

The social wasp community (Hymenoptera, Vespidae) and new distribution record of *Polybia ruficeps* in an area of Caatinga Biome, northeastern Brazil

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Abstract: Social wasps are broadly distributed in Brazil, and their distribution is closely related to local plant composition. However, only a few studies on the diversity of these insects have been carried out in northeastern Brazil, and in Caatinga Biome the diversity is probably underestimated due to the lack of inventories for the region. Aiming at advancing the knowledge about the wasp fauna, we carried out this study from October 2005 to September 2006 in Ibipeba, northeastern Brazil. We collected 172 wasps of five genera and eight species, and recorded *Polybia ruficeps* Schrottky, 1902 for the first time in the state of Bahia. The most abundant species was *Polybia ignobilis* (Haliday, 1836) ($n = 69$), and the least abundant were *Brachygastra lecheguana* (Latreille, 1824) ($n = 2$) and *Polistes canadensis* (Linnaeus, 1758) ($n = 2$). The present study inventory focused exclusively on the diversity of social wasps in an area of Caatinga, which contributes to advance the local fauna knowledge.

Key words: diversity, semi-arid, wasp fauna

INTRODUCTION

Social wasps of the subfamily Polistinae are very diverse in Brazil, with *ca.* 320 species described, among which there are over 100 endemic species (Carpenter and Marques 2001; Prezoto *et al.* 2007). Wasps have a close relationship with their environment, requiring specific resources, acting as predators and nectar-collectors, and may be used as bioindicators (Prezoto *et al.* 2008; Elisei *et al.* 2010; Souza *et al.* 2010; Clemente *et al.* 2012; Barbosa *et al.* 2014).

Wasps belong to the guild of flower visitors; they overlap with bees in resource exploitation and may represent an important share of foragers (Heithaus 1979a, 1979b; Santos *et al.* 2010; Clemente *et al.* 2012). Although little is known about the role of social wasps as pollinators, studies have shown that they can also efficiently contribute to this process (Hunt *et al.* 1991; Santos *et al.* 2010).

Due to the ecological importance and abundance of social wasps, studies on this group have been carried out in different regions and environments, such as agroecosystems (Aua

et al. 2010; De Souza *et al.* 2011), Atlantic Forest (Souza *et al.* 2012; Togni *et al.* 2014), Amazonian Rainforest (Silveira *et al.* 2012), Cerrado (Santos *et al.* 2009; Henrique-Simões *et al.* 2012), and rupestrian fields (Prezoto and Clemente 2010; Souza *et al.* 2010). However, other biomes, such as the Caatinga, have been poorly studied.

The Caatinga Biome, endemic to Brazil, covers 11% of the country's territory and more than half of its northeastern region (Leal *et al.* 2005; Alves *et al.* 2009). Fifty percent of the state of Bahia is covered by Caatinga (Silva *et al.* 2006), and in this state 72 species of social wasps have been recorded (Andena and Carpenter 2014); however this diversity is probably underestimated due to the lack of inventories of social wasps for the region. According to Drummond *et al.* (2002) and Leal *et al.* (2005), the Caatinga is composed of dry forests with trees, shrubs, and herbs; rainfall in the biome is below 1.000 mm and strongly concentrated in a short rainy season followed by a marked dry season of up to 10 months. This climate may be reflected in adaptive changes in the regional biota, which most probably influences the population dynamics of insects, in particular social wasps.

Hence, the present study aimed at advancing the knowledge of the wasp fauna of the northeastern semi-arid region of Brazil, with a focus on species distribution, and presents data of a study on social wasps in the Brazilian Caatinga.

MATERIAL AND METHODS

Wasp collection was carried out from October 2005 to September 2006, in the Caatinga forest of the reserve of the Company for the Development of the São Francisco and Parnaíba valleys (CODEVASF) has an area of 1,354 ha, in the municipality of Ibipeba, Bahia, northeastern Brazil (11°38'29" S, 042°00'45" W; altitude: 682 m above sea level) (Figure 1). The Caatinga climate is classified as semi-arid tropical, with high average annual temperatures, usually above 25°C, and which may reach up to 32°C in some sites; rains are scarce and irregular (500 to 700 mm) with long periods of drought (Köppen 1970).

