation of the Cerrado biome. Its phytophysionomies include Cerrado *sensu stricto*, *Cerradão*, *vereda*, gallery forest, *campo sujo*, and *campo limpo* (FUNATURA 2003; Ribeiro & Walter 2008). The climate of the region is tropical, in sub-humid conditions, with an average annual temperature of about 23°C, with maximums of 37°C to 40°C and minimums of 16°C to 19°C (FUNATURA 2003). The dry season in winter begins in May and lasts until September/October, and the rainy season in summer is from November to March. The average rainfall is 1,400 mm/year (FUNATURA 2003).

For this study, two methodologies were used for sampling social wasps: active and passive (Jacques et al. 2018), since the simultaneous use of different sampling methodologies optimizes the recording of species (Barbosa et al. 2020). Active sampling consisted of capturing social wasps in flight and/or in colonies with entomological nets (Souza & Prezoto 2006) from 9 a.m. to 1 p.m. and 4 p.m. to 6 p.m. (Jacques et al. 2023) for 24 days, six days per season, in September and November 2022 during the dry season, and in February and April 2023 during the rainy season. Four researchers conducted the searches, totaling 144 hours of sampling effort per researcher. They moved along pre-existing trails or roads in areas of gallery forests, *campo sujo*, *campo limpo*, *veredas*, and Cerrado *stricto sensu*.

Passive sampling was performed using attractant traps made with two-liter disposable PET (polyethylene terephthalate) bottles. Three triangular openings were made on the sides of the bottles (2 × 2 × 2 cm), about 10 cm from the base, and 150 ml of attractant were placed in each (Souza & Prezoto 2006). They were distributed in areas of *veredas*, gallery forests, and Cerrado *sensu stricto* by two different transects, totaling 20 traps, 10 with molasses diluted in water in a 50–50 proportion and 10 with passion fruit juice. The traps were positioned 10 m from each other and 1.5 m above the ground (Jacques et al. 2018), and were in the field for six days in each campaign, accounting for 576 hours of sampling per bottle used.

At both collection times, the specimens were sacrificed and stored in 70% alcohol for later identification in the laboratory. The genera and species were identified using dichotomous keys proposed by Richards (1978) and Somavilla & Carpenter (2021), and compared with the biological collection of social wasps (BCSW) of the Instituto Federal do Sul de Minas Gerais (IFSULDEMINAS), where the specimens are deposited (Tumble No. 09573-2022 to 09708-2023). The samples with doubtful taxonomy were sent to Dr. Orlando Tobias Silveira (Museu Emílio Goeldi, Belém, Pará), who collaborated with the identifications.

To evaluate the sampling effort, an accumulation curve was constructed using the observed richness with 95% confidence interval, under Bootstrap 1 estimator in the EstimateS 9.1.0 software (Cowell & Elsensohn 2014). This estimator uses information from all species collected instead of restricting the analysis to rare species (Santos 2003).

The species richness of the area studied was compared to three other CUs in northern Minas Gerais and Vale do Jequitinhonha (Figure 1), which used similar methodologies: the Parque Nacional das Sempre-Vivas (PNSV), an area of Cerrado associated with *campo rupestre*

