

Social wasps of two Cerrado localities in the northeast of Maranhão state, Brazil (Hymenoptera, Vespidae, Polistinae)

Suzanna de Sousa Silva¹, Gisele Garcia Azevedo² & Orlando Tobias Silveira¹

¹Departamento de Zoologia, Museu Paraense Emílio Goeldi, Avenida Perimetral 1901, Terra Firme, 66017-970 Belém-PA, Brasil.
suzanna_silva@yahoo.com.br; orlando@museu-goeldi.br

²Departamento de Biologia, Universidade Federal do Maranhão, Avenida dos Portugueses s/n, Campus do Bacanga 65080-040 São Luís-MA, Brasil.
gisabelha@yahoo.com.br

ABSTRACT. Social wasps of two Cerrado localities in the northeast of Maranhão state, Brazil (Hymenoptera, Vespidae, Polistinae). Results are presented of a survey of social wasps from two savanna localities 30 km apart from each other in the northeastern part of the Brazilian state of Maranhão, Brazil: village of Bom Jesus (municipality of Urbano Santos) and village of Tabocas (municipality of Barreirinhas). Two hundred and twenty-seven nests of 31 species of 13 genera were found and mapped. *Polybia rejecta* was the species with the largest average density of colonies/ha in both areas. The similarity (Jaccard's index) between the Tabocas and Bom Jesus faunas was 41.9%. Twenty-seven species of plants were utilized as nesting substrate. In Tabocas, *Qualea parviflora* Mart. (Vochysiaceae) trees were used as substrate by 30.3% of the wasp colonies. In Bom Jesus, the vast majority of colonies (27.9%) were found in a secondary vegetation type, the so-called carrasco, indicator of vegetation change. The number of social wasp species recorded in this study is similar to others obtained in several areas of Cerrado vegetation in Brazil. Nine species are new to Maranhão, and *Mischocyttarus cerberus* had its distribution confirmed, increasing to 58 the number of species known to occur in that state.

KEYWORDS. Cerrado; diversity; inventory; social hymenopterans.

RESUMO. Vespas sociais de duas localidades em Cerrado no nordeste do estado do Maranhão, Brasil (Hymenoptera, Vespidae, Polistinae). O presente trabalho consistiu no levantamento da fauna de vespas sociais em duas localidades em região de Cerrado, separadas por 30 km: vila de Bom Jesus (município de Urbano Santos) e vila de Tabocas (município de Barreirinhas), no nordeste do Maranhão, Brasil. Foram encontradas 227 colônias de 31 espécies de 13 gêneros. *Polybia rejecta* apresentou a maior densidade média de colônias/ha nas duas áreas. A similaridade da fauna (índice de Jaccard) entre Tabocas e Bom Jesus foi de 41,9%. Foram registradas 27 espécies vegetais utilizadas como substrato de nidificação nas duas áreas estudadas. Em Tabocas, *Qualea parviflora* Mart. (Vochysiaceae) foi a espécie vegetal mais utilizada, abrigo 30,3% das colônias. Em Bom Jesus, a grande maioria das colônias (27,9%) foi localizada em vegetação arbustiva secundária, ou carrasco, considerado indicador de alteração da vegetação original. O número de espécies de vespas sociais registradas no presente trabalho foi semelhante ao alcançado em outros estudos realizados em regiões de Cerrado no Brasil. Nove espécies constituem novos registros para o Maranhão e uma espécie teve sua ocorrência confirmada (*Mischocyttarus cerberus*), aumentando para 58 o número de espécies conhecidas para o estado.

PALAVRAS-CHAVE. Diversidade; himenópteros sociais; inventário, Maranhão.

