Iheringia
Série Zoologia

e-ISSN 1678-4766
www.scielo.br/isz

Museu de Ciências Naturais

Article

Report of the nest of *Megachile (Moureapis) benigna* (Hymenoptera: Megachilidae) from an urban environment, Rio de Janeiro, Brazil

Diego Marinho & Felipe Vivallo

Museu Nacional (MN), Universidade Federal do Rio de Janeiro (UFRJ), Departamento de Entomologia, Programa de Pós-graduação em Zoologia, Rio de Janeiro, RJ, Brasil. (diego.mp89@gmail.com; fvivallo@yahoo.com)

Received 31 August 2021
Accepted 12 January 2022
Published 25 February 2022
DOI 10.1590/1678-4766e2022005

ABSTRACT. One nest of *Megachile* (*Moureapis*) *benigna* Mitchell, 1930 (Hymenoptera: Megachilidae) was collected using trap-nests in a forest fragment (Atlantic Forest biome) into an urban matrix in Rio de Janeiro, Brazil, in October/2017. The nest architecture and larval food are presented providing initial data for management and conservation of this species in cities.

KEYWORDS. Leafcutter bee, pollen, solitary bee, trap-nest, urban ecology.

RESUMO. Registro do ninho de *Megachile* (*Moureapis*) *benigna* (Hymenoptera: Megachilidae) em uma área urbana do Rio de Janeiro, Brasil. Um ninho de *Megachile* (*Moureapis*) *benigna* Mitchell, 1930 (Hymenoptera: Megachilidae) foi coletado usando ninhos-armadilha em um fragmento de floresta (bioma Mata Atlântica) em uma área urbana no Rio de Janeiro, Brasil, em outubro/2017. A arquitetura do ninho e o alimento larval são apresentados fornecendo dados iniciais para o manejo e conservação desta espécie nas cidades.

PALAVRAS-CHAVE. Abelha cortadora de folhas, abelha solitária, ecologia urbana, ninho-armadilha, pólen.

Cities have been historically seen as non-suitable places for a diverse fauna, but in the last decades several reports from research conducted in urban areas have shown modest to great richness of wild insect species harboured, especially in non-tropical areas (Hall *et al.*, 2017). Focusing on bees (Hymenoptera: Anthophila), information about their ecology in urban areas shows that cities and urban environments at general are prone to sustain viable populations with implications for conservation, changing the view that those anthropic areas are sink for the fauna living there (Hall *et al.*, 2017).

Most research assessing the status of bee fauna in cities are conducted in Europe and North America (Hernandez *et al.*, 2009; Hall *et al.*, 2017). In the tropics, little research has addressed this issue (Hernandez *et al.*, 2009; Costa & Gonçalves, 2019) which rise concern about the situation of the bee fauna in this region. Specifically, concern is brought about the *Megachile* species in the Neotropical region whose bionomy is largely unknown, despite the diversity of this genus in the Neotropics with estimative of over 600 species (Raw, 2007). Some data regarding the biology of species placed in *Megachile* exist, but taxonomic impediment has made difficult the acquisition of new information (Costa & Gonçalves, 2019).

