

Research Article / Artículo de Investigación

***Atillum* André, 1903 (Hymenoptera: Mutillidae) in Brazil: current and new geographic distribution records**

Atillum André, 1903 (Hymenoptera: Mutillidae) en Brasil: actuales y nuevos registros de distribución geográfica

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Abstract. Popularly known as “witch ants” or “velvet ants”, mutillids are solitary ectoparasitoids wasps of immature insects. *Atillum* André, 1903, is a genus endemic to South America composed of 49 valid species. This study was motivated by the inconsistency of the available information, where, depending on the consulted bibliography, the number of *Atillum* species in Brazil varies. This contribution aims to reduce the knowledge gap on this genus, verifying the real number of species that comprise it and which actually inhabit Brazil. The specialized bibliography for Mutillidae and *Atillum* was consulted, in addition to carrying out an exhaustive consultation of the specialized bibliography. Additionally, to validate some of the records found, *Atillum* specimens deposited in the main collections that house this group were examined. As a result, records were found for ten *Atillum* species in Brazil, nine of which were confirmed as present in the country, and unpublished records of presence of *Atillum* and *Atillum bucephalum* (Perty, 1833) in four Brazilian states and eight municipalities located in the Northeastern region of the country.

Key words: Biodiversity; Neotropical; Wallacean deficit; wasp.

Resumen. Popularmente conocidas como “hormigas-brujas” u “hormigas de terciopelo”, los mutílidos son avispas solitarias ectoparasitoides de insectos inmaduros. *Atillum* André, 1903, es un género endémico de América del Sur compuesto por 49 especies válidas. Este estudio fue motivado por la inconsistencia de la información disponible, donde, dependiendo de la bibliografía consultada, varía el número de especies de *Atillum* en Brasil. En este aporte se pretende reducir la brecha de conocimiento sobre este género, verificando el número real de especies que lo componen y cuales habitan efectivamente en Brasil. Se consultó la bibliografía especializada para Mutillidae y *Atillum*. Adicionalmente, para validar algunos de los registros encontrados, se examinaron especímenes de

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Atillum depositados en las principales colecciones que albergan a este grupo. Como resultado, se encontraron registros para diez especies de *Atillum* en Brasil, nueve de las cuales fueron confirmadas como presentes en el país, y también se entregan registros inéditos de presencia de *Atillum* y *Atillum bucephalum* (Perty, 1833) en cuatro estados brasileños y ocho municipios localizados en la región noreste del país.

Palabras clave: Avispa; biodiversidad; déficit Wallaceano; Neotropical.

Introduction

Mutillidae (Insecta: Hymenoptera) are characteristic solitary wasps, mainly due to their pronounced sexual dimorphism, where females are always wingless and males are winged, rarely brachypterous or wingless (Brothers 2006a). Due to the length of bristles and the absence of wings in females, these wasps are popularly known as “witch ants” or “velvet ants” (Gall et al. 2018). They are ectoparasitoids of other immature insects, mainly of the order Hymenoptera (superfamily Apoidea), and to a lesser extent of the orders Diptera, Lepidoptera, Coleoptera and Blattaria (Brothers 2006a, b).

Females usually have a highly visible aposematic coloration, which is consistent with their extremely painful sting (Brothers 2006a). Some researchers have argued that aposematic coloration is directly related to effectiveness in defense against predators, with predation being the selective force in determining these characteristics over evolutionary time (Wilson et al. 2012; Gall et al. 2018; Wilson et al. 2018). Others argue that there is a strong correlation between the color pattern and abiotic factors such as humidity, altitude and solar incidence (Heidrich et al. 2018; Lopez et al. 2021), or even the result of the evolutionary process of this family's adaptation to different environments (Wilson et al. 2020).

Mutillidae is the second most diverse family of the superfamily Pompiloidea, second only to Pompilidae (Natasi et al. 2023). Mutillids are widely distributed across the world, occurring in all zoogeographical regions, but with greater diversities in tropical and subtropical regions of the globe (Lelej and Nemkov 1997). Currently, more than 4,300 species are considered valid, distributed across approximately 216 genera (Brothers and Lelej 2017). However, according to estimates, the Mutillidae fauna should comprise approximately 10,000 species worldwide (Brothers 2006a, b). Over 1,500 species and 74 genera are known to occur in Neotropical regions (Fernández 2022), of which about 440 species, 38 subspecies and 32 genera have been registered in Brazil (Bartholomay 2023).