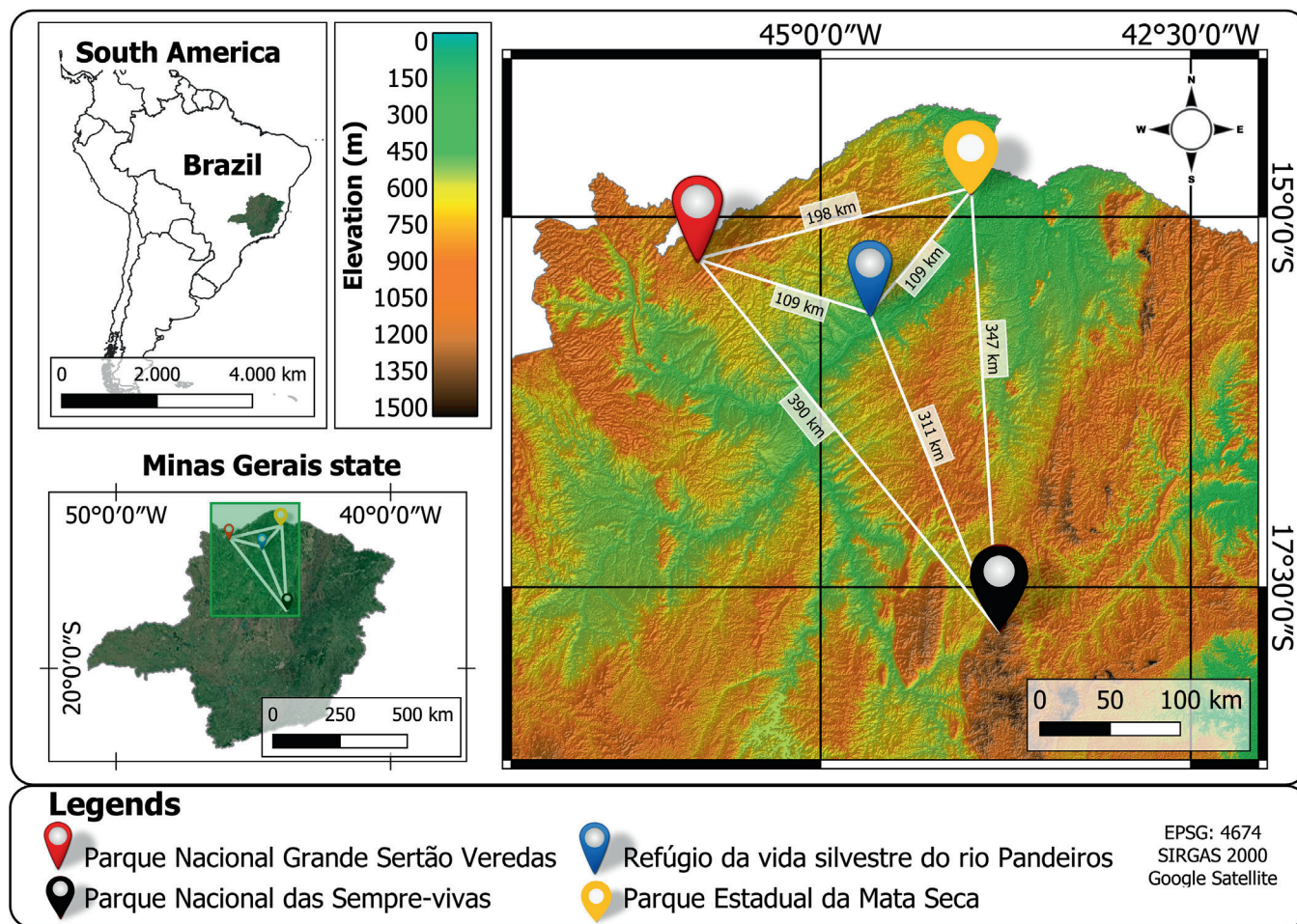


Figure 1. Location of the Parque Nacional Grande Sertão Veredas; approximate distance and elevation of the other conservation units compared with northern Minas Gerais (Parque Estadual da Mata Seca and Refúgio da Vida Silvestre do Rio Pandeiros) and Vale do Jequitinhonha (Parque Nacional das Sempre-Vivas), Minas Gerais, Southeastern Brazil.

(Souza et al. 2020a); the Refúgio da Vida Silvestre do Rio Pandeiros (RVS), Cerrado-Caatinga transition zone (Brunismann et al. 2016); and the Parque Estadual da Mata Seca (PEMS), located in an area of Caatinga (Jacques et al. 2023) (Figure 2).

To evaluate the similarity of the species community between the areas, a principal coordinate analysis (PCoA) was performed using Jaccard’s index, produced from the presence/absence data of the species. Then, a permutational multivariate analysis of variance (PERMANOVA) was performed using the same software to check for any significant difference in the community between the areas. Moreover, a cluster analysis of diversity among the areas was performed, also using Jaccard’s similarity index. All analyses were performed using the Past program (Hammer et al. 2005). Wasps not identified to species level were removed from analyses. The study was authorized by SISBIO license No. 83294-1.

Results

1. Richness and composition of the social wasp fauna

We recorded 41 species of 14 genera of social wasps in the Parque Nacional Grande Sertão Veredas (PNGSV) (Table 1; Figure 3),

especially *Mischocyttarus campestris* Raw, 1985 (Figure 4), which is a new occurrence in the state of Minas Gerais.