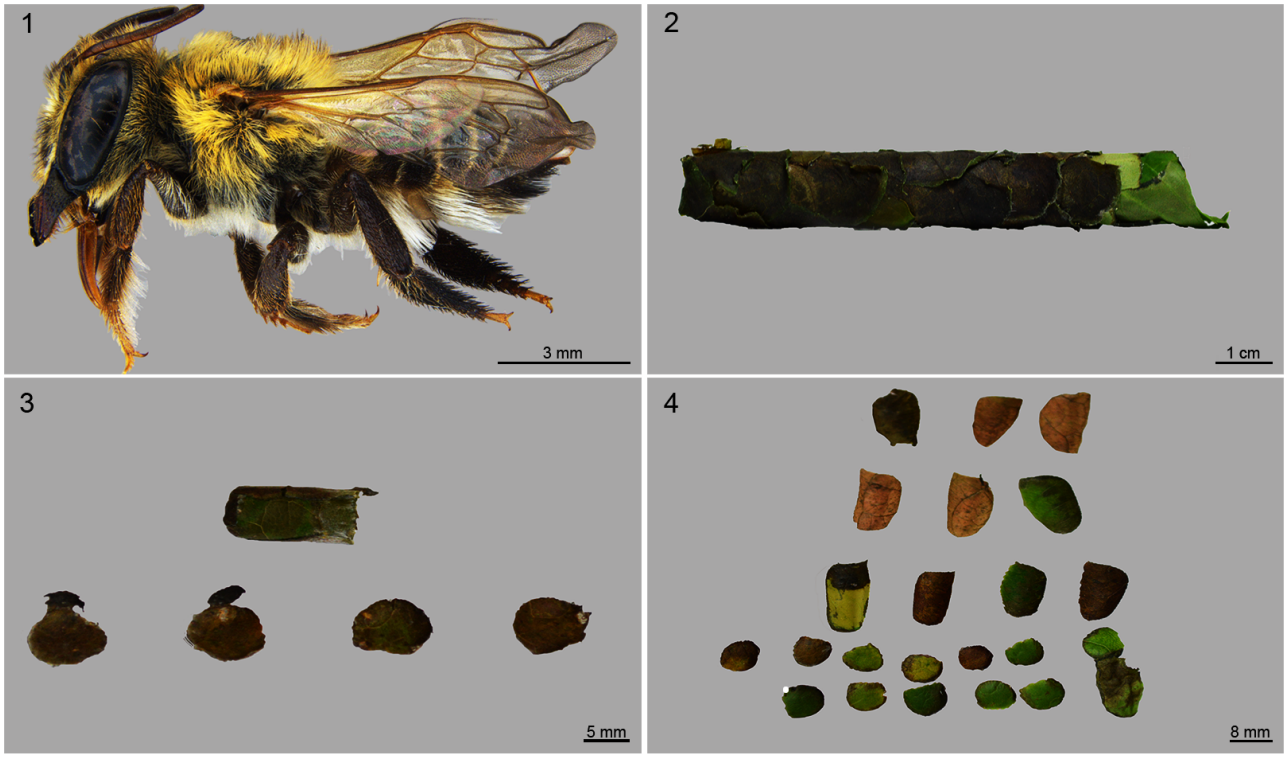
Popularly known as leafcutter bees, *Megachile* use leaf or petal for lining their brood cells, and most of the knowledge gathered from its species comes from pre-existing cavity nesters (Michener, 2007). Also, there are reports of disruptive behaviours of *Megachile* species using plastic fragment for building their nests, indicating human activity deeply affecting their ecology (MacIvor & Moore, 2013; Allasino *et al.*, 2019; Quintos-Andrade *et al.*, 2021).

In Brazil, there is a modest knowledge over *Megachile* species (Costa & Gonçalves, 2019). Authors report leafcutter bees visiting species of Asteraceae and Fabaceae (Garófalo *et al.*, 2004), but some species in Amazonia, collect pollen from Arecaceae species (Marinho *et al.*, 2018). Additionally, ruderal plants, those mainly use in gardening, have also been pointed as important source of food for these bees (Schlindwein, 2004). Presenting data from urban areas regarding *Megachile* is an important initiative for thinking about conservation biology in cities.

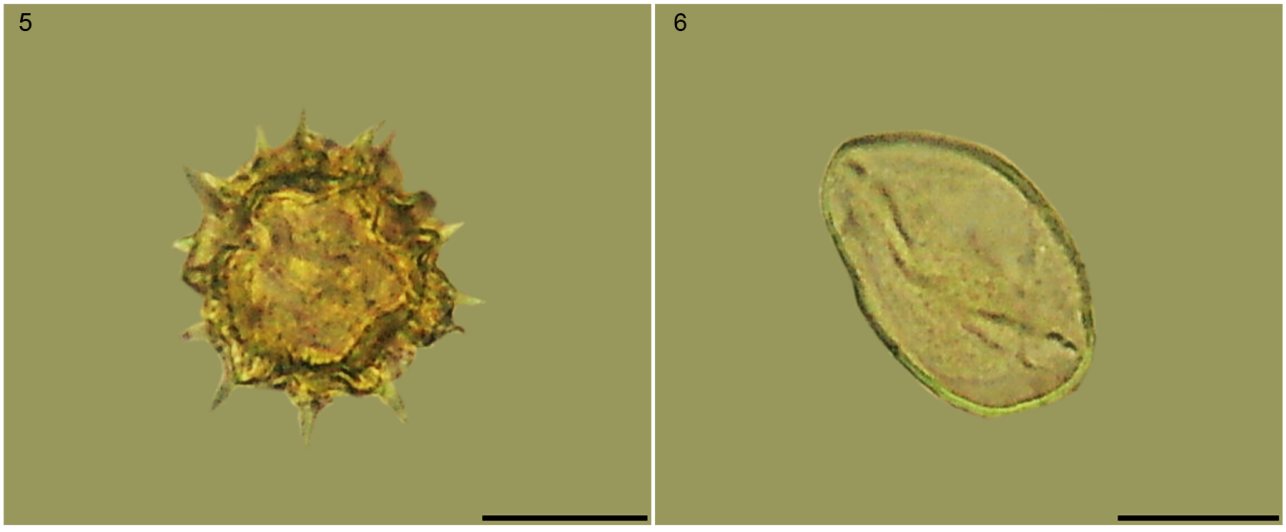
Megachile (*Moureapis*) *benigna* Mitchell, 1930 was studied by Teixeira *et al.* (2008) at São José do Ubá in the State of Rio de Janeiro and by Cardoso & Silveira (2012) in the State of Minas Gerais and. Both studies accounted for seasonality and nest architecture of this species in natural areas of Atlantic Forest and the former found no nest in urban or disturbed areas. In this context, this study presents the description of the nest of *M. benigna* Mitchell, 1930 collected in urban areas as well as the first pollen record used by this species to feed their immatures.

