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REVIEW

Social Wasps (Hymenoptera: Vespidae: Polistinae) from Northeastern Brazil: State of the Art

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Abstract

For many years, research about social wasps in the Northeast was neglected due to its climatic and vegetative characteristics, insufficient incentive for training researchers to study these animals and perpetuation of low diversity of these groups in arid environments proposed by Ducke. This study carried out a bibliographic survey of research about social wasps in a 40 year period from January/1979 to December/2019, to determine the overall reality of biodiversity and richness knowledge for social wasps species. One hundred and twenty-four (124) social wasp species have been registered in the Northeast Region, distributed among 20 genera. Epiponini stands out with 84 species, followed by Mischocyttarini (24) and Polistini (16). Sergipe is the only state with no studies and records of species thus far. Such results show the importance of continuing taxonomic studies of these insects to expand their geographic distribution and to determine areas for environmental preservation in the Northeastern biomes, i.e., the Caatinga *sensu lato*, Cerrado and Amazon rainforest and their transition zones, as they have been insufficiently studied and present high potential for new discoveries. We suggest Alagoas, Ceará, Pernambuco and, especially Sergipe as priority areas since there is a lacking data in these states. Finally, we recommend continuing research on species reports in states like Bahia, using the map created herein to choose future study areas.

Introduction

The Northeast region of Brazil occupies 18.27% of the country's territory, covering 1,558,000 km², and is divided into nine states: Alagoas, Bahia, Ceará, Maranhão, Paraíba, Pernambuco, Piauí, Rio Grande do Norte and Sergipe. The region presents phytophysiognomies from the Cerrado, Atlantic Forest, Amazon Forest and Caatinga biomes, with the latter almost exclusively found in the Northeast region where it covers more than half of its territory and mostly coincides with the Semi-Arid region. Additionally, it holds several transition zones between biomes, which are considered potential places of endemism (Vieira et al., 2017).

The Semi-Arid region is made up of Caatinga, characterized by high temperatures, low rainfall and water deficit, which is why this region was thought to be the result of anthropic degradation of forest regions such as the Atlantic Forest and the Amazon Rainforest (Alves et al., 2009). Such perception has recently changed with the recognition of this region's high biodiversity and endemism of species, including social wasps (Oliveira et al., 2012; Andena & Carpenter, 2014).

Polistinae wasps (Vespidae) are a group of Hymenoptera mainly characterized by social behavior, nest building and parental care until the end of the pupal stage (Carpenter & Marques, 2001). Brazil presents the greatest biodiversity of social wasps in the world, with 346 species recorded, 104 of which are endemic (Richards, 1978; Carpenter & Marques, 2001; Andena & Carpenter, 2014; Barbosa et al., 2016; Hermes et al., 2015). Social wasps have important ecological functions, including pollination of some plants (Quirino & Machado, 2001) and decomposition of organic material, as they feed on carcasses. In addition, these wasps prey on immature and adult forms of other insects, helping to naturally control agricultural pests (Prezoto & Giannotti, 1994; Moretti et al., 2011).

The incentive of research with social wasps in the Northeast has been neglected for many years (Andena & Carpenter, 2014). This is due to understanding of the first works of naturalists, such as Adolpho Ducke (1907), of poor diversity compared to other biomes in Brazil due to characteristics related to the climate, low rainfall and vegetation conformation of the region predominantly covered by the Caatinga biome. However, currently this is not the reality, with data, mainly from Bahia the most sampled state in the Northeast and third most sampled in Brazil (Barbosa et al., 2016), indicate marked richness of species in the Northeast (Andena & Carpenter, 2014).

Based on the locations where these surveys were conducted, there is a knowledge gap regarding the social wasp community in the Northeastern region, as many areas have not yet been sampled (Andena & Carpenter, 2014; Barbosa et al., 2016). Therefore, it is not possible to determine the actual number of social wasp species in these biomes, nor the occurrence and distribution of rare or endemic species. Due to the importance of understanding local biodiversity, this study aimed to perform a bibliographic survey of research about social wasps in the Northeast to create an overview of the current knowledge about their biodiversity and richness and demonstrate which states present such information, as well as indicate regions with higher and lower sampling.

Material and Methods

We used Richards (1978) as a starting point for collecting data of social wasp species records in Brazil. After cataloging the species present in this book, we searched for scientific works in the Capes, Web of Science, Scielo, Scopus, Science Direct and Google Scholar databases using the search terms ("Vespa Social", AND "State name" AND "Vespidae"), in Portuguese and English, searching within the 40 year period from January 1979 to December 2019. At the end, data from the Taxonomic Catalog of Fauna of Brazil (CTFB) (Hermes et al., 2015) was used to create the species tables.

Results were included according to the following criteria: period of publication, approach consistent with the research and indexed in any of the databases mentioned above. For each article, we isolated the study area, year of publication, magazine used to publish the results, sampling method used, number of species identified and duration of the collections.