Cerrado is the second largest Brazilian biome, covering approximately two million km², almost 23% of the national territory, being overcome only by the Amazon Forest. With great physiognomic heterogeneity, the Cerrado biome encompasses several hydrographic basins (Amazon, Tocantins, Paraná, Paraguay, São Francisco and Parnaíba rivers), and exhibits a great diversity of soils and climates, that together support a greatly diversified biota (Silva *et al.* 2006). More than half of the Cerrado have been converted into farm lands along the last 35 years. The extent of area still preserving the original vegetation reaches approximately 33,000 km² (Klink & Machado 2005). In the Maranhão state, the Cerrado spreads from the south up to the northeastern region, occupying about one hundred thousand km², around 30% of the total area of the state. Sifeddine *et al.* (2003) studied regional paleoclimatic changes in continuous lake sediment in northeastern Maranhão state (Caço Lake) located in the same region of the present

study. They suggest that the surrounding landscape is composed of at least three dune generations. Caço Lake is formed by blockage by the second dune generation, nowadays 100 km distant from the huge coastal dune complex of the "Lençóis Maranhenses". Modern vegetation ranges from littoral steppe vegetation (restinga) to sandy savanna (cerrado with restinga species admixed), and is governed by dune dynamics.

Social wasps are an outstanding component of the fauna in Brazilian biomes. Besides the complexity of their social behavior (Carpenter 1991) and of the architectonic diversity of their nests (Wenzel 1998), these insects are important predators of other insects in Neotropical ecosystems (Gobbi *et al.* 1984; Raw 1992; Raveret Richter 2000). Moreover, several wasp species are consumers of carcasses of dead animals (O'Donnell 1995; Silveira *et al.* 2005). In the last two decades, efforts have been made to increase the knowledge on diversity of the Brazilian fauna of social wasps. A major

part of the studies has been made in Cerrado areas, and include aspects of faunistic composition and abundance (Mehi & Moraes 2000; Souza & Prezoto 2006; Elpino-Campos *et al.* 2007; Santos *et al.* 2009), population density (Henriques *et al.* 1992; Diniz & Kitayama, 1994; Raw 1998), preference for nesting habitats (Raw 1992; Diniz & Kitayama 1994), and seasonality (Diniz & Kitayama 1998). These studies, along with Richards's 1978 book, and a list of Cerrado species reported by Raw (published online, but no longer available) sum up to 130 the number of recorded species and subspecies in the Cerrado. Such number is probably an under estimative given the huge extent of areas encompassing the Cerrado biome. Accordingly, most of the studies were made around the core area in central Brazil, exception are surveys made in the states of Bahia (Santos *et al.* 2009) and Minas Gerais (Sousa & Prezoto 2006; Elpino-Campos *et al.* 2007). The present work aims to report data collected during the first systematic survey of the social wasp fauna made in a Cerrado area in the northeastern part of the state of Maranhão. The diversity of social wasps is still little known for this portion of the country, the only published data are those of Richards (1978), which list 48 species for the state.

MATERIAL AND METHODS

Studied Areas. The collecting activities were carried out in two localities distant 30 km from each other, covered by open Cerrado, within the outskirts of the villages of Bom Jesus (03°17'S; 43°09'W), and Tabocas (03°02'S; 43°07'W), respectively in the municipalities of Urbano Santos and Barreirinhas, in Maranhão state (Fig. 1). The village of Bom Jesus is located in an area covered mainly by Cerrado with elements of shrubby secondary vegetation, formed by invader plants, and so-called carrasco bushes. The village of Tabocas is located in an area of stricto-sensu Cerrado in a better preserved state than in Bom Jesus (Drummond *et al.* 2008).

Drummond *et al.* (2008) studied the process of vegetation clearing and regeneration on the outskirts of the villages of Tabocas and Bom Jesus through the analysis of a twenty-year long series of satellite images, and topographic charts. Their work indicates that the vegetation around the two villages belong to the same phytoecographic area. Currently observed differences are the result of historical human occupation over a period of 110 years, the approximate age of both villages.