Eight subfamilies are recognized in Mutillidae (*sensu* Waldren et al. 2023): Pseudophotopsidinae, Ticoplinae, Rhopalomutillinae, Dasylabrinae, Odontomutillinae, Myrmillinae, Mutillinae and Sphaeropthalminae; only the latter two have been recorded in Neotropical regions (Brothers and Lelej 2017; Pagliano et al. 2020). Of the subfamilies that occur in the New World, we highlight Sphaeropthalminae, as it has the greatest diversity of the species, and exhibits great variation in tegument color, as well as in the activity period of individuals; the majority of species are diurnal, however several species forage at night and at twilight (Brothers 2006b; Pitts et al. 2010). Currently, Sphaeropthalminae is composed of five tribes nominated: Ephutini, Sphaeropthalmini, Dasymutillini, Pseudomethocini and Euspinoliini and six clades not yet named (but with tribe status) (see Waldren et al. 2023). The tribe Euspinoliini is composed of only three genera: *Euspinolia* Ashmead, 1903, *Hoplocrates* Mickel, 1937 and *Atillum* André, 1903.

Atillum André, 1903, the focus of this research, is a genus endemic to South America, with 49 valid species (Mickel 1943; Pagliano et al. 2020). Depending on the bibliography consulted, the number of *Atillum* species considered as occurring in Brazil is variable (e.g., Mickel 1943; Nonveiller 1990; Pagliano et al. 2020; Bartholomay 2023), and it was

precisely this inconsistency in information that motivated this research. Knowing the actual distribution of species is relevant information, given that such knowledge contributes to reducing the Wallacean deficit (Ramos *et al.* 2022), and can, for example, support research that seeks to assess the ecological importance of these organisms and provide subsidies for the implementation of biodiversity conservation policies, in order to establish actions such as the creation of reserves (Lemes 2011), management of fauna and their natural enemies and the biological control of agricultural pests, and countless other strategies.

Despite advances in knowledge about New World Mutillidae (*e.g.*, Aranda and Catian 2008; Luz *et al.* 2016, 2017; Williams *et al.* 2017, 2020; Cambra *et al.* 2018, 2022; Bartholomay *et al.* 2019a, b, c, 2022; among others), knowledge about the ecology, behavior, biology and taxonomy for most species of the extremely rich Neotropical Mutillidae fauna is still incipient (Brothers 2006a, b; Aranda and Catian 2008; Luz *et al.* 2017). This is also true for *Atillum*, where, from 49 species known to science, only the biology of *A. sumptuosum* (Gerstaecker, 1874) is known (Mickel 1943), as well as the ‘potential’ hosts of only further four species (Luz *et al.* 2016). Thus, with the intention of contributing to reducing the gap in knowledge about *Atillum*, this research aimed to verify the real number of *Atillum* species and to identify which species occur in Brazil, in addition to providing unpublished records of *Atillum bucephalum* (Perty, 1833) for locations in the Northeastern region of Brazil.

Material and Methods

To verify the number and which *Atillum* André, 1903 species that have had occurrence records in Brazil at some point, we consulted the main bibliographies for Mutillidae and for *Atillum* (*e.g.*, Mickel 1943; Nonveiller 1990; Pagliano *et al.* 2020; Bartholomay 2023), also performing an exhaustive consultation of the specialized bibliography. Additionally, to validate some of the information found, we examined specimens of *Atillum* deposited in some of the main collections of this group (Luz *et al.* 2017).

The consulted depository institutions and their initials are as follows: Departamento de Zoologia, Universidade Federal do Paraná, Curitiba, Paraná, Brazil [DZUP]; Museu Nacional do Rio de Janeiro, Rio de Janeiro, Rio de Janeiro, Brazil [MNRJ] (Institution visited before the fire in 2018); Museu Paraense Emílio Goeldi, Belém, Pará, Brazil [MPEG]; Museu de Zoologia da Universidade Estadual de Feira de Santana, Feira de Santana, Bahia, Brazil [MZUEFS]; Museu de História Natural da Bahia, Universidade Federal da Bahia, Salvador, Bahia, Brazil [MHNBA]; Museo de Invertebrados G. B. Fairchild, Universidad de Panamá, Ciudad de Panamá, Panamá [MIUP].

The classification used in this work follows Waldren *et al.* (2023). To make the species distribution map, we used the exact geographic coordinates, when available, of the collection location, when not available, we used the geographic coordinates as specific as possible (of the municipality or of state capital). The map was created in Qgis software (2023).