The richness of the PNGSV may be even higher than our records shows, according to the species accumulation curve (Figure 5), which has not reached an asymptote. Moreover, the number of species estimated by BootStrap1 is 44.65, outside the 95% confidence limit.

2. Composition and similarity of the Polistinae fauna in Cerrado and Caatinga CUs

PCoA and PERMANOVA (Figure 6) showed a statistical difference between the social wasp fauna of the different studies in CUs in northern Minas Gerais and Vale do Jequitinhonha ($p = 0.0001$).

We observed a low similarity between the CUs — PNGSV and RVS (Refúgio da Vida Silvestre do Rio Pandeiros) were the most similar, with 52.38%. The similarity between the PNGSV and the Parque Nacional das Sempre-Vivas (PNSV) was 31.81%. The lowest similarities were between the PEMS (Parque Estadual da Mata Seca) and the PNGSV (16.66%), and the PEMS and the PNSV (20%). The RVS was the most similar CU to the PEMS (23.52%) (Figure 7).



Figure 2. Conservation units where the degree of similarity of social wasp communities in the state of Minas Gerais was evaluated: Caatinga, Parque Estadual da Mata Seca (a–b); Cerrado associated with *campo rupestre*, Parque Nacional das Sempre-Vivas (c–d); Cerrado-Caatinga transition zone, Refúgio da Vida Silvestre do Rio Pandeiros (e–f); Cerrado, Parque Nacional Grande Sertão Veredas (g–h).

Table 1. Social wasp species and richness in the Parque Nacional Grande Sertão Veredas (PNGSV), the Parque Estadual da Mata Seca (PEMS), the Refúgio da Vida Silvestre do Rio Pandeiros (RVS RP), and the Parque Nacional das Sempre-Vivas (PNSV). (1 = presence; 0 = absence).

Species	PNGSV	PEMS	RVS RP	PNSV
<i>Agelaia angulata</i> (Fabricius, 1804)	1	0	0	0
<i>Agelaia multipicta</i> (Haliday, 1836)	1	0	1	1
<i>Agelaia pallipes</i> (Olivier, 1792)	1	0	0	0
<i>Agelaia vicina</i> (de Saussure, 1854)	0	0	1	1
<i>Apoica flavissima</i> Van der Vecht, 1972	0	0	0	1
<i>Apoica gelida</i> Van der Vecht, 1973	0	0	1	1
<i>Apoica pallens</i> (Fabricius, 1804)	1	0	1	1
<i>Apoica thoracica</i> du Buysson, 1906	1	0	1	0
<i>Brachygastra augusti</i> (Saussure, 1854)	1	0	1	0
<i>Brachygastra lecheguana</i> (Latreille, 1824)	1	1	1	1
<i>Brachygastra moebiana</i> (de Saussure, 1867)	0	0	1	0
<i>Brachygastra</i> sp.	1	0	0	0
<i>Chartergellus communis</i> Richards, 1978	1	0	1	1
<i>Chartergus globiventris</i> de Saussure, 1854	1	0	1	0
<i>Clypearia angustior</i> Ducke, 1906	0	0	1	0
<i>Metapolybia cingulata</i> (Fabricius, 1804)	1	0	1	0
<i>Mischocyttarus bertonii</i> Ducke, 1918	0	1	1	0
<i>Mischocyttarus campestris</i> Raw, 1985	1	0	0	0
<i>Mischocyttarus cassununga</i> (R. von Ihering, 1903)	1	1	1	1
<i>Mischocyttarus cerberus</i> Ducke, 1918	1	0	1	1
<i>Mischocyttarus consimilis</i> Zikán, 1949	0	1	0	0
<i>Mischocyttarus drewseni</i> de Saussure, 1857	1	1	1	1
<i>Mischocyttarus giffordi</i> Raw, 1985	0	0	0	1
<i>Mischocyttarus ignotus</i> Zikán, 1949	0	0	0	1
<i>Mischocyttarus iheringi</i> Zikán, 1935	0	0	0	1
<i>Mischocyttarus latior</i> (Fox, 1898)	1	0	0	1
<i>Mischocyttarus marginatus</i> (Fox, 1898)	0	0	0	1
<i>Mischocyttarus matogrossoensis</i> Zikán, 1935	1	1	0	1
<i>Mischocyttarus montei</i> Zikán, 1949	0	0	1	0
<i>Mischocyttarus rotundicollis</i> (Cameron, 1912)	1	0	1	1
<i>Mischocyttarus socialis</i> (de Saussure, 1854)	1	0	0	1
<i>Mischocyttarus</i> (<i>Monogynoecus</i>) sp.	1	0	0	0
<i>Mischocyttarus</i> sp. 01	1	0	0	0
<i>Mischocyttarus</i> sp. 02	0	0	1	0
<i>Mischocyttarus</i> sp. 03	0	0	1	0
<i>Parachartergus fraternus</i> (Gribodo, 1892)	1	0	1	1
<i>Parachartergus smithii</i> (de Saussure, 1854)	0	0	1	0