Collecting Methods. Each area was demarcated by three parallel transects measuring 2 km in length, separated by in-

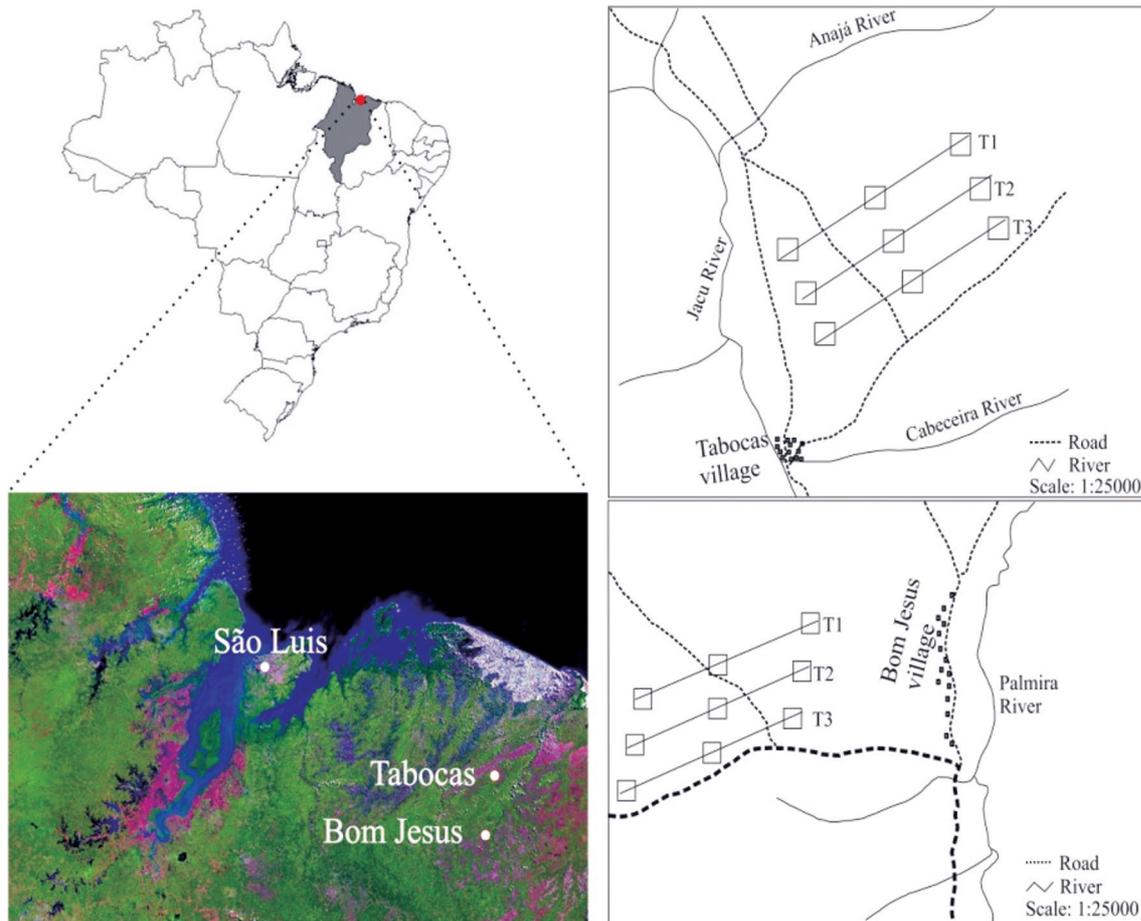


Fig. 1. Satellite image LANDSAT of the northeast Maranhão state showing the location of the Tabocas e Bom Jesus villages. The right side pictures show more details of the arrangement of the transects T1, T2 and T3 with the nine plots.

tervenient distances of 400 m. In each transect, three 4-hectare plots (200 x 200 m), apart 1 km each other, were demarcated (Fig. 1). The plots were searched for colonies of social wasps using a zigzag searching method proposed by Drummond *et al.* (2008). Sometimes nests found in surroundings of both villages were collected.

The areas were visited monthly from August 2003 to August 2004, resulting in a total effort of 42 working days. For each nest found, UTM geographic coordinates, kind of nesting substrate and height of the nest from the ground were recorded. Trees with social wasps nests were identified using Silva (2004) as reference, who gives us a list of about 90 plant species of the Cerrado in northeastern Maranhão.

