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Additions to the bee Brazilian fauna: first record of *Anthrenoides, Callonychium* and *Psaenythia* (Hymenoptera, Apoidea) in the state of Piauí

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Abstract: The bee genera *Callonychium* Brèthes, *Psaenythia* Gerstaecker and *Anthrenoides* Ducke are newly recorded in Piauí State, northeastern Brazil. The species reported here are *Callonychium brasilience* (Ducke, 1907) and *Psaenythia variabilis* Ducke, 1908, and an as yet unidentified species of *Anthrenoides*. Images and all known distributional records of these species are also provided. The new occurrences reported herein expand the distribution range of the species to the Caatinga biome.

Key words: Calliopsini, distribution, Protandrenini, solitary bees, South America.

INTRODUCTION

Piauí is the third largest State in Northeastern Brazil and exhibits mesic characteristics of relief, climate, vegetation and hydrography. It represents the transition zone among three Brazilian biomes: Caatinga, Cerrado and the Atlantic Forest. The climate is tropical hot and humid in the West and Southwest of the State and semi-arid in most of the East and Southeast (Castro 2007, CEPRO 2010). Caatinga is the predominant biome, representing 28.4% of the territory's vegetation, followed by the Cerrado that occupies much of the southern portion of the State (Castro 2007, CEPRO 2010). Both biomes are relatively rich in endemic species but, unfortunately, they have suffered environmental degradation mainly due anthropic action leading to drastic changes of most pristine areas (Sampaio & Batista 2004, Aguiar & Monteiro 2005, MMA 2011, 2018). The accelerating losses of natural habitats in the State of Piauí are mainly driven by economic activities of the primary sector, such as agriculture (soybean, corn, cassava, cotton and sugar cane crops) and livestock (goats, cattles, pigs and chickens) (Castro 2007, CEPRO 2010).

Habitat fragmentation and loss of native vegetation may alter climate conditions on a regional scale and affects interactions between pollinators and plants (Hegland et al. 2009). Studies on the Brazilian plant communities show bees as the main pollinators of native and agricultural plant species (Kevan & Imperatriz-Fonseca 2002). Bees constitute the largest group of Aculeata, with more than 20,000 described species (Michener 2007). Despite their great importance for the maintenance of terrestrial ecosystems, the knowledge of the group's diversity is still poorly documented. The Brazilian territory houses around 1,900 recorded species (Melo et al. 2012, Ascher & Pickering 2020) and an estimated number of 3.000 existing species for the country (Silveira et al. 2002).

The bee diversity of Piauí has remained relatively unstudied compared to that of others States in Northeastern Brazil. Studies regarding the native species are scarce and the known

diversity is certainly underestimated. Published studies are basically focused on economic impacts of social bee species in commercial honey production, such as the stingless bees (Meliponini) and the exotic *Apis mellifera* Linnaeus, 1758 (Apini). To date, only three studies about bee species of Piauí have been published: the flora visited by the eusocial Apini and Meliponini in the Parque Nacional Serra da Capivara (Lorenzon et al. 2003), the bee fauna and the plants visited in Teresina (Lopes et al. 2010) and an inventory of Euglossini diversity in Sete Cidades National Park (Nascimento et al. 2016).

Comprehensiveness information about species diversity and distribution are essential for the conservation management of the local biodiversity and contribute to the sustainable use of environmental resources such as pollination (Pinheiro-Machado et al. 2002). Considering the meager knowledge on native bees of Piauí, the present study reports for the first time the bee genera *Callonychium* (Calliopsini), *Anthrenoides* and *Psaenythia* (Protandrenini) in the State and provides new distributional records for the species *C. brasiliense* (Ducke, 1907), *Anthrenoides* sp. and *P. variabilis* Ducke, 1908. In addition, we summarized information on the geographical distribution of these taxa in Northeastern Brazil in order to improve the knowledge and to encourage further investigations of the largely unexplored fauna of the Piauí State.