Continue...

Continuation

Species	PNGSV	PEMS	RVSRP	PNSV
<i>Polistes billardieri</i> Fabricius, 1804	1	0	0	0
<i>Polistes cinerascens</i> de Saussure, 1854	0	1	0	1
<i>Polistes erythrocephalus</i> Latreille, 1813	1	0	0	0
<i>Polistes ferreri</i> de Saussure, 1853	1	1	0	1
<i>Polistes lanio</i> (Fabricius, 1775)	0	0	0	1
<i>Polistes satan</i> Bequaert, 1940	0	0	0	1
<i>Polistes simillimus</i> Zikán, 1948	1	0	1	1
<i>Polistes subsericeus</i> de Saussure, 1854	1	0	1	1
<i>Polistes versicolor</i> (Olivier, 1791)	1	1	0	1
<i>Polistes</i> sp.	1	0	0	0
<i>Polybia chrysothorax</i> (Lichtenstein, 1796)	0	0	1	1
<i>Polybia fastidiosuscula</i> (de Saussure, 1854)	1	0	0	1
<i>Polybia ignobilis</i> (Haliday, 1836)	1	1	1	1
<i>Polybia jurinei</i> de Saussure, 1854	0	0	1	1
<i>Polybia occidentalis</i> (Olivier, 1791)	1	1	1	1
<i>Polybia paulista</i> (H. von Ihering, 1896)	1	0	0	1
<i>Polybia punctata</i> Buysson, 1908	0	0	1	0
<i>Polybia ruficeps</i> (Schrottky, 1902)	1	0	1	1
<i>Polybia sericea</i> (Olivier, 1791)	1	1	1	1
<i>Polybia striata</i> (Fabricius, 1787)	1	0	0	0
<i>Polybia</i> sp.	1	0	0	0
<i>Protonectarina sylveirae</i> (de Saussure, 1854)	1	1	1	1
<i>Protopolybia exigua</i> (de Saussure, 1854)	0	1	1	1
<i>Protopolybia sedula</i> (de Saussure, 1854)	1	0	1	1
<i>Pseudopolybia vespiceps</i> (de Saussure, 1863)	1	0	0	0
<i>Synoeca cyanea</i> (Fabricius, 1775)	0	0	0	1
<i>Synoeca surinama</i> (Linnaeus, 1767)	1	0	1	1
Species Richness	41	14	35	39
Unique species for each Ucs	12	1	7	8

Discussion

1. Richness and composition of the social wasp fauna

This richness and composition of the community of the PNGSV is expressive compared to other inventories conducted in the Brazilian Cerrado (Santos et al. 2009; Auko et al. 2017; De Castro et al. 2021; Oliveira et al. 2022). The occurrence of 41 species is possibly due to the sum of different biotic, abiotic, and methodological factors.