In order to calculate the Constancy of the species mentioned, we followed the methodology proposed by Barbosa et al. (2016) in which each publication found is used as a sample; with species present in more than 50% of the samples considered constant, those in 25% to 50% considered accessory and those in less than 25% considered accidental. We used the data from collected areas to form thematic maps in the free Qgis software, with the objective of spatially distributing the collection areas in this region and to demonstrate priority areas for new inventories.

Results

We found 26 publications from 1979 to 2019, most of which were scientific articles (61.5%), along with Short Communications (30.8%) and Book Chapters (7.7%) (Table 1). A total of 124 species of social wasps distributed among 20 genera have been registered in the Northeast Region (Table 2). Epiponini stands out with 84 species, followed by Mischocyttarini (24) and Polistini (16). After Richards (1978), 53 species were added through new research, representing an increase of 74.6% in two decades of active research.

With the exception of Sergipe, all states in the Northeastern region present publications and records of social wasp fauna (Fig 1). The first study was carried out in Bahia, and over 10 years, it was the only state to present research

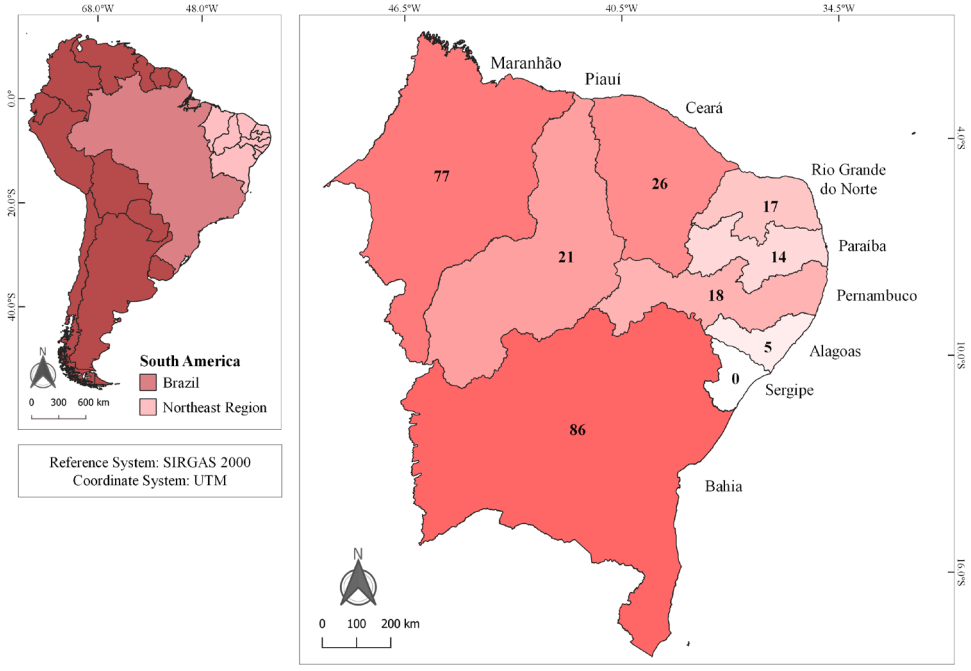

Fig 1. Distribution of social wasp species in the Northeastern states.

Table 1. Studies of social wasps in the Northeast region of Brazil from January 1979 to December 2019. - Data not available in publication; States: AL: Alagoas; BA: Bahia; CE: Ceará; MA: Maranhão, PB: Paraíba; PE: Pernambuco; PI: Piauí; RN: Rio Grande do Norte. Biomes: Agr - Agricultural System; Amz - Amazon Forest; Atl - Atlantic Forest; Atv - active collection; Caa - Caatinga; Cer - Cerrado; Man - Mangrove forest; Res - Restinga. Methods: Flw - collection in flowers; Lgt - light trap; Lqd - attractive liquid; Mls - Malaise trap; Msp - Malaise suspended trap; Nst - nest collection. *included in the biome column for easy viewing.