MATERIAL AND METHODS

The area where this study was carried out comprehended the Jardim Botânico do Rio de Janeiro (22°58'14"S, 43°13'8"W, henceforth referred to as JBRJ), a park at the city of Rio de Janeiro, Brazil. Trap nests made of bamboo cane (22 cm in length and diameter ranging from 0.4-2.4 cm), rubber hose (15 cm in length ranging from 1.27-0.79 cm) and plastic straws (10 cm in length and 0.5 cm of diameter) were placed between April/2017 to February/2019 in the JBRJ area as described in Marinho & Vivallo (2020). The pollen load in the brood cells of the nest was analysed using the acetolys process following the Erdtman protocol modified by Lieux (1980). Three slides per cells were made, and 300 pollen grains by slide were counted. The vouchers of this study were recorded by photography (Figs 1-6), but only the pollen slides remain deposited at the Universidade Federal do Rio de Janeiro, since the emerged female (Fig. 1) and the nest (Fig. 2) were lost in a fire that burned down the Museu Nacional on September, 2018.



Figs 1-4. *Megachile* (*Moureapis*) *benigna* Mitchell, 1930: 1, female spawned from the nest (habitus, lateral view); 2, nest collected in the trap-nest; 3, brood cell and round-shaped fragments of leaf forming the cell opercula; 4, different shapes of leaf fragments employed by the female foundress for nest building.



Figs 5, 6. Pollen grains found in the pollen slides analysed from the nest: 5, *Cyrtocymura* sp. (Asteraceae); 6, Type Fabaceae pollen grain. Pollen grains magnified 40x. Scale bars = 10 µm.

RESULTS

The *M. benigna* nest was collected in October/2017 (Marinho & Vivallo, 2020). It was built in a bamboo cane with 12 of diameter, its bottom against the node wall of the culm. The external wall of the nest was tightly attached to the inner skin of the bamboo trap. So, it was removed sliding an A4 sheet between the nest and the trap to take it out. The entire nest was built using leaf fragments that seemed tender visually and when touched (Figs 2-4). Two layers of leaf fragments covered the brood cells, those on the outermost side of the nest were round-shaped at the edges whereas those in contact with the brood cells had a truncated side (Fig. 3). The leaf fragment cupping the bottom of the nest was almost entirely rounded. This nest was 8.5 cm long, its averaged width was 1.2 cm + 0.9 cm + 1 cm measured at the entrance, middle part, and bottom, respectively.

The three brood cells were arranged linearly, with the opercula of the brood cell facing the bottom of the next cell ahead. Each cell was built with subtrapezoidal leaf fragments, their bottom formed by bent leaf fragments. The cells were built with five leaf fragments tightly fasten together, its rear side formed by bent fragments, conferring to the cell a cylindrical shape (Fig. 3). The brood cells had their measurements as follows (cm): cell 1 –length: 1.7; cell 2 – length:1.1; cell 3 – length:1.1; all cells had 0.7 of width. Cell opercula varied in number of leaf fragments, the innermost cell with five rounded leaf pieces; the middle one with two leaf pieces; and the outermost cell with 11 leaf pieces.

Nest provision of the three cells was moistened with nectar, the pollen load yellow. Eggs were oviposited onto the pollen mass, and the larva when hatched from the egg started feeding at intervals, eating the provision under its body. The middle cell was found empty, although it was fully provisioned and sealed as though if ready for oviposition. The immature from the outermost cell died due to handling in the laboratory. Only the female of the innermost cell emerged (Fig. 1). Analysis of the pollen load revealed 98.56% of the pollen mass consisting of *Cyrtocymura* sp. (Asteraceae) (Fig. 5) and the 1.34% remaining of an unidentified species belonging to the Fabaceae family (Fig. 6).