Results and Discussion

Following the Mutillidae and *Atillum* André, 1903 bibliographic consultations, we found records of occurrence of ten of the 49 species of this genus in Brazil (Tab. 1), however, some of these records appear to be erroneous. Quintero and Cambra (1996), previously mentioned that although *A. rubriceps* (Schrottky, 1902) had an occurrence record for Brazil, Nonveiller (1990) omitted the occurrence of this species for the country, and it seems this mistake was repeated in following studies (*e.g.*, Pagliano *et al.* 2020; Bartholomay 2023). Although Pagliano *et al.* (2020), did not record *A. sumptuosum* (Gerstaecker, 1874) in Brazil, this species undoubtedly occurs in Brazil, including the type specimens (lectotype and paratypes) from southern Brazil (Alegrete - Rio Grande do Sul) (Tab. 2).

Pagliano *et al.* (2020) recorded *A. captiosum* Mickel, 1943 in Brazil (Tab. 1), without providing any collection data or mentioning the origin of this information. This species is only known to occur in Paraguay and Argentina. It is likely that the record of *A. captiosum* in Brazil, proposed by Pagliano *et al.* (2020), is a mistake, since we do not know of any research that formally registers this species in Brazil, nor did we find any specimens of *A. captiosum* deposited in the consulted collections. Thus, of the ten species previously recorded for Brazil, we confirmed the occurrence of nine, with six of them endemic to Brazil (Tab. 2).

Table 1. *Atillum* André, 1903 species recorded in Brazil and the respective bibliography that registered the species. / *Atillum* André, 1903 especies que tienen registros de presencia en Brasil y la respectiva bibliografía que registró la especie.

<i>Atillum</i> species	Mickel (1943)	Nonveiller (1990)	Pagliano <i>et al.</i> (2020)	Bartholomay (2023)
<i>A. albipictum</i> Mickel, 1943	X	X	X	X
<i>A. bucephalum</i> (Perty, 1833)	X	X	X	X
<i>A. captiosum</i> Mickel, 1943			X	
<i>A. dulce</i> (Gerstaecker, 1874)	X	X	X	X
<i>A. facetum</i> Mickel, 1943	X	X	X	X
<i>A. feroculum</i> Mickel, 1943	X	X	X	X
<i>A. impacatum</i> Mickel, 1943	X	X	X	X
<i>A. magisterium</i> Mickel, 1943	X	X	X	X
<i>A. rubriceps</i> (Schrottky, 1902)	X			
<i>A. sumptuosum</i> (Gerstaecker, 1874)	X	X		X

Table 2. Geographic distribution and known sex of *Atillum* André, 1903 species whose occurrence has been confirmed in Brazil. New records are marked in bold. / Distribución geográfica y sexo conocido de las especies de *Atillum* André, 1903 cuya presencia ha sido confirmada en Brasil. Los nuevos registros están marcados en negrita.

Atillum André, 1903 species with confirmed occurrence in Brazil

A. albipictum Mickel, 1943

Geographic distribution: Brazil (Mato Grosso do Sul - Três Lagoas)

Known sex: Female

References: Mickel (1943), Luz *et al.* (2017), Bartholomay (2023)

A. bucephalum (Perty, 1833)

Geographic distribution: Brazil (Minas Gerais; Rio Grande do Norte; **Bahia - Amélia Rodrigues, Feira de Santana, Maracás, Sambaíba; Piauí - Bacaina; Ceará - Aurora; Paraíba - Juazeirinho, Santa Luzia**)

Known sex: Female

References: Mickel (1943), Bartholomay (2023), this study

A. dulce (Gerstaecker, 1874)

Geographic distribution: Brazil (Rio Grande do Sul - Porto Alegre), Uruguay

Known sex: Male

References: Mickel (1943), Bartholomay (2023)

A. facetum Mickel, 1943

Geographic distribution: Brazil (Mato Grosso)

Known sex: Male

References: Mickel (1943), Bartholomay (2023)

A. feroculum Mickel, 1943

Geographic distribution: Brazil (Mato Grosso; Mato Grosso do Sul - Corumbá and Campo Grande)

Known sex: Female

References: Mickel (1943), Luz *et al.* (2017), Bartholomay (2023)

A. impacatum Mickel, 1943

Geographic distribution: Brazil (São Paulo - Jundiaí)

Known sex: Female

References: Mickel (1943), Bartholomay (2023)

A. magisterium Mickel, 1943

Geographic distribution: Brazil (Mato Grosso; Mato Grosso do Sul - Corumbá and Sidrolândia)

Known sex: Female

References: Mickel (1943), Luz *et al.* (2017), Bartholomay (2023)

A. rubriceps (Schrottky, 1902)

Geographic distribution: Brazil (no data collected), Argentina (Buenos Aires, La Plata)

Known sex: Female

Reference: Mickel (1943)

A. sumptuosum (Gerstaecker, 1874)

Geographic distribution: Brazil (Rio Grande do Sul - Alegrete), Uruguay, Argentina

Known sex: Female

References: Mickel (1943), Bartholomay (2023)

Additionally, we present unpublished occurrence records for *Atillum* André, 1903 with *A. bucephalum* (Perty, 1833) (Figs. 1A-B) for four Brazilian states and eight municipalities located in the Northeastern region of the country (Tab. 2, Fig. 2).