Year/Author(s)	State	Biome	Collection method(s)	Duration (months)
2000				
Raw, A.	BA	Atl	-	1
2005				
Melo et al.	BA	Cer	Atv	8
2006				
Gilberto et al.	BA	Caa	Atv	13
Silva-Pereira & Santos	BA	Cer	Flw	7
2007				
Santos et al. (a)	BA	Atl (Man*; Res*)	Atv	36
Santos et al. (b)	BA	Caa	Atv	9
2009				
Santos et al. (a)	BA	Cer	Nst	8
Santos et al. (b)	BA	Cer (Agr*)	Nst	6
2010				
Menezes et al.	BA	Atl	Atv	-
2011				
Menezes et al.	BA	Atl	-	-
Silva Neto & Andena	BA	Atl	-	-
Andena & Carpenter	MA	-	-	-
Silva et al.	MA	Cer	Nst	13
2014				
Somavilla et al.	MA	Amz	Nst; Mls; Msp; Lgt; Lqd	9
Rocha & Silveira	PI	Caa	Nst	2
Andena & Carpenter	BA; PI	Caa	Lgt; Mls	-
2015				
Melo et al.	BA	Caa	Atv	12
Elisei et al.	PB	Caa	Atv; Lqd	-
Santos Junior et al.	BA; CE; MA; PB; PE; PI; RN	-	-	-
2016				
Aragão & Andena	BA	Atl	Atv; Lgt; Mls	12
Virgínio et al.	RN	Atl	Nst	11
2017				
Lopes & Menezes	BA; PE	Atl	-	-
Somavilla et al.	CE; PI	Caa	Atv; Nst; Mls; Msp; Lgt	2
Elisei et al.	PB	Caa	Atv; Lqd	24
2018				
Barbosa et al.	AL	Atl	Atv	-
Virgínio et al.	RN	-	-	4

about social wasps, accumulating nine papers up to 2010. This state presents 61.5% of all research from the Northeast and is the most inventoried state in the region, with four times more studies than Piauí and Maranhão. In addition, it shows the greatest consistency in studies and sampled biomes.

Bahia and Maranhão have the most Polistinae records, with 85 and 77 registered species, respectively. Individually, the other states hold up to 35% of the total records found for Bahia. Alagoas has the fewest described species and Sergipe has no wasp records at all.

During the period of active publications, i.e., starting in 2000, there was an increasing number of publications, which remained stable over the years. In 2011 there is the most works, however, at the end of the last decade, there was an unprecedented drop until end of 2019.

The Atlantic forest and Caatinga were the most sampled biomes, with nine and eight works, respectively. The Cerrado presented five works and the Amazon had one, being the biomes with the least amount of research in the Northeastern region. Furthermore, some authors (Silva et al., 2007a; Santos et al., 2009b) highlighted specific regions that were inventoried within these biomes, i.e., restinga, mangrove and an agricultural system.

When mapping the collection areas of the works for spatial visualization of inventoried locations, non-sampled zones are noticeable in highly inventoried states such as Bahia. It is important to highlight that the Conservation Units were shown to be priorities when choosing study areas (Fig 2).

The fauna of the Caatinga is the richest among the Northeastern biomes (Table 2), holding 65% of all species found within the Northeast region. Additionally, *Mischocyttarus* and *Polistes* present their highest diversity in the Caatinga. However, some studies do not report the biome in which specimens were found and exclusively present taxonomic and phylogenetic research with species description by territory (Andena & Carpenter, 2011; Santos Junior et al., 2015; Virgínio et al., 2018).

The collection methods employed were active collection (12 works), nest collection (8), light trap and Malaise trap (4), attractive liquid (3), suspended malaise trap (2) and collection in flowers (1). Most surveys used only one sampling method. The *in situ* sampling period lasted for an average of 11 months with most samplings lasting from 6 months to a year. The shortest period was 2 months and the longest was 36 months.

According to the Constancy Index, 83.2% of the total species reported were accidental, 11.2% were accessory, and only 5.6% were constant. *Brachygastra lecheguana* (Latreille, 1824), *Polistes canadensis* (Linnaeus, 1758), *Polybia ignobilis* (Haliday, 1836), *Polybia occidentalis* (Olivier, 1792), *Polybia sericea* (Olivier, 1792), *Protopolybia exigua* (de Saussure, 1854) were the only constant species. Additionally, all the *Mischocyttarus* species were accidental along with the rest of *Polistes*.

Agelaia pallipes (Olivier, 1792), *Angiopolybia pallens* (Lepeletier, 1836), *Apoica pallens* (Fabricius, 1804), *Polybia chrysothorax* (Lichtenstein, 1796), *P. ignobilis, P. occidentalis, P. rejecta* (Fabricius, 1798), *P. sericea, Polistes versicolor* (Olivier, 1791), *Protopolybia exigua* and *Synoeca surinama* (Linnaeus, 1767) were the most common species collected in all biomes, with *P. occidentalis* and *P. sericea* most frequently found in the studies. Some species do not present data about the biome where they were collected and only present the sampled state.