DISCUSSION

This is the first nest of *M. benigna* reported for an urban area. Previous studies recorded this species nesting only in natural areas (Teixeira *et al.*, 2011; Cardoso & Silveira, 2012) and reveal the potential of cities as conservation areas. Comparatively with other *Megachile* species placed in the subgenus *Moureapis* Raw, 2002 (Moure *et al.*, 2012), *M. benigna* is the best-known species so far, with accounts of its nest architecture, seasonality, and the different habitats where it occurs (Teixeira *et al.*, 2011; Cardoso & Silveira, 2012).

In the Northeast of Rio de Janeiro, *M. benigna* nests were built between October and March (Teixeira *et al.*, 2011), matching the period the nest reported in this study was collected at the JBRJ. Teixeira *et al.* (2011) did not collect *M. benigna* nests in urban or anthropogenetic areas, whereas the nest collected at the JBRJ brings evidence that this species may inhabit in urban areas as well.

The nest architecture found matches remarkably with the populations assessed by Cardoso & Silveira (2012, Fig. 1), with tender leaves used to build the nest, and the resemblance of the nest habitus. Teixeira *et al.* (2011) reported nests built with petals and the use of mud beneath it, forming two layers, the outer layer made of petals and the inner layer made of mud. However, the two nests that they report as being of *M. benigna*, which differ greatly of the other 15 they collected, probably were of some *Megachile* (*Chrysosarus*) species, since the females of this subgenus have no cutting edges in their mandibles, which would explain the use of petals in nest building, besides the use of mud. Other aspects regarding the nest architecture of *M. benigna* such as leaf fragment shape match with this study and the one presented by Cardoso & Silveira (2012).

The brood cell totally provisioned with pollen and nectar, but curiously with no egg, was unseen to our knowledge, even though the innermost and outermost cell had one egg each. The probable explanation for this is some type of failure at the bee oviposition mechanism, or even the fact that the bee was elder and running out of eggs. Vestibular and intercalary cells differ in the sense that they are not provisioned (Krombein, 1967), and it is a difficult strategy that spend time and effort for load an entire brood cell for leaving it with no offspring.

The knowledge on the food sources used by *Megachile* in the Neotropics is limited, despite its high diversity (Raw, 2007). The subgenus *Moureapis* seems to be oligolectic, in the light of data reported so far. Schlindwein (1998) reported females of *Megachile apicipennis* Schrottky, 1902 visiting flowers of Asteraceae and other females of an unidentified species of *Megachile* visiting flowers of Asteraceae and Cactaceae. These observations agree with the pollen analysed from brood cells of other species belonging to the *Moureapis* subgenus: for *Megachile maculata* Smith, 1853 in the transition of the Cerrado and Atlantic Forest, it harvested pollen from *Baccharis* and *Vernonia* flowers (Asteraceae) predominantly (Sabino *et al.*, 2016); and *M. benigna* at the JBRJ, in the Atlantic Forest, pollen from *Cyrtocymura* flowers (this report). Interestingly, Buschini *et al.* (2009) reported an unidentified species of *Megachile* (*Moureapis*) provisioning its cells with pollen of two *Ludwigia* species (Onagraceae), *L. sericea* (Cambess.) H. Hara and *L. peruviana* (L.) H. Hara, in the Araucaria Forest of the Brazilian South, which may point to some variation in the subgenus level, but fidelity of pollen foraging by females of one species. The food source report made by *M. benigna* in this study is presented with confidence based on the study of Dorado *et al.* (2011) that observed reliability on data extracted from pollen loads analysed from trap-nests.

Acknowledgements. We thank the *Coordenação de Aperfeiçoamento de Pessoal de Nível Superior* – CAPES, Finance Code 001, for partly funding this research, and the *Conselho Nacional de Desenvolvimento Científico e Tecnológico* – CNPq for the grant to DM (proc. 131188/2017-8). We thank the personnel of the Jardim Botânico do Rio de Janeiro, especially Maria Lúcia Teixeira Moscatelli, for the help provided; Claudia Barbieri for kindly identifying the pollen types. This article is part of the SIGMA Project nº 21565MN/UFRJ. It is the contribution nº60 from the HYMN. Museu Nacional VIVE!!!

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