Two collectors captured the wasps by active searching on a pre-existent 800 m long trail (Clemente *et al.* 2012). This procedure was repeated for two days on month (totalized 24

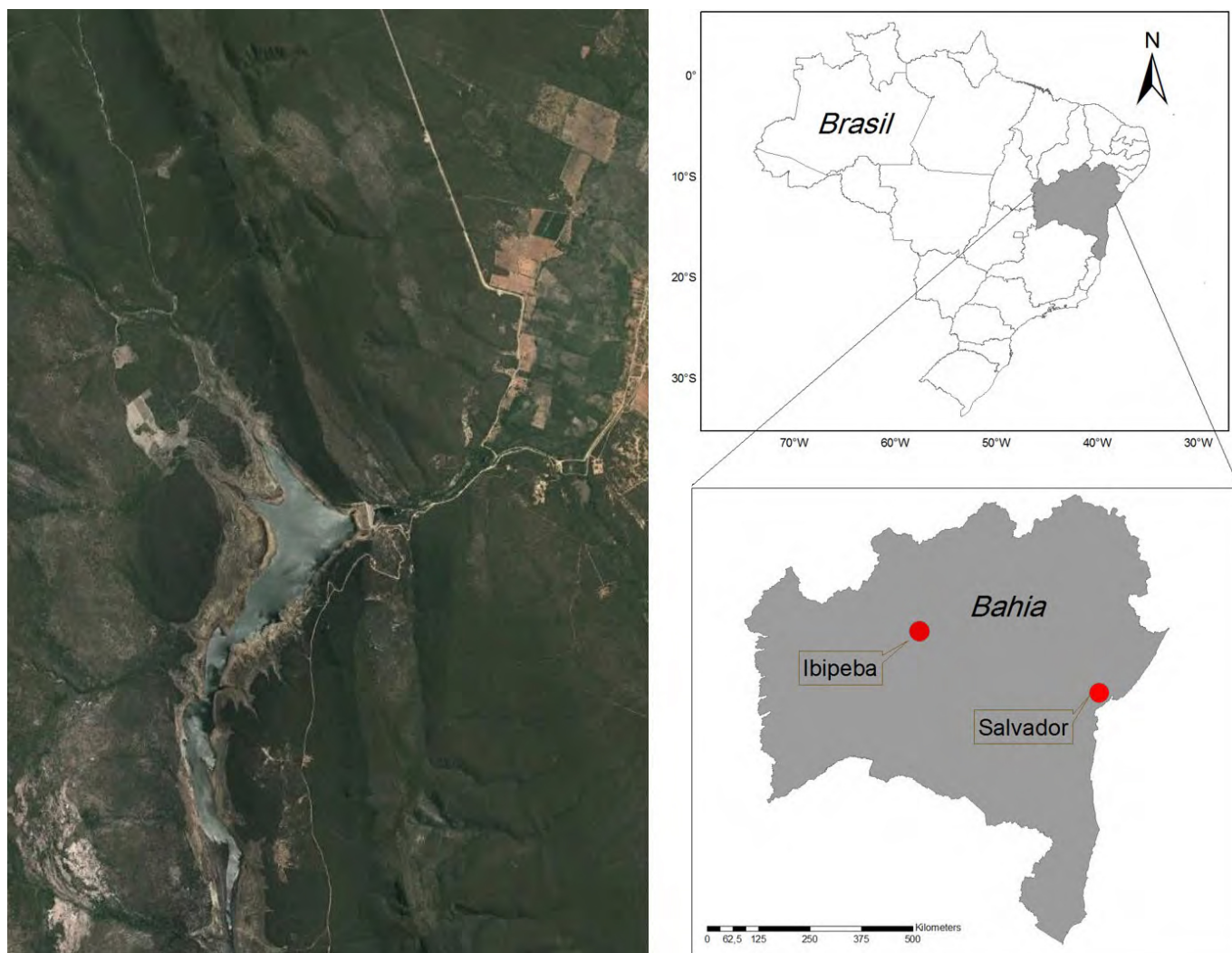


Figure 1. Location of the study area.