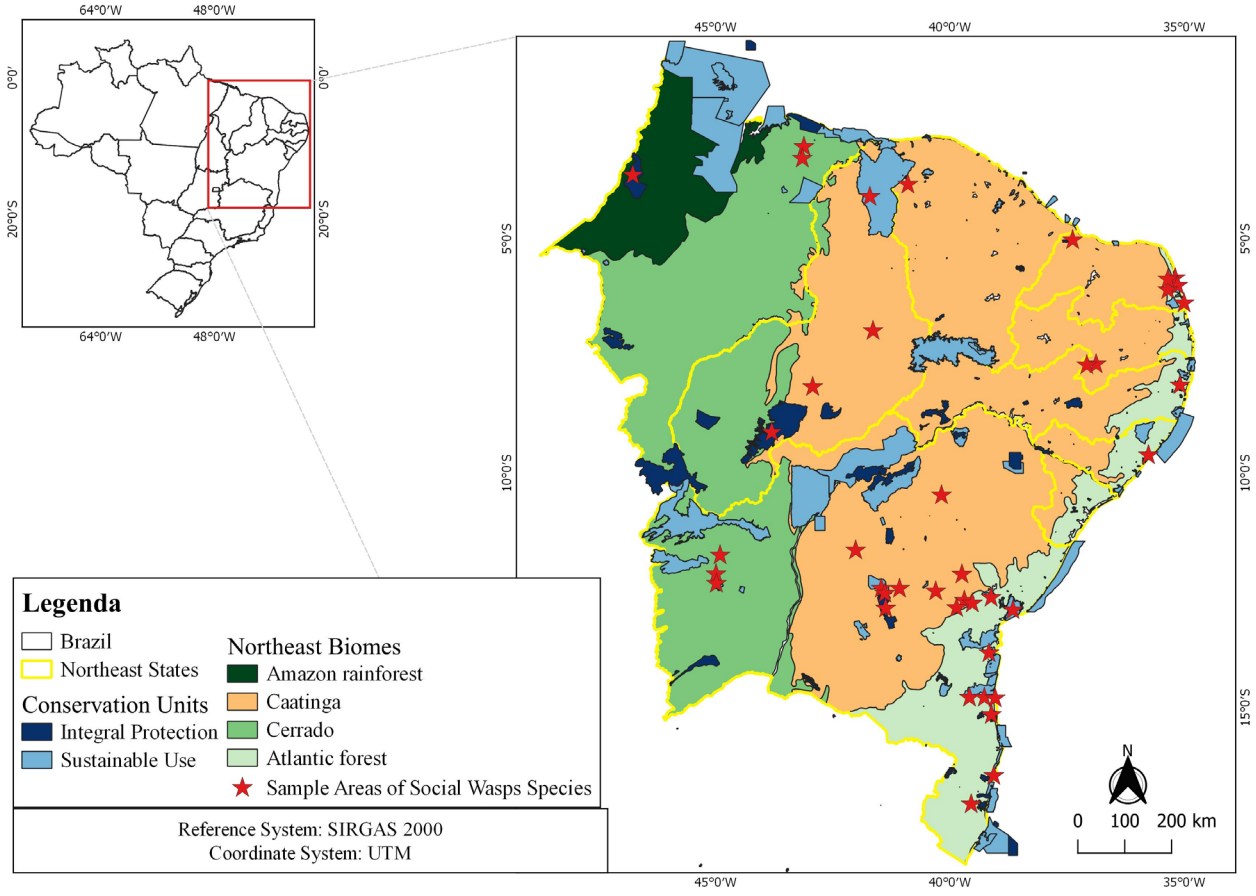

Fig 2. Areas chosen for sampling social wasps in the Northeast Region of Brazil.

Polybia, *Mischocyttarus* and *Polistes* stand out as the most diverse genera in the Northeast, while *Polybia* is found in all states with records of social wasps, *Mischocyttarus* has not yet been recorded in Piauí and Rio Grande do Norte and is more diverse in Bahia, with 75% of registered species. The genus *Polistes* was most described in the Caatinga compared to the other biomes, and the Amazon Forest (2) presented less records.

Discussion

The first work to compile species described in the Northeast is by Andena and Carpenter (2014). These authors adopted the portion of the region covered by the semiarid as a study area; the research was conducted with material attached in two museums, bibliographic research and collections in two places in the state of Bahia and one in Piauí. They recorded 76 species, 70 more than Ducke's (1907) records. The states of Sergipe, Alagoas and Piauí are treat as priorities for research due to little data.

After that publication, Piauí was curiously sampled only in the portion covered by the semiarid region, reporting an addition of 17 new species (Rocha & Silveira, 2014; Somavilla et al., 2017) to that found by Andena and Carpenter (2014). Alagoas with a survey on a fragment of Atlantic forest (Barbosa et al., 2018) and Sergipe remains as the only one without sampling.

As demonstrated by Andena and Carpenter (2014), Barbosa et al. (2016) and Somavilla et al. (2017), the Northeastern region is still poorly sampled compared to other regions of Brazil, mainly due to its climatic characteristics and low concentration of researchers, but not because it has low species diversity. By mapping the sampling areas from studies carried out in the Northeast, it was possible to determine the most inventoried areas (mainly in Bahia), as well as places that need new studies. Such biomes lacking studies include the Cerrado and the Amazon Rainforest, which is not surprising. Currently, these biomes show high deforestation due to the expansion of agriculture, population and industrial production (Silva et al. 2018). For the Amazon Rainforest region, timber extraction also occurs in the Belém Endemism Area, in Maranhão (Ricardo et al., 2017).