The PNGSV has several phytophysiognomies, such as Campo Limpo, Cerradão, gallery forests and veredas (Neto et al. 2001), which provides greater diversity of ecological niches for social wasps

(Santos et al. 2007), since each phytophysiognomy it forms a distinct environment, with different communities of social wasps (Diniz & Kitawama (1994, 1998). Added to this are three other factors; first, the conservation status of the area (Graça & Somavilla 2018), which may favor species with restricted environments, since there are species that better explore more conserved environments, with lower anthropic pressure, and those in environments with greater anthropic pressure (Souza et al. 2010); second, the mosaic of environments in different stages of ecological succession, which favors greater plant diversity, which provides different substrates for nesting and a greater supply of food (Lawton, 1983; Santos et al. 2007; Souza et al. 2010); third, the

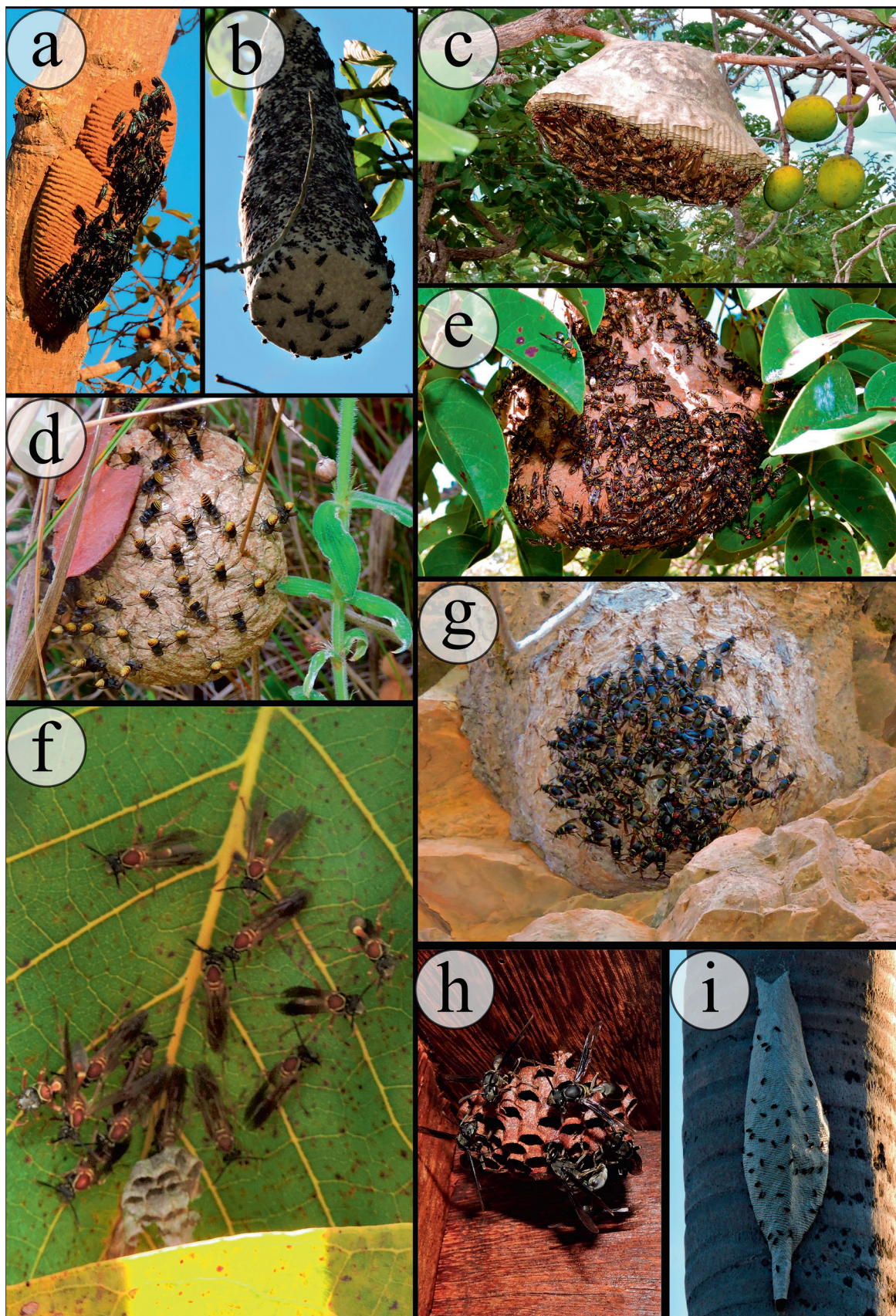


Figure 3. Some species of Polistinae recorded in the Parque Nacional Grande Sertão Veredas, northern Minas Gerais: (a) *Synoeca surinama*; (b) *Chartergus globiventris*; (c) *Apoica pallens*; (d) *Brachygastra augusti*; (e) *Polybia ruficeps*; (f) *Mischocyttarus campestris*; (g) *Chartergellus communis*; (h) *Mischocyttarus latior*; (i) *Parachartergus fraternus*.