Sampled species were identified using the keys published in Richards (1978) and Cooper (1996a, 1996b, 1997a, 1997b) and through comparison with specimens deposited in the Invertebrate Collection of the Museu Paraense Emílio Goeldi (MPEG). Voucher specimens were deposited in the entomological collections of the Laboratory of Bee Studies of the Biology Department of the University of Maranhão ((LEA/DEBIO/UFMA), and in MPEG collection.

Data Analysis. Density of social wasp nests was calculated as the number of nests per hectare (nests/ha) in each plot, and grand averages (for all nine plots in each area) were compared between the two localities. It was also calculated the average density of nests/ha for each species found in the both areas. Local species frequency was given by the total number of plots where the species was present divided by nine, the total number of the plots in each area. The diversity in the both areas was measured using Shannon's index (Wolda 1983). The similarity between the areas was evaluated by means of the Jaccard's index (Krebs 1989).

RESULTS AND DISCUSSION

A total of 31 species of 13 genera of social wasps were recorded in the two studied Cerrado areas in Maranhão state (Table I). *Protopolybia sedula* and *Pseudopolybia vespiceps* were indirectly detected by the finding of their abandoned nests. Nine species (*Agelaia cajennensis*, *Brachygastra bilineolata*, *Parachartergus smithii*, *Polybia platycephala*, *Polybia dimorpha*, *Polybia jurinei*, *Polybia bicyttarella*, *Metapolybia unilineata*, and *Mischocyttarus timbira*) are new records to Maranhão and one species (*Mischocyttarus cerberus*) quoted as doubtful by Richards (1978) had its occurrence confirmed. Added to the 48 species already mentioned by Richards (1978), the new records raise the number of known species in Maranhão to 58.

Including social wasps occasionally collected in the outskirts of both villages, we sampled 27 species in Tabocas ($H' = 2.9$), and 17 in Bom Jesus ($H' = 2.45$) (Table I). The similarity (Jaccard's index) between the both areas was 41.9%. Silva & Silveira (2009) found a similar value (42%) when comparing two social wasps' species lists obtained in two areas 30 km apart and under Amazonian rain forest in Pará state.

Of 227 nests found, 35 (15%) were collected occasionally around the two villages, out of the regularly sampling plots. These occasional findings contributed to the recording of 8 species (25%) of the total 31 species found in the region (Table I). Considering only the sampling plots, 134 nests were found in Tabocas and 58 in Bom Jesus. The density ranged from 1 to 8 nests/ha in Tabocas ($\bar{x} = 3.72 \pm 2.72$), and from 1 to 3 nests/ha in Bom Jesus ($\bar{x} = 1.61 \pm 0.71$).

Polybia rejecta was the species with the biggest average density of nests in both areas (Table I). Their nests were frequently found in close association to nests of *Azteca chartifex* (Forel, 1896), often sharing the same substrate. This association has been mentioned in the literature as a defensive strategy against vertebrates or other species of predatory ants (Richards 1978; Dejean *et al.* 1998). *Polistes canadensis* had the second biggest nest density (0.39) in Tabocas, but was not recorded in Bom Jesus (Table I).

Three others species of *Polybia* stand out in density of nests, one of them (*Polybia* sp. 3) being the third species with the biggest average density and present in more than 70% of the plots in Tabocas. These unidentified *Polybia* species (numbered 1 to 3 in the list of Table I) belong to the group of *P. occidentalis* (Olivier), with very similar nests. They were very commonly found in the plots, corresponding to 20% of the total of collected nests. The nest envelope in these three species presents narrow lateral projections, similar to small "feet", and wasps are regionally known as "footed pan" wasp ("pé-de-panela"). A total of 31 nests similar to the above described had only their occurrence annotated, with no sampling of the colony's individuals. (Table I – *Polybia* unidentified colonies), and could not be recognized as one of the three morphospecies. Probably, these records would bring a significant increase in the density and frequency of the three species of this *Polybia* group, especially in Tabocas where the largest numbers of these nests were obtained (23).