MATERIALS AND METHODS

The specimens studied were collected in Corrente and Barreiras do Piauí (Piauí State) and are deposited in the Museu de Zoologia da Universidade de São Paulo, Brazil (MZSP). Both municipalities are located in an area predominantly covered Cerrado in the south of the State, characterized by a semi-humid tropical climate, with two well-defined climatic seasons: a dry period, from May to October, and a rainy period, from November to April (CEPRO 2010, Alvares et al. 2013).

The taxonomic classification follows Melo & Gonçalves (2005) and Moure et al. (2012) in which recognizes all bees in a single family - Apidae. Labels of the specimens were exactly transcribed with apostrophe marks (‘ ’) indicating information of different labels, a backslash (\) indicating a line break. Identification of the *Anthrenoides* specimen was based on keys for species provided by Urban (2005, 2007, 2008) and the examination of type specimens from Northeastern Brazil described by Urban (2006), deposited in the Departamento de Zoologia, Universidade Federal do Paraná, Curitiba, Brazil (DZUP). The identification of the species of *Callonychium* and *Psaenythia* was done by comparing the specimens to images of type specimens (see Acknowledgments).

Images were taken with a Leica video camera MC190 HD attached to a Leica M205C stereomicroscope, and the series of images were processed in the software Helicon Focus 6.7.1 to produce confocal images. Illumination system employed the dome and light diffuser created using tracing paper as proposed by Kawada & Buffington (2016). Final figures were edited in commercial software for small adjustments, such as brightness and contrast.

The distribution maps were constructed using the software Quantum GIS (http://www.qgis.org). Distributional records for species were compiled from cited references in the distribution topic. Longitude and latitude coordinates were also compiled from the cited references and by consulting online SpeciesLink (http://www.splink.cria.org.br) when not provided in literature.

RESULTS AND DISCUSSION

Below we provide the first record of the andrenine bee genera *Callonychium* (Calliopsini), *Anthrenoides* and *Psaenythia* (Protandrenini) in Piauí State represented by, respectively, *C. brasiliense*, *Anthrenoides* sp. and *P. variabilis* (Figure 1). These three genera restricted to South America are very speciose, mainly occurring in xeric and temperate areas (Silveira et al. 2002, Michener 2007, Moure et al. 2012, Gonzalez & Engel 2016, Ascher & Pickering 2020).

Callonychium comprises rather small (3-7 mm long), largely yellow-and-black species, mainly recognized by yellow spots on the genal area, antennal sockets usually at the lower fourth of the face, lateral parts of the clypeus strongly bent posteriorly, and sterna of males considerably modified with ridges and projections (Michener 2007). Thirteen species have been recognized in the genus with only two species reported in Brazil (Moure et al. 2012, Gonzalez & Engel 2016, Ascher & Pickering 2020). In the Brazilian Northeast, there is only