Figure 4. *Mischocyttarus campestris* collected in the Parque Nacional Grande Sertão Veredas, northern Minas Gerais.

availability of water (Henriques et al. 1992), present all year round, ensured by the Veredas (Ribeiro & Walter 2008).

In addition to biotic and abiotic factors, the use of two collection methodologies (active search and attractive traps) increases the sampling effort, and the consortium of methodologies is the best way to record the species richness of an area, as the more methods applied, the greater the chances of capturing the largest number of species possible (Barbosa et al. 2020).

Besides the number of species recorded, which highlights the importance of the PNGSV, the presence of the species *M. campestris*, which until then had only been recorded in a Cerrado area in the Federal District (Raw 2016), reinforces the role of the CU in the conservation of the Cerrado Polistinae fauna. However, its occurrence reported in this study may represent a possible restriction of the species to this biome, requiring further study.

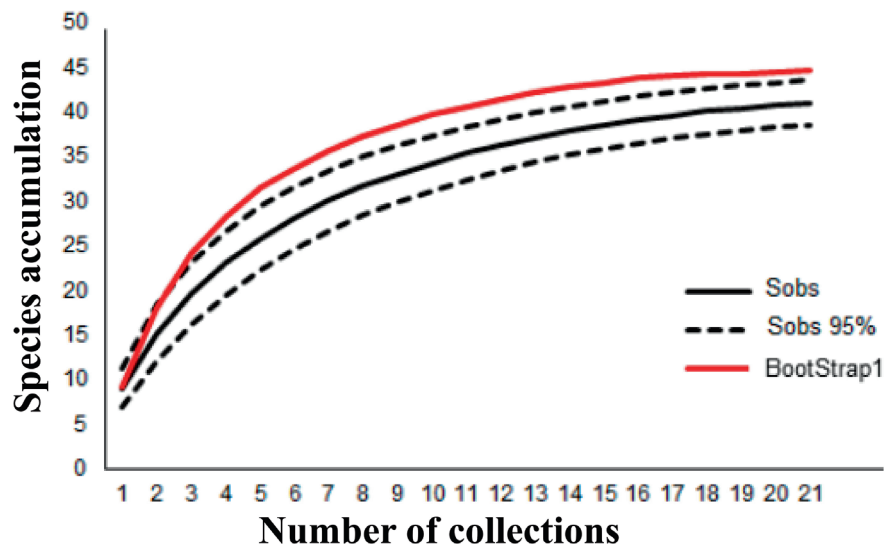


Figure 5. Species accumulation curve for social wasps collected in the Parque Nacional Grande Sertão Veredas using observed species richness, within a 95% confidence interval, and estimated species richness (Bootstrap 1).