The results for both studied areas indicate that they are different in relation to species diversity, taxonomic composition and nest density of social wasps. The average nest density found in Tabocas was more than two fold that of Bom Jesus. Such difference might be correlate to differences in vegetation conservation of both areas. Accordingly, in Bom Jesus, burning of the native vegetation on the outskirts of the community for agriculture proposes is common and fire occasionally escape to control reaching further areas. Such a practice may be directly affecting the abundance of colonies in this area by destruction of nests, or indirectly by destruction of the appropriate plant nesting substrates.

In Tabocas, 21 vegetal species were recorded serving as nesting substrates for wasp species. *Qualea parviflora* Mart. (Vochysiaceae) served as substrate for 30.3% of the sampled colonies, followed by *Parkia platicephala* Benth. (Fabaceae) which was used by 14.8% of the sampled colonies. In *Qualea parviflora* trees, phragmocytarous nests (nests hanging free from branches), astelocytarous nests (those plainly attached to the surface of trunks) and stelocytarous nests (constructed within pre-existent cavities) were found. *Polistes canadensis*

Table I. List of species of social wasps in two Cerrado areas in the northeast of Maranhão state, Brazil, with the number of colonies found in sampling transects (T1, T2, T3) and during occasional collecting (OC), as well as the frequency of species in each area (F%) and average density/species (\bar{X} D). Unidentified (uncollected) *Polybia* colonies were most probably of *P. (Myrapetra)* spp. 1, 2, and 3 in the list.

Species	Tabocas						Bom Jesus					
	T1	T2	T3	OC	F%	\bar{X} D	T1	T2	T3	OC	F%	\bar{X} D
1 <i>Agelaia cajennensis</i> (Fabricius, 1798)					–	–		1			11.11	0.03
2 <i>Agelaia pallipes</i> (Olivier, 1791)	1	2		1	33.33	0.08	1				11.11	0.03
3 <i>Apoica flavissima</i> Van der Vecht, 1973	1	3	1		33.33	0.14	2	3	1		44.44	0.17
4 <i>Brachygastra bilineolata</i> Spinola, 1841				2	–	–					–	–
5 <i>Chartergellus communis</i> Richards, 1978					–	–		1			11.11	0.03
6 <i>Chartegus globiventris</i> de Saussure, 1854		1	3		33.33	0.11				2	–	–
7 <i>Metapolybia cingulata</i> (Fabricius, 1804)		1	3	1	22.22	0.11					–	–
8 <i>Metapolybia unilineata</i> (R. v. Ihering, 1904)					–	–				1	–	–
9 <i>Metapolibia suffusa</i> (Fox, 1898)	1		3	2	22.22	0.11			1	1	11.11	0.03
10 <i>Mischocyttarus (Megachantopus)</i> sp.				2	–	–					–	–
11 <i>M. cerberus</i> Ducke, 1918	1	5		2	33.33	0.17					–	–
12 <i>M. injucundus</i> (de Saussure, 1854)				3	–	–					–	–
13 <i>M. timbira</i> Silveira, 2006				1	–	–					–	–
14 <i>Parachartegus fraternus</i> (Gribodo, 1892)			2		11.11	0.06	3		1	1	33.33	0.11
15 <i>P. smithi</i> (de Saussure, 1854)				3	–	–					–	–
16 <i>Polistes canadensis</i> (Linnaeus, 1758)	1	8	5		66.67	0.39					–	–
17 <i>Polybia (Myrapetra)</i> sp. 1		2	7	1	44.44	0.25	2	5	2		44.44	0.25
18 <i>Polybia (Myrapetra)</i> sp. 2			3		11.11	0.08	1	1	2		44.44	0.11
19 <i>Polybia (Myrapetra)</i> sp. 3	3	4	5		77.78	0.33		1			11.11	0.03
20 <i>Polybia bicyttarella</i> Richards, 1951			1	4	11.11	0.03					–	–
21 <i>Polybia chrysothorax</i> (Lichtenstein, 1796)					–	–	1	2			22.22	0.08
22 <i>Polybia dimorpha</i> Richards, 1978			3		11.11	0.08					–	–
23 <i>Polybia jurinei</i> de Saussure, 1854			1		11.11	0.03					–	–
24 <i>Polybia platycephala</i>			1		11.11	0.03	1				11.11	0.03
25 <i>Polybia rejecta</i> (Fabricius, 1798)	5	7	14	1	66.67	0.72	3	7	2		44.44	0.33
26 <i>Polybia ruficeps</i> Schrottky, 1902	5	2	1		55.56	0.22	1		3		44.44	0.11
27 <i>Polybia sericea</i> (Olivier, 1791)	1	2		1	22.22	0.08			1		11.11	0.03
28 <i>Protopolybia exigua</i> (de Saussure, 1854)				3	–	–		1			11.11	0.03
29 <i>Protopolybia sedula</i> (de Saussure, 1854)				1	–	–					–	–
30 <i>Pseudopolybia vespiceps</i> (de Saussure, 1864)				1	–	–					–	–
31 <i>Synoeca surinama</i> (Linnaeus, 1767)		2		1	11.11	0.06					–	–
<i>Polybia</i> unidentified colonies	4	16	3		66.67	–	4	2	2		33.33	–
Total of nests	23	55	56	30			19	24	15	5		
Number of species						27					17	