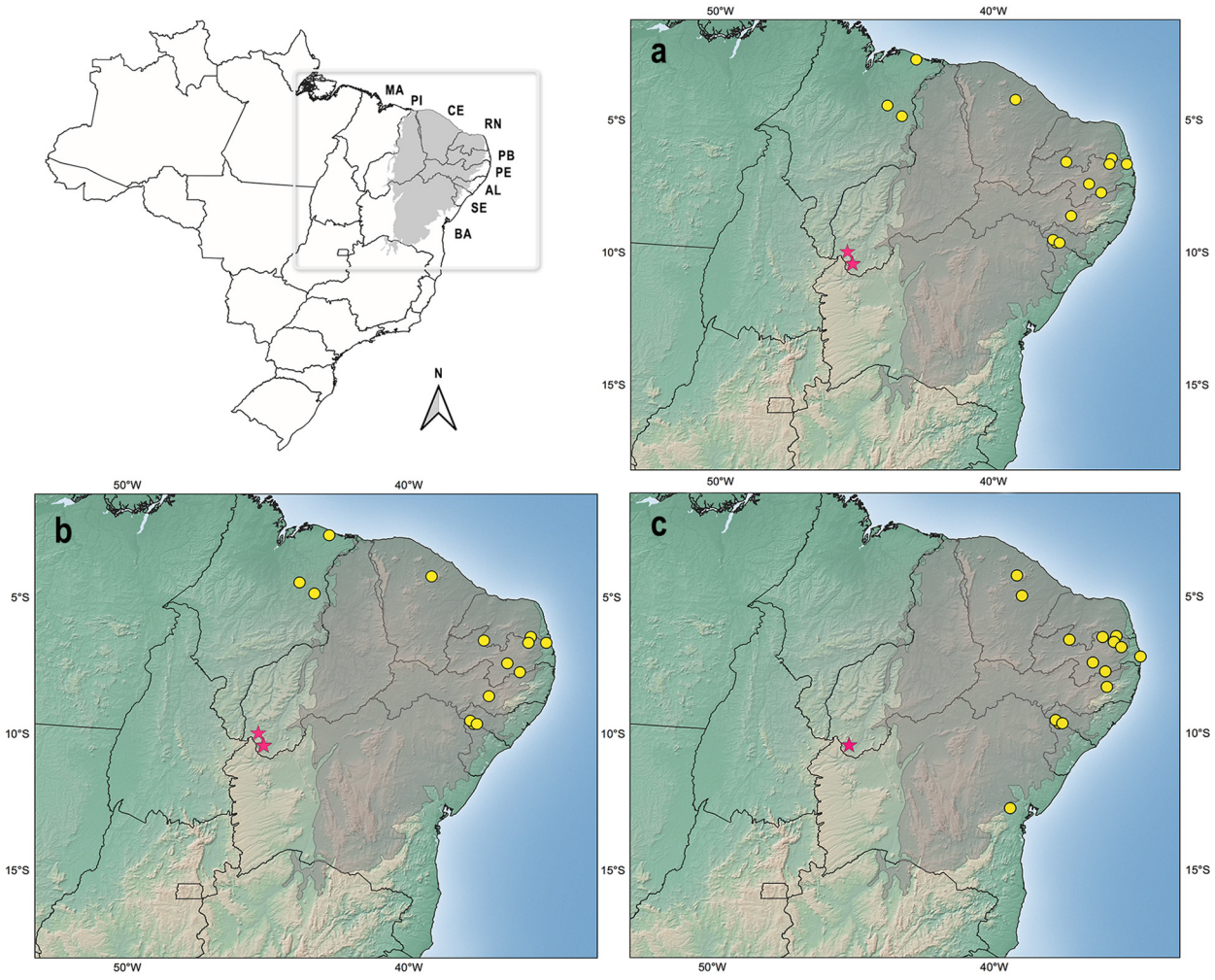

Figure 1. Geographical distribution in the northeast of Brazil. a. *Callonychium brasiliense* (Ducke, 1907). b. *Anthrenoides* species. c. *Psaenythia variabilis* Ducke, 1908. Northeastern Brazilian States: Alagoas (AL), Bahia (BA), Ceará (CE), Maranhão (MA), Pernambuco (PE), Paraíba (PB), Piauí (PI), Rio Grande do Norte (RN), and Sergipe (SE). Pink stars: new records. Yellow circles: known records from literature. Gray area = Caatinga biome.

one record of *C. brasiliense* (Figure 2), although undescribed species are also known for this region (Silveira et al. 2002, K.S.R. pers. obs.).

The genus *Anthrenoides* (Figure 3) includes 63 described species, most of which are registered in Brazil (53) especially in the Southeast and South regions of the country (Moure et al. 2012, Ascher & Pickering 2020). It is a very morphologically heterogeneous group with relatively small sized species (length 5-7 mm) that lack large yellow areas on the body (Michener 2007, Silveira et al. 2002). In this way, a generic revision of *Anthrenoides* became increasingly important to solve the current uncertainties in the delimitation of species based on adult morphology. Five *Anthrenoides* species are known to occur in Northeastern Brazil: *A. caatingae* Urban, 2006, *A. deborae* Urban, 2006, *A. cearensis* Urban, 2006, *A. nordestinus* Urban, 2006 and *A. petrolinensis* Urban, 2006 (Moure et al. 2012, Ascher & Pickering 2020). Species identification of the *Anthrenoides* specimen herein reported was not possible because a few characteristics disagree with those of other known species.