Atillum is morphologically characterized by having antennae with 13 segments; head notably wider than the mesosoma and with a pair of posteroventral processes over the genae; first metasomal segment evenly merging with second, without a distinct horizontal dorsal face; metasternum with prominent elongate median process overlying bases of hind coxae (Brothers 2006b). For *A. bucephalum* see diagnosis.

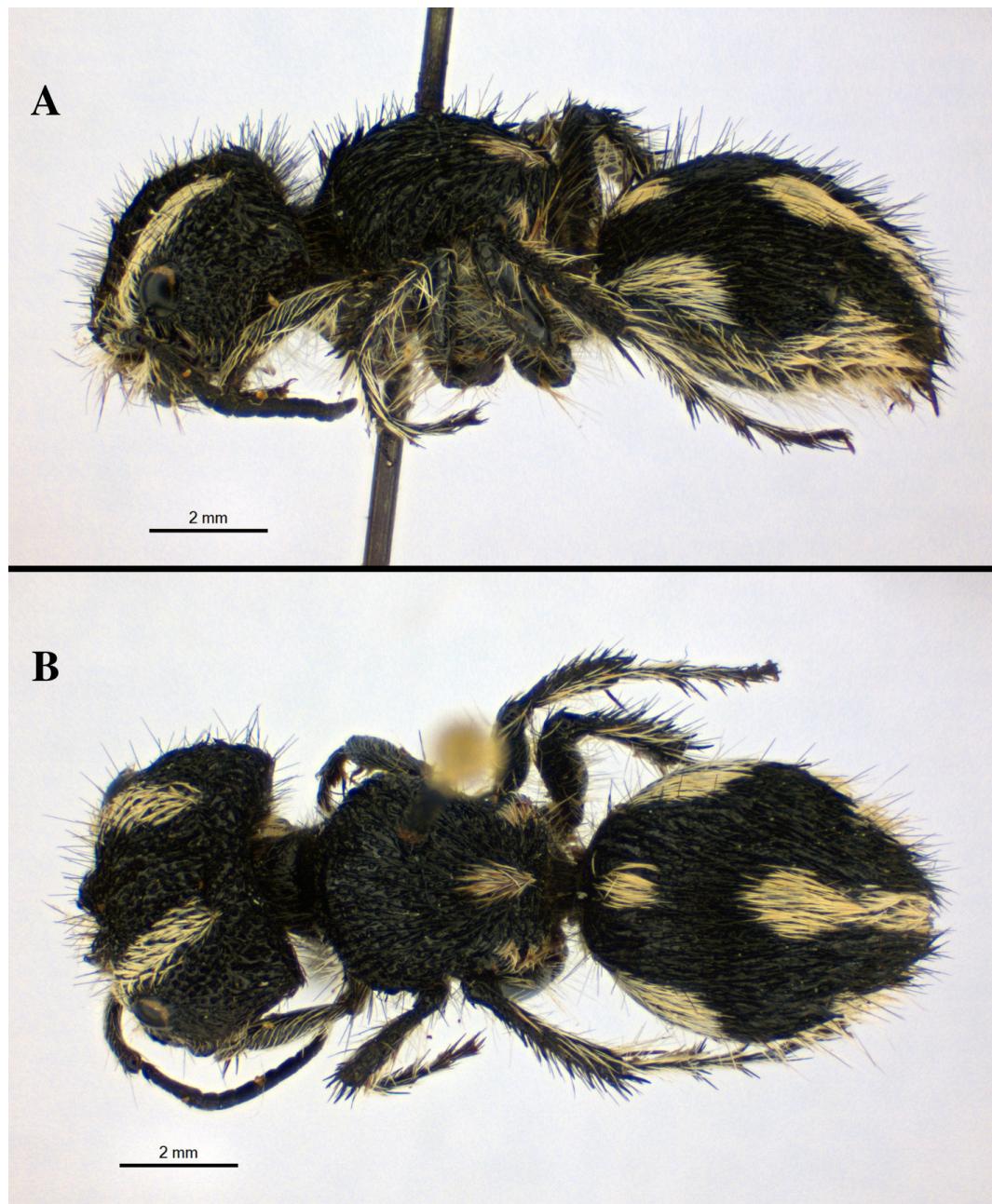


Figure 1. *Atillum bucephalum* (Perty, 1833). A. Habitus lateral. B. Habitus dorsal. Photos: K. A. Williams. / A. Hábito lateral. B. Hábito dorsal. Fotos: K. A. Williams.