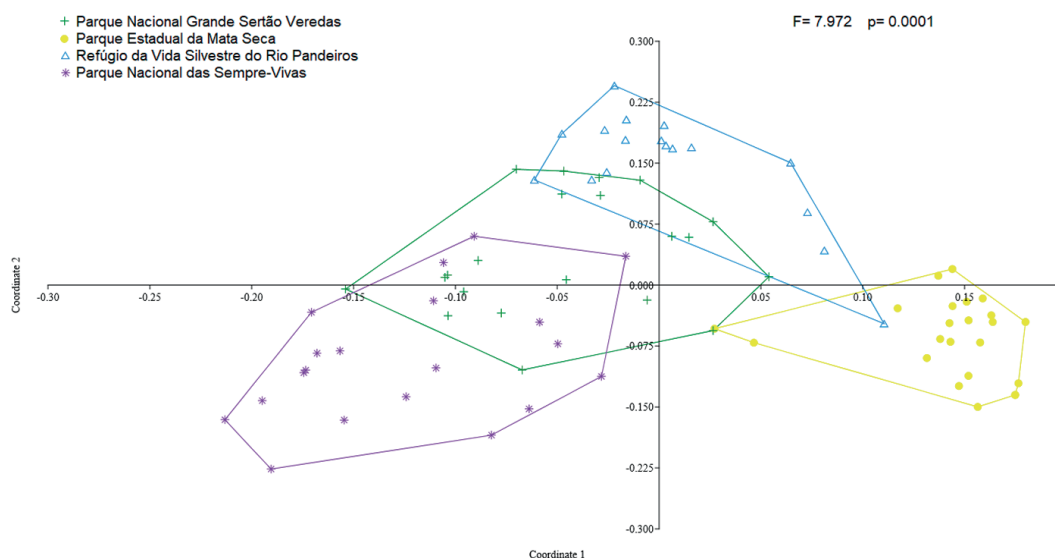


Figure 6. Principal coordinate analysis (PCoA) and Permutational multivariate analysis of variance (PERMANOVA) of the social wasp community. The different colors represent the different conservation units in northern Minas Gerais and Vale do Jequitinhonha, Minas Gerais, Brazil. PERMANOVA results are at the top.

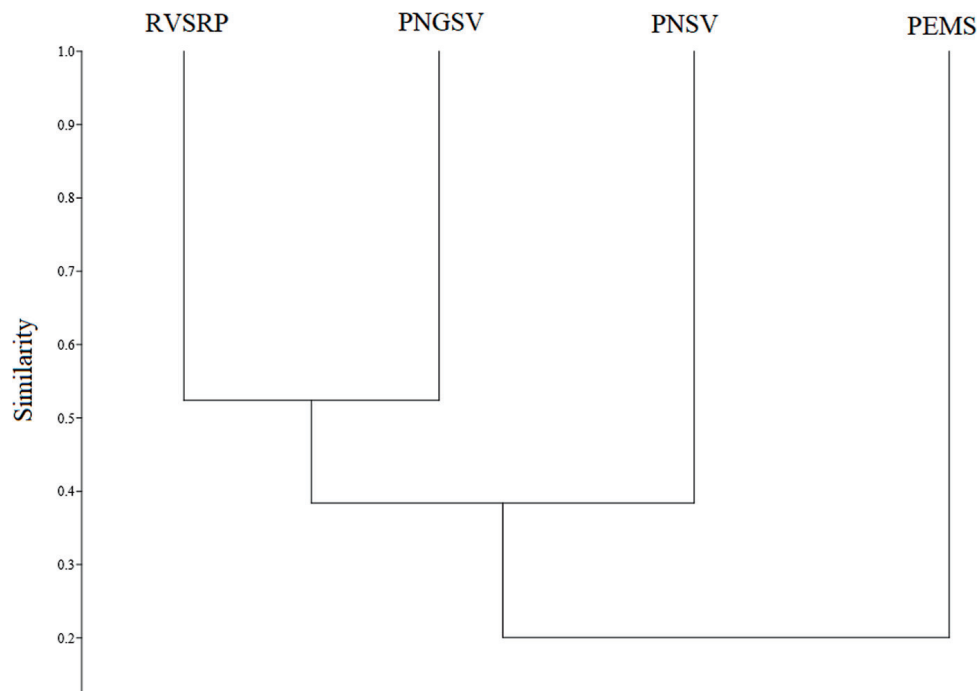


Figure 7. Cluster analysis between social wasp faunas from different conservation units in northern Minas Gerais and Vale do Jequitinhonha, Minas Gerais. RVSRP = Refúgio da Vida Silvestre do Rio Pandeiros; PNGSV = Parque Nacional Grande Sertão Veredas; PNSV = Parque Nacional das Sempre-Vivas; PEMS = Parque Estadual da Mata Seca.

2. Composition and similarity of the *Polistinae* fauna in Cerrado and Caatinga CUs

Although the works in the different UCs have used similar methodologies, mainly due to the use of the active search method, considered more effective for sampling social wasps by different authors (Souza & Prezoto 2006; Silva & Silveira 2009; Jacques et al. 2018), we cannot rule out that the collection methodology of each work may have some influence on the composition of the communities of each UC, however, the low similarity between communities indicates that it is a result of the biological diversity and unique environmental characteristics of each protected area. Different social wasp communities play specific ecological roles in ecosystems, in which some species may be more efficient in controlling certain insect populations (Southon et al. 2019; Pinheiro et al. 2023), while others may have specific interactions with plants or other organisms (Clemente et al. 2012; Barbosa et al. 2021). Therefore, conserving the diversity of social wasp communities directly affects the maintenance of the ecological balance of the ecosystems where they are located.