Psaenythia are relatively moderate-sized species (7-14 mm long), almost always exhibiting yellow markings and is the only Protandrenini group with a longitudinal ridge on the posterior side of the hind femur which bears a depressed glabrous area below (Michener 2007). There are more than seventy described species in the genus, 17 of which registered in Brazil mainly in the South and Southeast regions of the country (Silveira et al. 2002, Moure et al. 2012, Ascher & Pickering 2020). The only recorded species in the Northeast of Brazil is *P. variabilis* (Figure 4) (Moure et al. 2012).

In this work we expand the distribution range of these species by hundreds of kilometers from previous known records. This new distributional data correspond to the southwest most known occurrence of these genera in the Caatinga. All localities in Piauí State where the specimens were collected are in the semiarid region, marked by transitional areas between Cerrado and Caatinga biomes, with the predominance of species typical of the Cerrado (CEPRO 2010). However, the bee species in question seems to be primarily associated with the Caatinga biome as observed by the others known distribution records (Figure 1).

Calliopsini

Robertson, 1922

Callonychium (*Callonychium*) *brasiliense* (Ducke, 1907)

Label data of new records. Brazil, Piauí: 1 female 'Brasil, Piauí, 15km SE de\ Barreiras do Piauí, 515m,\ 05-06.i.2012, 09°59'06"S\ 45°21'08W K. Ramos &\ V. Kanamura col. (MZSP)' '*Callonychium brasiliense*\ (Ducke, 1907)\ K. Ramos det. 2020'; 1 female 'Brasil: Piauí, Corrente,\ Bairro de Nova Corrente\ Área entorno do Rio Corrente,\ -10.431765°S, -45.184844°W\ 10.v.2019, Malaise, 427m\ B. Castro & H. Onody cols.' '*Callonychium brasiliense*\ (Ducke, 1907)\ K. Ramos det. 2020'; 5 females, same data except '08.viii.2019'; 2 females 'Brasil: Piauí, Corrente\ Campus UESPI, 04.vi.2019\ -10.4485°S -45.1511°W\ S. Costa & H. Onody cols\ pan trap yellow' '*Callonychium brasiliense*\ (Ducke, 1907)\ K. Ramos det. 2020'; 1 female, same data except 'pan trap blue'.

Distribution. Alagoas (Moura 2008), Ceará (Ducke 1910a, b), Maranhão (Ducke 1907, 1910b, Gostinski et al. 2016), Paraíba (Aguiar & Martins 1997, Aguiar & Martins 2003, Zanella & Martins 2005, Moura et al. 2018), Piauí (present study), Pernambuco (Schlindwein 2003), Rio Grande do Norte (Zanella 2003), Sergipe (Moura 2003, 2008) (Figure 1a).