Atillum bucephalum (Perty, 1833)

Mutilla bucephala Perty, 1833. Delect. Anim. Art. Brasil, p. 137, Tab. 27, fig. 8, female.
Atillum bucephalum André, 1903. Gen. Ins. Fasc. 11, p. 47, female.

Diagnosis. Mandible with a distinct, triangular projection on the ventral margin approximately one-third the distance from the base to the tip; body only with black and

white setae, at least the hind tibiae externally, between the two rows of spines, clothed with black setae; white setae lines on vertex and frons broad, conspicuous and long, extending along inner eye margins to the antennal scrobes.



Figure 2. Geographic distribution of *Atillum* André, 1903 in Brazil. Due to the lack of precise data on the origin of the material, *A. rubriceps* (Schrottky, 1902) was not added to the map. / Distribución geográfica de *Atillum* André, 1903 en Brasil. Debido a la falta de datos precisos sobre el origen del material, *A. rubriceps* (Schrottky, 1902) no se agregó al mapa.

Atillum bucephalum (Perty, 1833). BRAZIL. 3 females, Paraíba, Juazeirinho, vi.1956, A.G.A. Silva leg. [DZUP]; 1 female, Paraíba, Juazeirinho, vi.1956, A.G.A. Silva leg., Casal det. [MNRJ]; 2 females, Paraíba, Santa Luzia, Brandão Junco, viii.1956, Cincinato leg. [MNRJ]; 1 female, Ceará, Aurora, 12.v.1955, A.P. Soares leg., Casal det. [MNRJ]; 1 female, Piauí, Bocaina, 22 km distante, 31.iii.1994, F.P. Benton leg. [MPEG]; 8 females, Bahia, Maracás, II.1965, F.M. Oliveira leg. [MNRJ]; 1 female, Bahia, Sambaíba, 24.viii.1993 [MIUP]; 1 female, Bahia, Maracás, 19.xi.2004 [MZUEFS]; 1 female, Bahia, Feira de Santana, 21.ix.1998, P. Alves leg. [MZUEFS]; 1 female, Bahia, Amélia Rodrigues, Centro de Agroecologia Rio Seco (CEARIS), 12°23'5.48"S/38°47'51.34"W, 20.xi.2022, A.L. Marambaia leg., R.L. Ramos det. [MHNBA].

Atillum bucephalum occurs, predominantly, in the Caatinga morphoclimatic domain (Tab. 2, Fig. 2) and shares the 'black and white' color pattern with some species that are also common in this environment, such as *Hoplomutilla gigantea* (Perty, 1833), *Traumatomutilla bifurca* (Klug, 1821), *Leucospilomutilla cerbera* (Klug, 1821) (Williams et al. 2020) and *Suarezilla gazagnairei* (André, 1895). Perhaps the 'black and white' color pattern shared by these species provides some kind of benefit to them in this environment, whether it be camouflage for protection against natural enemies, since periods of drought are usually prolonged in this type of environment and the white-black-gray color pattern dominates the landscape, or even thermal comfort related to the high temperatures and insolation observed in this region throughout the year. A similar phenomenon was observed by Wilson et al. (2020), which found that totally white mutillids that occur in the North American deserts have greater thermal comfort than those with aposematic coloration. In this context, new research aimed at understanding how the color pattern contributes to the fitness of the species are strongly recommended, especially to provide subsidies for other studies focusing on the conservation and sustainable use of fauna.

Conclusion

The present study provides reliable update on the geographic distribution of *Atillum* André, 1903 in Brazil, providing the number of species and their known current distribution in the country. Additionally, we also provide the first record of the genus *Atillum* with the species *A. bucephalum* (Perty, 1833) for four Brazilian states and eight municipalities located in the Northeastern region of the country (Bahia: Amélia Rodrigues, Feira de Santana, Maracás, Sambaíba; Piauí: Bacaina; Ceará: Aurora; Paraíba: Juazeirinho, Santa Luzia). Research on the distribution and expansion of species occurrence is essential to reducing the Wallacean deficit, and can additionally subsidize other research, supporting work on ecology, biogeography, niche modeling, biology and/or behavior, among others. We also suggested that the potential relationship between the color pattern of *A. bucephalum* and the Caatinga environment should be tested, as well as the coloration of other Mutillidae species.

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