showed some evidence of preference for nesting in *Qualea parviflora* with colonies being always located inside tree holes. Usually, each cavity had various small nests of *P. canadensis*, in aggregated fashion. Trees of *Qualea parviflora* of larger size were rarely observed in the Bom Jesus plots, with a single colony of *Metapolybia suffusa* being found nesting on this vegetal species in this area. Nests of *P. canadensis* were not sampled in Bom Jesus, what may be related to the apparent absence of adult trees of *Qualea parviflora* in that locality.

In Bom Jesus, 13 vegetal species were recorded as nesting substrates. The great majority of nests were located in the so-called carrascos bushes (27.9%), which occurrence has been considered evidence of alteration of the original

vegetation in this area (Drummond *et al.* 2008). Several species of *Polybia* were found nesting on this vegetation. The second most used vegetal species (16.3%) was a palm tree (*Astrocaryum* Myer (Arecaceae). According to Dejean *et al.* (1998), the shape and height of leaves of *Astrocaryum* (concave and close to the ground) may favor the building of wasps' nests, offering good protection against severe weather and, probably, against vertebrate predators.

The number of 31 wasp species found in the present work is similar to that obtained by Diniz & Kitayama (1994) in Chapada dos Guimarães, Mato Grosso state, in several kinds of Cerrado but also including gallery forest (wet field, dirty field, and stricto-sensu cerrado). *Polybia ruficeps* was the

most common species in Chapada dos Guimarães, with the majority of the nests found in areas of Cerrado (stricto-sensu). Another common species reported from that locality is *Epipona tatus*, not found in the studied Cerrado in Maranhão state.

Souza & Prezoto (2006) recorded 38 species of social wasps in Cerrado and semideciduous forest in Mata do Baú, Barroso, Minas Gerais state. The authors used four collecting methods, including attraction traps, concluding that combining different methods was important for finding that number of species. In general, the lower and open aspect of the vegetation in Cerrado facilitates the visualization of nests of social wasps. However, smaller colonies (e.g. *Mischocyttarus*), or those camouflaged or built inside cavities (e.g. species of *Agelaia*) may easily go unnoticed.

CONCLUSIONS

The present study recorded a significant number of species (31) and colonies of social wasps considered the relatively small area covered (two areas with 36 ha each). Ten new records raised the number of known social wasps in Maranhão state to 58 species. Another four unidentified species, *Mischocyttarus* (*Megacanthopus*) sp., and *Polybia* (*Myrapetra*) spp. 1, 2, and 3, are candidates for recognition as new taxa in the future. Our data show the importance of Cerrado conservation for diversity and abundance of social wasps. *Polistes canadensis* showed some evidence of preference for nesting on a typical cerrado plant species (*Qualea parviflora*). Additional surveys within Cerrado areas, as well as the use of complementary sampling methods may reveal an even larger number of species in the studied localities.

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