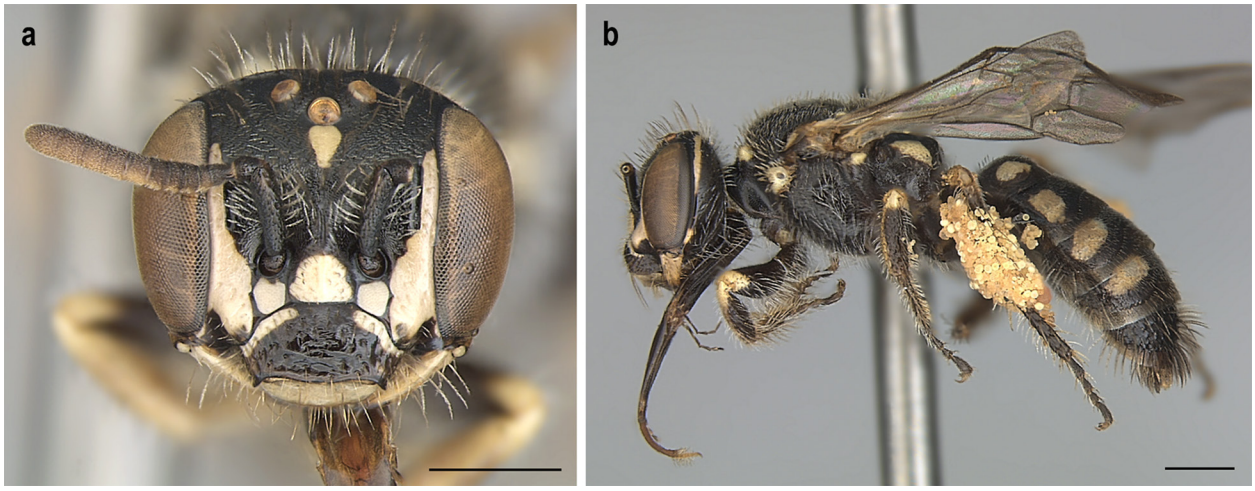

Figure 2. Female of *Callonychium brasiliense* (Ducke, 1907) from Barreiras do Piauí, Piauí, Brazil. a. Head in frontal view. b. habitus. Scale bars = 0.5 mm.

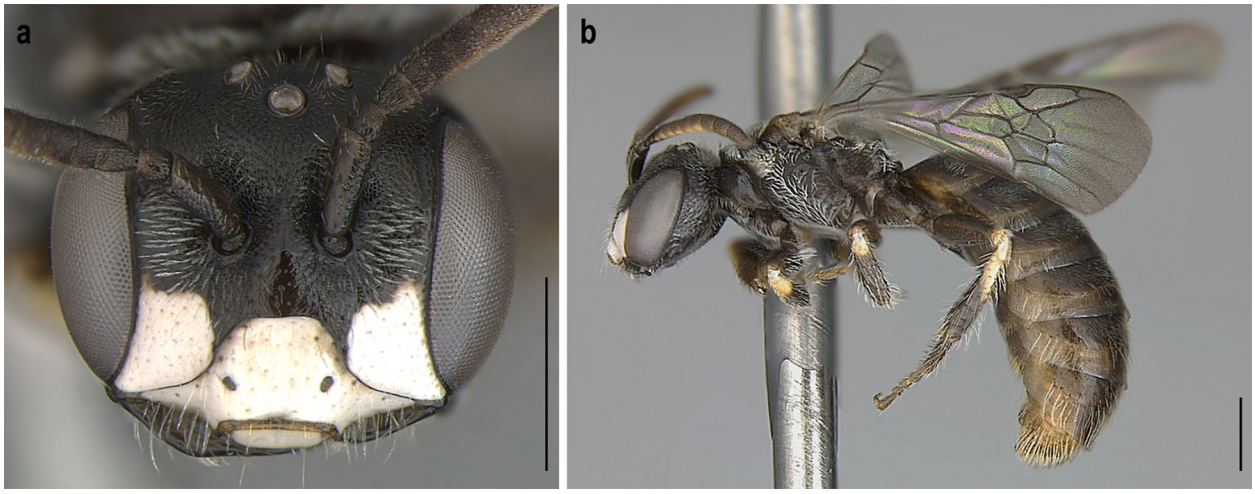

Figure 3. Male of *Anthrenoides* sp. from Corrente, Piauí, Brazil. a. Head in frontal view. b. habitus. Scale bars = 0.5 mm.

Protandrenini

Robertson, 1904

Anthrenoides sp.

Label data of new records

Brazil Piauí: 1 male 'Brasil, Piauí, Corrente\ Campus UESPI\ 04-08.iv.2019, Varredura\ Onody, H.C. col.' '*Anthrenoides* sp.\ K. Ramos det. 2020'.

Distribution

Alagoas (Moura 2003, 2008), Bahia (Urban 2006), Ceará (Urban 2006), Paraíba (Moura et al. 2018), Piauí (present study), Pernambuco (Urban 2006), Sergipe (Moura 2008) (Figure 1b).