Conservation Units are the most frequently used areas for sampling social wasps' species in Northeast (Aragão & Andena, 2014; Somavilla et al., 2017; Barbosa et al., 2018). Usually, researchers work in these areas due to the reduction or absence of fragmentation of the environments and anthropic pressures, as well as exclusive species, presenting unchanged or only slightly altered conditions (Gurgel et al., 2009).

The active publication period occurred along with that reported by Barbosa *et al*. (2016) for Brazil, with 61.5 % of the papers occurring in the last 10 years, especially in 2011. Only in the last decade studies about social wasps been carried out in the other Northeastern states, increasing knowledge of social wasp fauna (Silva et al., 2011; Rocha & Silveira, 2014; Elisei et al., 2015; Virgínio et al., 2016; Virgínio et al., 2018).

The active collection method was most frequently used in the Northeast. Such method is considered the most efficient when compared to other methods (Silveira, 2002; Jacques et al., 2018), especially for semi deciduous forests and savannas since it samples species exclusive to this method, as well as species collected in the other methods (Elpino-Campos et al., 2007; Souza et al., 2011; Elisei et al., 2017).

We did not find any standardization for the collection methods adopted in the research, especially for the passive collection methods. The methods differ regarding the duration of active collections in the field (Melo et al., 2005; Santos et al., 2006; Santos et al., 2007a; Virginio et al., 2017) and in the association of different methods (Andena & Carpenter, 2014; Aragão & Andena, 2016; Elisei et al., 2017; Somavilla et al., 2017). This affects the evaluation of efficiency of such methods and makes it impossible to determine which of those used in the northeast were more or less efficient in collecting wasps. There have been proposals for active collection methods associated with Malaise traps in the forest (Somavilla et al., 2014b), adoption of more efficient attractive liquids and optimization of the size and distance between traps (Maciel et al., 2016; Jacques et al., 2018); however, there have been few or have not yet been adopted in the Northeast.

The average period spent on collections was 11 months. As reported in other surveys, this period allows the analysis of seasonal changes (Elpino-Campos et al., 2007; Barbosa et al., 2016; Maciel et al., 2016), which helps analyze both seasonality and fluctuation of species throughout the year and prevents underestimation of local species (Jacques et al., 2018).

The success of Epiponini in the semiarid region is possibly due to their nesting habit by swarming and protecting their nest with an enclosure that allows greater chances of successful dispersion in search of new nesting sites and better homeothermic control when compared to the others (Andena & Carpenter, 2014). From the 19 genera of Epiponini occurring in Brazil (Carpenter & Marques, 2001), only *Nectarinella* was not registered in the Northeast, it is a genus that is found in the Amazon (Silveira, & Santos-Junior, 2016), a poorly sampled biome in the Northeast. Polistini and Mischicyttatini are tribes with independent foundation (Carpenter & Marques, 2001) that, even having the most diverse genera, are less frequent during sampling (Silva & Pereira, 2006; Santos et al., 2009a; Virgínio et al., 2016; Elisei et al., 2017), but also, they can be more difficult to collect depending on the method chosen for sampling (Somavilla et al., 2014a).

As seen by Barbosa et al. (2016), most of the species found (> 80%) are accidental. Regarding the constant species, *Brachygastra lecheguana*, *Polybia ignobilis*, *P. occidentalis* and *P. sericea* presented the same status in the Northeast as they do throughout Brazil. The species *Polistes versicolor*, which is reported as constant in Brazil, is an accessory species in the Northeast, but is present in all biomes studied.

It is important to highlight a considerable increase in the records of recently described species, adding new

occurrences and representing about one third of the national biodiversity (Richards, 1978; Carpenter & Marques, 2001; Andena & Carpenter, 2014; Hermes et al., 2015; Barbosa et al., 2016). Such records refute the perspectives of low diversity (Ducke, 1907) for the Northeast, especially in the Caatinga region (81 species). Thus far, this biome presents the highest species diversity on the Northeast; however, the other biomes were not as well sampled, making it impossible to affirm if it is actually the richest in the Northeast.

In Brazil, Bahia presents the most studies and reports of species in the region and is consequently more diverse. However, despite having little research compared to Bahia, Maranhão presents satisfactory diversity of species and could hold more species since much of its territory has not yet been inventoried. Additionally, it contains areas of Amazon, Cerrado, Caatinga and transition zones between these biomes that have been poorly studied.

Such results highlight the importance of continuing taxonomic studies of these insects to expand their geographic distribution and to determine areas for environmental preservation in the Northeastern biomes, i.e., Caatinga *sensu lato*, Cerrado and Amazon rainforest and their transition zones, as they have been insufficiently studied. We suggest primarily research in Sergipe, the only unsampled state, in the same way in Alagoas, Pernambuco, Ceará, Paraíba, Rio Grande do Norte, Piauí and Maranhão according to the number of studies carried out in each state. Furthermore, we recommend continuing research about species reports in states like Bahia, using the map created herein to choose future study areas.