days of collections \times 10 h of work/day, from 7:00 to 17:00 h). For each flowering plant, we made 10 minutes of observation, captured social wasps with an insect net and placed them in vials with 70% alcohol (adapted from Aguiar 2003). To identify the wasps we used the genera and species keys by Richards (1978) and Carpenter and Marques (2001), and we also compared the collected specimens with those deposited in the Laboratory of Entomology at the State University of Feira de Santana. The captured specimens were deposited in the Professor Johann Becker Entomological Collection of the Zoological Museum at the State University of Feira de Santana (MZFS), deposited with voucher numbers from #54.699 to #54.805.

The sampling sufficiency was verified by the Jackknife index (Cain 1938) calculated by the program DivEs 2.0. The collected social wasps were categorized by abundance and constancy, following Silveira-Neto *et al.* (1976), as constant species (present in more than 50% of the samples), accessory species (25 and 50%), and accidental species (less than 25%).

RESULTS

In the present study, we collected 172 social wasps of five genera and eight species (Table 1; Figure 2), Jackknife index, was 9.6 estimated species, most of those species (62.5%) found their nests through swarming, in which tens of queens and hundreds of workers leave to build a new nest. Among the

sampled species, *Polybia ruficeps* Schrottky, 1902 (Figure 2A) was recorded for the first time in the Caatinga of Bahia state.

Twenty-five percent of the species were considered constant, 50% accessory, and 25% accidental; *Polybia ignobilis* (Haliday, 1836) (Figure 2D) stood out as the most abundant species ($n = 69$); *Brachygastra lecheguana* (Latreille, 1824) (Figure 2E) and *Polistes canadensis* (Linnaeus, 1758) (Figure 2F) were the least abundant species (Table 1).

DISCUSSION

The small fauna of social wasps found in the present study is closely associated with the study site, a vegetation mosaic typical of the Caatinga. These areas are poor in resources and substrates for wasp nesting; water being a limiting factor and probably responsible for the low diversity found. However, estimation from Jackknife index of the total species richness collected throughout the year is 9.6 and the total species observed in this study was eight species, so 83% of the species were sampled indicating satisfactory sampling effort (Figure 3), corroborated other studies of diversity of social wasps (Tanaka and Noll 2011; Simões *et al.* 2012.).

These results were similar of other two studies in the Caatinga that recorded a small number of social wasps: Melo *et al.* (2005) found 12 species and Santos *et al.* (2006) with 13 species. These three studies had four common species: *B. lecheguana*, *P.*