Psaenythia variabilis

Ducke, 1908

Label data of new records

Brazil Piauí: 1 female and 1 male 'Brasil, Piauí, Corrente\ Campus UESPI\ 04-08.iv.2019, Varredura\ Onody, H.C. col.' '*Psaenythia variabilis* \ (Ducke, 1908)\ K. Ramos det. 2020'.

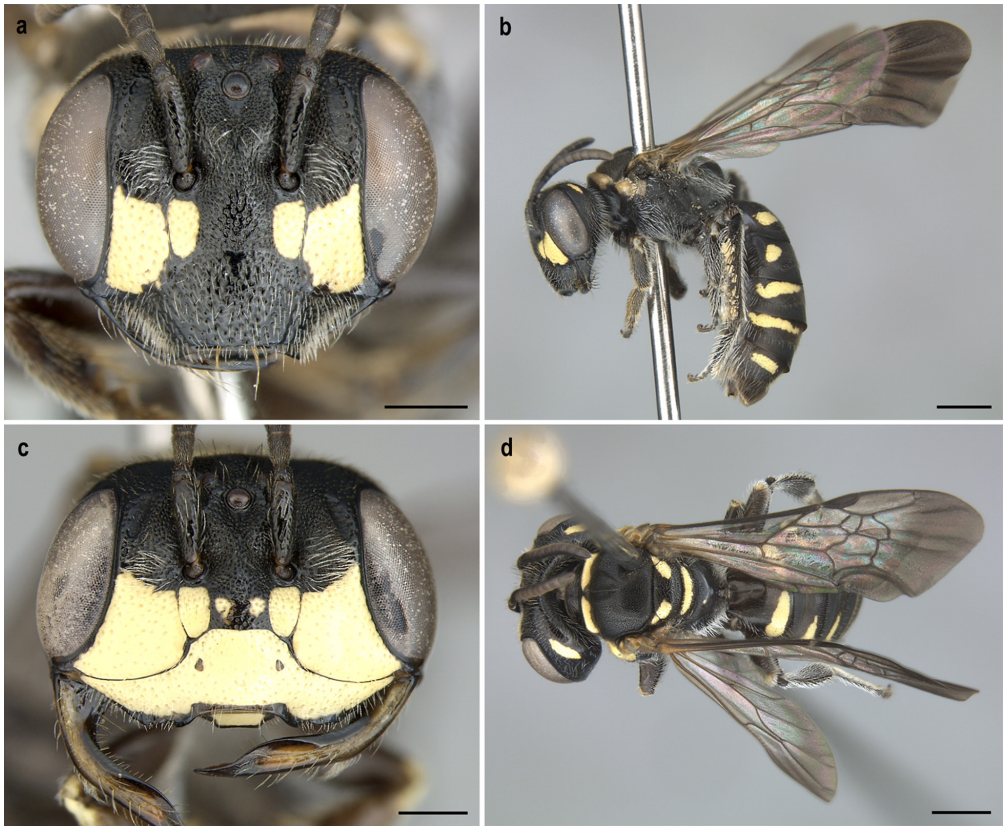

Figure 4. ***Psaenythia variabilis*** **Ducke, 1908 from Corrente, Piauí, Brazil. a. Female head in frontal view. b. female in lateral view. c. male head in frontal view. d. male in dorsal view. Scale bars: a and c = 0.5 mm, b and d = 1 mm.**

Distribution

Alagoas (Moura 2003, 2008), Bahia (Santos et al. 2013), Ceará (Ducke 1908, 1910a, b), Paraíba (Cockerell 1912, Aguiar & Martins 1997, Schlindwein 2003, Zanella & Martins 2005, Schlindwein & Medeiros 2006, Oliveira & Santos 2016, Moura et al. 2018), Piauí (present study), Pernambuco (Schlindwein 2003, Locatelli et al. 2004), Rio Grande do Norte (Zanella 2003), Sergipe (Moura 2008) (Figure 1c).

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KSR and HCO performed the fieldwork; KSR identified the species and prepared the figures; KSR, HCO and CRFB discussed and wrote the manuscript.