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Table 2. Species of Social Wasps registered in Northeastern Brazil. States: AL: Alagoas; BA: Bahia; CE: Ceará; MA: Maranhão, PB: Paraíba; PE: Pernambuco; PI: Piauí; RN: Rio Grande do Norte. Biomes: Atl: Atlantic Forest; Amz: Amazon Forest; Caa: Caatinga; Cer: Cerrado. Constance: Acc: Accessory; Aci: Accidental; Cons: Constant. *New species records after Richards (1978).

Species	State(s)	Biome(s)	Const.
Epiponini			
Agelaia Lepeletier, 1836			
Agelaia angulata (Fabricius, 1804)	BA; MA	Amz; Atl	Aci
Agelaia cajennensis (Fabricius, 1798)	BA; MA	Caa; Cer	Aci
Agelaia centralis (Cameron, 1907)	BA; MA	Amz; Atl; Caa	Aci
Agelaia flavipennis (Ducke, 1905)	MA	-	Aci
Agelaia fulvofasciata (Degeer, 1773)	MA	Amz	Aci
Agelaia myrmecophila (Ducke, 1905)	BA; MA	Amz; Atl	Aci
Agelaia pallipes (Olivier, 1792)	BA; CE; MA; PI; RN	Amz; Atl; Caa; Cer	Acc
Agelaia testacea (Fabricius, 1804)*	MA	Amz	Aci
Agelaia vicina (de Saussure, 1854)	AL; BA; CE; MA	Caa; Cer	Aci
Angiopolybia Araújo, 1946			
Angiopolybia pallens (Lepeletier, 1836)	BA; MA; PE	Amz; Atl; Caa; Cer	Acc
Angiopolybia paraensis (Spinola, 1851)*	BA; MA	Amz; Caa	Aci
Apoica Lepeletier, 1836			
Apoica arborea de Saussure, 1854	MA	Amz	Aci
Apoica flavissima Van der Vecht, 1973	AL; CE; MA; PB; PI	Atl; Caa; Cer	Aci
Apoica gelida Van der Vecht, 1973*	PE; RN	Atl; Caa	Aci
Apoica pallens (Fabricius, 1804)*	BA; CE; MA	Amz; Atl; Caa; Cer	Aci
Apoica pallida (Olivier, 1791)	BA; CE; MA	Amz; Atl; Caa;	Aci
Apoica strigata Richards, 1978*	MA	Amz	Aci
Asteloca Raw, 1985			
Asteloca traili (Cameron, 1906)*	MA	Amz	Aci
Brachygastra Perty, 1833			
Brachygastra augusti (de Saussure, 1854)*	PI	Amz; Caa; Cer	Aci
Brachygastra bilineolata Spinola, 1841*	MA	Caa; Cer	Aci
Brachygastra lecheguana (Latreille, 1824)	BA; CE; MA; PB; PE; PI; RN;	Atl; Caa; Cer	Cons
Brachygastra scutellaris (Fabricius, 1804)	MA; PE; PI	Caa	Aci
Chartergellus Bequaert, 1938			