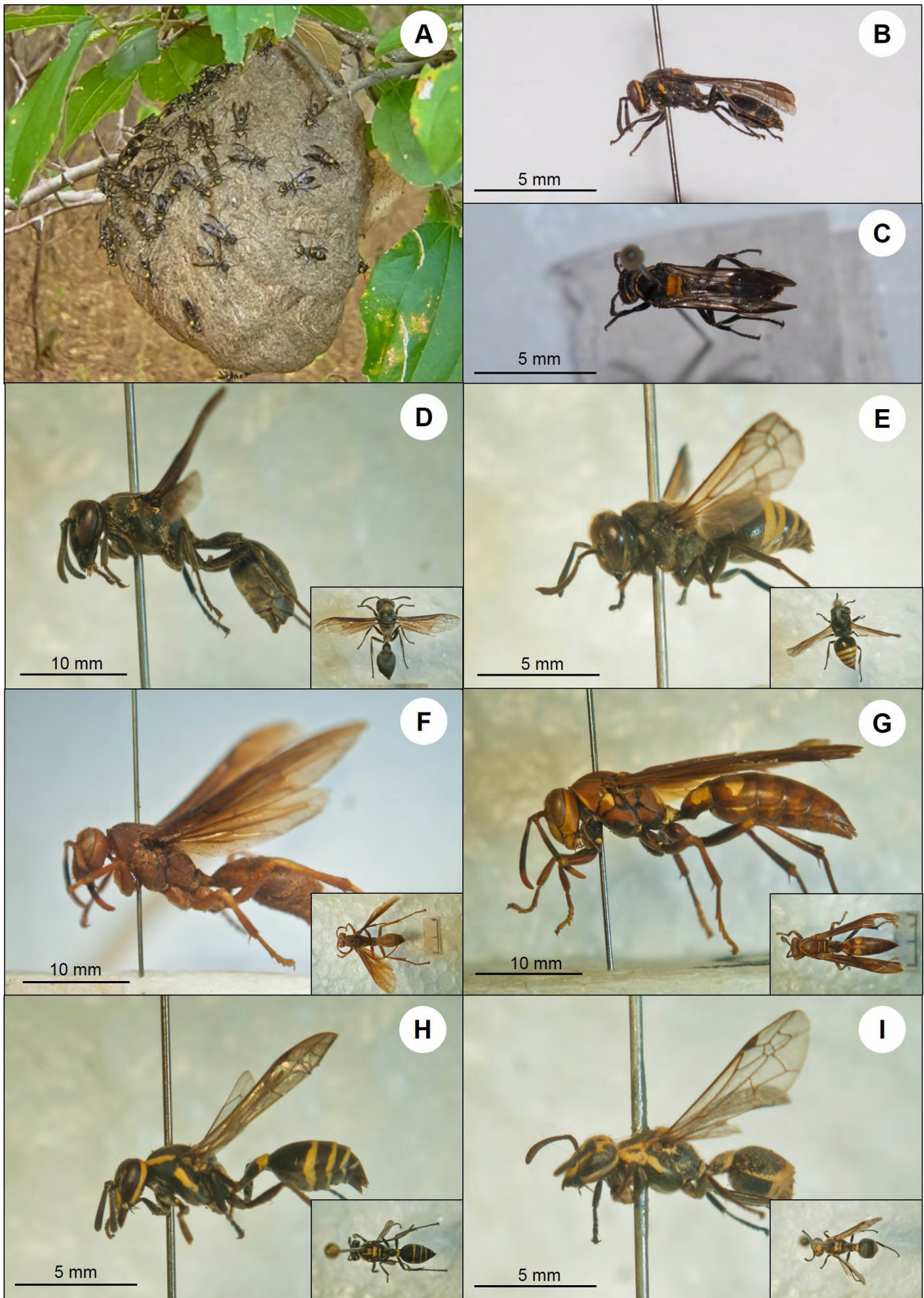


Figure 2. (A) A colony of *Polybia ruficeps* Schrottky, 1902 found in the Caatinga Biome of Ibipeba, Bahia, northeastern Brazil; (B) lateral view of individual of *P. ruficeps*; (C) dorsal view of individual of *P. ruficeps*; (D) *Polybia ignobilis* (Haliday, 1836); (E) *Brachygastra lecheguana* (Latreille, 1824); (F) *Polistes canadensis* (Linnaeus, 1758); (G) *Polistes similimus* Zikán, 1951, (H) *Polybia occidentalis* (Olivier, 1791) and (I) *Protonectarina sylveirae* (de Saussure, 1854).

Table 1. Abundance and constancy of social wasps collected in the caatinga of Ibipeba, Bahia, northeastern Brazil, from October 2005 and September 2006.