Social wasps have a close relationship with different habitats, adapting and interacting in specific ways with each of them (Santos et al. 2007). Their interactions with the environment include choosing nest sites, searching for food resources, and defending their territory (Resende et al. 2001; Brito et al. 2018; Ferreira et al. 2022). Besides the different communities in each CU, the presence of 12 unique species in the PNGSV, eight in the PNSV, seven in the RVSRP, and one in the PEMS (Table 1) also reinforces this reality.

PNGSV and RVSRP, although close (109 km), have different phytophysiognomies. The RVSRP has a predominance of Cerrado, including the presence of *veredas*, which justifies a greater similarity with the PNGSV, but with traces of Caatinga, such as a dense seasonal

deciduous forest or dry forest, open arboreal Caatinga, and *carrasco* (IEF 2022). This shows the unique environmental characteristics of each protected area and consequently a biological diversity.

The similarity between PNGSV and PNSV is possibly linked to a greater geographic distance between the analyzed units (390 km). Moreover, the PNGSV covers an area ranging from about 600 to 900 m above sea level, with an average annual temperature of 23°C (FUNATURA 2003). In turn, the PNSV is located in the Serra do Espinhaço and has a more pronounced altimetric variation, with a predominance of altitudes of 1,100 to 1,250 m, the presence of *campos rupestres*, which are absent in the PNGSV, and a milder temperature, with an annual average of 19°C (MMA/ICMBio 2016). Several insect species are restricted to high altitudes due to increased climatic severity, reduced area, resources, and primary productivity, absence or reduction of morphophysiological adaptive traits, and even geographic isolation (Janzen 1973; Lawton et al. 1987; Fernandes 2016). This also occurs with social wasps (Souza et al. 2015; Oliveira et al. 2021), since their flight usually requires their body temperature to be higher than that of the environment (Hozumi et al. 2010).

The lowest similarities between PEMS and PNGSV and PEMS and PNSV was expected, as PEMS is located in an area of Caatinga domain, while PNGSV and PNSV are in Cerrado areas. The RVSRP was the most similar CU to the PEMS, since, besides their proximity (109 km), the RVSRP, as aforementioned, has a predominance of Cerrado, but with traces of Caatinga, including a dry forest, just like the PEMS. The dry forest, a deciduous forest, has two well-defined climatic seasons: one rainy followed by another with a long dry period. Its tree layer is predominantly deciduous, and more than 50% of the trees become leafless in the unfavorable season (Belém et al. 2021). The responses of social wasps to dry periods in deciduous forests are variable. Some

species of Epiponini, due to their ability to store resources in their nests, such as proteins and carbohydrates (Ihering 1896; Machado & Parra 1984), manage to maintain active colonies during the dry season (Jacques et al. 2023). In turn, in the subfamily Polistini, some species, such as *Polistes versicolor* (Olivier, 1791), form aggregations of queens in a state of hibernation during the period of intense drought (González et al. 2002), and as soon as the rains start, with a rapid replacement of leaves, the number of colonies increases (Jacques et al. 2023), showing an adaptation to the dry season.

The presence of distinct social wasp communities in the Cerrado and Caatinga conservation units analyzed in this study, reinforces and justifies the creation of these fully protected areas, which ensure the conservation of this biological heritage and the environmental services provided by these taxa, besides providing subsidies for the management and sustainable use of the natural resources of these CUs.

Conclusion

The presence of distinct social wasp communities in the Cerrado and Caatinga conservation units analyzed in this study, reinforces and justifies the creation of these fully protected areas, which ensure the conservation of this biological heritage and the environmental services provided by these taxa, besides providing subsidies for the management and sustainable use of the natural resources of these CUs

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Conflicts of Interest

The author(s) declare(s) that they have no conflict of interest related to the publication of this manuscript

Data availability

The data collected and generated during this study are available in the SpeciesLink at <https://specieslink.net/col/CBVS/>. The dataset includes social wasps species used in the analysis and can be accessed at <https://specieslink.net/search/records/col/430>. The authors confirm that all data necessary for reproducing the study findings are available in the designated dataset.

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