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Species	State(s)	Biome(s)	Const.
Epiponini			
Chartergellus communis Richards, 1978	BA; CE; MA	Caa; Cer	Aci
Charterginus Fox, 1898			
Charterginus fulvus Fox, 1898	MA	-	Aci
Chartergus Lepeletier, 1836			
Chartergus globiventris de Saussure, 1854*	BA; CE; MA. PI	Caa; Cer	Aci
Clypearia de Saussure, 1854			
Clypearia angustior Ducke, 1906*	BA	Caa; Cer	Aci
Epipona Latreille, 1802			
Epipona media Cooper, 2002*	BA	Cer	Aci
Epipona tatua (Cuvier, 1797) *	MA	Amz	Aci
Leipomeles Möbius, 1856			
Leipomeles dorsata (Fabricius, 1804)	BA	Atl; Caa	Aci
Metapolybia Ducke, 1905			
Metapolybia cingulata (Fabricius, 1804)	BA; CE; MA; PI	Atl; Caa; Cer	Acc
Metapolybia decorata (Gribodo, 1896)*	BA	Atl	Aci
Metapolybia docilis Richards, 1978*	CE	Caa	Aci
Metapolybia miltoni Andena & Carpenter, 2011*	MA	Cer	Aci
Metapolybia suffusa (Fox, 1898)	BA; MA	Cer	Aci
Metapolybia unilineata (R. von Ihering, 1904) *	MA	Cer	Aci
Parachartergus R. von Ihering, 1904			
Parachartergus fraternus Gribodo, 1892	MA	Amz; Cer	Aci
Parachartergus pseudoapicalis Willink, 1959	BA; PE	Atl; Caa; Cer	Aci
Parachartergus smithii (de Saussure, 1854) *	MA	Cer	Aci
Polybia Lepeletier, 1836			
Polybia belemensis Richards, 1970*	BA	Caa	Aci
Polybia bicyttarella Richards, 1951*	MA	Cer	Aci
Polybia bistriata (Fabricius, 1804)	AL; BA; MA	Atl; Amz	Aci
Polybia catillifex Möbius, 1856*	BA	Atl	Aci
Polybia chrysothorax (Lichtenstein, 1796)	BA; CE; MA; PI; RN;	Amz; Atl; Caa; Cer	Acc
Polybia depressa (Ducke, 1905) *	MA; PI	Amz; Caa	Aci
Polybia dimidiata (Olivier, 1792)	BA; MA	Caa	Aci
Polybia dimorpha Richards, 1978*	MA	Cer	Aci
Polybia fastidiosuscula Saussure, 1854	BA	Caa; Atl	Aci
Polybia flavifrons Smith, 1857	BA; MA	Caa; Cer	Aci
Polybia flavitincta Fox, 1898	BA	Atl	Aci
Polybia ignobilis (Haliday, 1836)	BA; CE; MA; PB; PE; PI; RN	Amz; Atl; Caa; Cer	Cons
Polybia jurinei Saussure, 1854	BA; CE; MA	Amz; Atl; Caa; Cer	Aci
Polybia liliacea (Fabricius, 1804)	MA	Amz; Cer	Aci
Polybia micans Ducke, 1904	MA	Amz; Caa	Aci
Polybia minarum Ducke, 1906	BA	Caa	Aci
Polybia occidentalis (Olivier, 1792)	BA; CE; MA; PB; PE; PI; RN	Amz; Atl; Caa; Cer	Cons
Polybia paulista von Ihering, 1896*	BA; CE	Atl; Caa; Cer	Acc
Polybia platycephala Richards, 1951*	BA; MA	Atl; Cer	Aci
Polybia procellosa Zavattari, 1906*	BA	Atl	Aci
Polybia punctata Du Buysson, 1908	BA	Atl; Caa	Aci

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Species	State(s)	Biome(s)	Const.
Epiponini			
Polybia rejecta (Fabricius, 1798)	BA; CE; MA; PB; PI; RN	Amz; Atl; Caa; Cer	Acc
Polybia ruficeps Schrottky, 1902	BA; CE; MA; PI; RN	Atl; Caa; Cer	Acc
Polybia rufitarsis Ducke, 1904*	BA	Atl	Aci
Polybia scrobalis Richards, 1970*	MA	Amz	Aci
Polybia scutellaris (White, 1841)	BA; PI	Caa	Aci
Polybia sericea (Olivier, 1792)	BA; CE; MA; PB; PI; RN	Amz; Atl; Caa; Cer	Cons
Polybia signata Ducke, 1910*	BA	Atl	Aci
Polybia singularis Ducke, 1905*	MA	Amz	Aci
Polybia striata (Fabricius, 1787)	MA	Amz	Aci
Polybia velutina Ducke, 1905*	BA	-	Aci
Protonectarina Ducke, 1910			
Protonectarina sylveirae (de Saussure, 1854)	BA; CE; PB; PI; RN	Atl; Caa; Cer	Acc
Protopolybia Ducke, 1905			
Protopolybia acutiscutis (Cameron, 1906)	MA	Amz	Aci
Protopolybia bituberculata Silveira & Carpenter, 1995*	MA	Amz	Aci
Protopolybia chartergoides (Gribodo, 1891)*	MA; PI	Amz; Caa; Cer	Aci
Protopolybia dilligens (Smith, 1857)*	MA	Caa	Aci
Protopolybia duckei (du Buysson, 1905)*	BA	Caa	Aci
Protopolybia exigua (de Saussure, 1854)*	BA; CE; MA; PB; PE; PI; RN	Amz; Atl; Caa; Cer	Cons
Protopolybia potiguara Santos, Silveira & Carpenter 2015*	PB	Caa	Aci
Protopolybia sedula (de Saussure, 1854)	BA; CE; MA	Atl; Caa; Cer	Aci
Pseudopolybia de Saussure, 1863			
Pseudopolybia compressa (de Saussure, 1854)*	BA	Caa	Aci
Pseudopolybia vespiceps (de Saussure, 1863)	BA; MA; PI	Amz; Caa; Cer	Aci
Synoeca Saussure, 1852			
Synoeca cyanea (Fabricius. 1775)	BA; PE	Atl; Caa; Cer	Acc
Synoeca ilheensis Lopes & Menezes, 2017*	BA; PE	Atl	Aci
Synoeca surinama (Linnaeus, 1767)	BA; MA; PB; PE; RN	Amz; Atl; Caa; Cer	Acc
Synoeca virginea (Fabricius, 1804)	MA; PI	Amz; Caa	Aci
Mischocyttarini			
Mischocyttarus de Saussure, 1853			
Mischocyttarus alfkenii (Ducke, 1904)*	BA	Caa	Aci
Mischocyttarus bahiae Richards, 1945	BA; PE	Caa	Aci
Mischocyttarus bahiaensis Zikán, 1949	BA; PE	Caa	Aci
Mischocyttarus carbonarius de Saussure, 1854	MA	-	Aci
Mischocyttarus carinulatus Zikán, 1949*	BA	Caa	Aci
Mischocyttarus cassununga (Ihering, 1903)	BA	Caa; Cer	Aci
Mischocyttarus cearenses Zikán, 1945	BA; CE; MA	Caa; Cer	Acc
Mischocyttarus cerberus Ducke, 1910	BA; CE; MA	Caa; Cer	Acc
Mischocyttarus drewseni Saussure, 1857	BA	Caa; Cer	Aci
Mischocyttarus efferus Silveira, 2006*	MA	-	Aci
Mischocyttarus flavicornis Zikán, 1935	MA	Caa	Aci
Mischocyttarus imitator (Ducke, 1792)*	MA	Amz	Aci
Mischocyttarus injucundus (de Saussure, 1854)	BA; MA	Caa; Cer	Aci
Mischocyttarus labiatus (Fabricius, 1804)*	BA	Caa	Aci