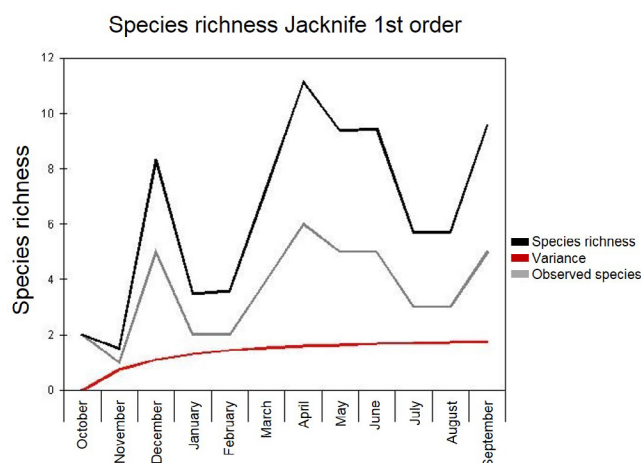
Species	Number of individuals (n)	Relative Abundance (%)	Constancy (%)
<i>Brachygastra lecheguana</i> (Latreille, 1824)	2	1.16	16.67
<i>Mischocyttarus cearensis</i> Richards, 1945	4	2.33	25.00
<i>Polistes canadensis</i> (Linnaeus, 1758)	2	1.16	8.34
<i>Polistes similimus</i> Zikán, 1951	18	10.47	50.00
<i>Polybia occidentalis</i> (Olivier, 1791)	49	28.49	75.00
<i>Polybia ignobilis</i> (Haliday, 1836)	69	40.12	91.66
<i>Polybia ruficeps</i> Schrottky, 1902	23	13.37	50.00
<i>Protonectarina sylveirae</i> (de Saussure, 1854)	5	2.91	41.67

canadensis, *Polybia occidentalis* (Olivier, 1791) and *Protonectarina sylveirae* (de Saussure, 1854). This may be because they are species that occur easily in surveys and because of these studies have presented the same methodology, they appeared in the three studies. Habitat heterogeneity may have an expressive impact on local diversity (Ricklefs 2010), as observed in the present study. In the Andena and Carpenter (2014) compilation of social wasps in the semi-arid region, the authors made short sampling and analysis of biological collections and estimate 76 species for the entire Caatinga Biome.

The high number of swarming wasps found in the present study can be explained by these species require large amounts of food, as their colonies have hundreds or thousands of individuals, accounting for high biomass. These populous colonies make their local abundance higher than that of species with independent nest founding: when colonies are founded by one of few females, this quantity becomes decisive as regards the collection of resources. According to the theories that explain foraging, large groups of individuals are more successful in finding resources than a few isolated individuals in hostile environments (Krebs and Davies 1997). In addition, swarming wasps present marked age polyethism and perform highly specialized tasks, which increase the chance of survival of colonies (Jeanne 1991). Other studies in dry (Santos et al. 2009; Henrique-Simões et al. 2012) and humid environments, such as the Atlantic Forest (Togni et al. 2014) and the Amazon Forest (Silveira et al. 2012), also revealed a predominance of tribe Epiponini, with no relationship with resource and nesting site availability for new nest foundations.

Among the species found in the study area, stands out the first record of *P. ruficeps* for the state of Bahia, which had not been recorded yet by previous studies (Melo et al. 2005 and Santos et al. 2006), and, hence, demonstrate the importance of a need for studies on the biological diversity of the Caatinga. Richards (1978) recorded this species for the states of Ceará, Goiás, Maranhão, Mato Grosso, and Santa Catarina, but more recent studies expanded the records to the states of São Paulo (Lima et al. 2010; Gomes and Noll 2009; Tanaka-Jr. and Noll 2011), Mato Grosso do Sul (Pereira and Antonialli-Junior 2011; Grandinete and Noll 2013), and Paraíba (Nadia et al. 2007a; Nadia et al. 2007b).

The present study inventory focused on the diversity of social wasps in the Caatinga and, hence, it contributes to advance the local knowledge of the biome. This kind of study also can add to demonstrate the potential increasing of the distribution for some species. Furthermore, social wasps are key organisms for understanding and monitoring

**Figure 3.** Collector curve showing the cumulative number (observed species) and the estimation of species richness (Jackknife) of social wasps in an area of Caatinga Biome, northeastern Brazil, from October 2005 to September 2006.

environmental conditions. Hence, the constant monitoring of wasps can be used to assess the conservation status of a given area, such as, for example, the Caatinga.

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