Table 2. Species of Social Wasps registered in Northeastern Brazil. States: AL: Alagoas; BA: Bahia; CE: Ceará; MA: Maranhão, PB: Paraíba; PE: Pernambuco; PI: Piauí; RN: Rio Grande do Norte. Biomes: Atl: Atlantic Forest; Amz: Amazon Forest; Caa: Caatinga; Cer: Cerrado. Constance: Acc: Accessory; Aci: Accidental; Cons: Constant. *New species records after Richards (1978). (Continuation)

Species	State(s)	Biome(s)	Const.
Mischocyttarini			
Mischocyttarus lanei Zikán, 1949*	BA	Caa	Aci
Mischocyttarus marginatus (Fox, 1898) *	BA	Caa	Aci
Mischocyttarus montei Zikán, 1949*	BA	Caa	Aci
Mischocyttarus nomurae Richards, 1978	BA; CE	Caa	Aci
Mischocyttarus punctatus Ducke, 1904	MA	-	Aci
Mischocyttarus rotundicollis (Cameron, 1912)	AL; BA	Atl; Caa	Aci
Mischocyttarus santacruzi Raw, 2000*	BA	Atl	Aci
Mischocyttarus surinamensis de Saussure, 1854*	BA; CE; MA	Caa	Aci
Mischocyttarus timbira Silveira, 2006*	MA	Cer	Aci
Mischocyttarus tomentosus Zikán, 1935*	BA	Atl	Aci
Polistini			
Polistes Latreille, 1802			
Polistes billardieri (Fabricius, 1804)	BA; PB; PE; RN	Atl; Caa; Cer	Acc
Polistes brevifissus Richards, 1978	BA; MA; PB	Caa; Cer	Aci
Polistes canadensis (Linnaeus, 1758)	BA; CE; MA; PB; PE; PI; RN	Atl; Caa; Cer	Cons
Polistes carnifex (Fabricius, 1775)	BA; MA; PE; RN	Atl; Caa	Aci
Polistes cinerascens de Saussure, 1854	AL; BA	Atl; Caa; Cer	Aci
Polistes ferreri de Saussure, 1853	BA	Caa; Cer	Aci
Polistes geminatus Fox, 1898*	BA	Caa	Aci
Polistes lanio (Fabricius, 1775)	BA	Caa	Aci
Polistes melanosoma de Saussure, 1853*	BA	Atl	Aci
Polistes occipitalis Ducke, 1904*	MA	-	Aci
Polistes pacificus Fabricius, 1804	BA; MA	Caa; Cer	Aci
Polistes ridleyi Kirby, 1890	PE (Fernando de Noronha)	-	Aci
Polistes simillimus Zikán, 1951	BA; PB; RN	Atl; Caa; Cer	Acc
Polistes subsericeus de Saussure, 1854	BA	Caa	Aci
Polistes testaceicolor Bequaert, 1937*	MA	Amz	Aci
Polistes versicolor (Olivier, 1791)	BA; MA; RN	Amz; Atl; Caa; Cer	Acc

Authors Contribution

LVB Santos, DP Monteiro, JR Almeida Neto- Conceptualization
LVB Santos, DP Monteiro, A Somavilla - data analysis;
LVB Santos, DP Monteiro- software;
LVB Santos, DP Monteiro, A Somavilla, JR Almeida Neto, PRR Silva - writing

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