v. 3, n. 10, 2023

International Journal of Biological and Natural Sciences

# SURVEY AND DISTRIBUTION OF NATIVE STINGLESS BEE NESTS (HYMENOPTERA: APIDAE, MELIPONINI) IN A REMNANT AREA OF CERRADO, MINAS GERAIS, BRAZIL

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**Abstract:** Bees are the most abundant in the pollination of angiosperms. Native stingless bees are also efficient in this task and can be used to improve agriculture. The aim of the present work was to survey the nests of native stingless bees in the municipality of Buritis, Minas Gerais, Brazil. During the study period of one year between May 2020 and May 2021. A total of nineteen nests were found, mostly in Cerrado *sensu stricto* areas surrounded by wetlands. The species found were: *Frieseomelitta varia*, *Geotrigona mombuca*, *Melipona rufivrentris*, *Nannotrigona testaceicornes*, *Tetragonisca angustula*, *Trigona hyalinata*, *Tetragona clavipes*. Of these, *Tetragonisca angustula* and *Trigona hyalinata* accounted for 63% of the recorded nests. The results show a low diversity of native bee species but a good number of nests, although the farm has vegetation and potential phytophysiognomic variation that could host more bee groups and species. We believe that with a proper management plan, the area can be a great place to implement a meliponary that would contribute to the biodiversity of the Apidae family in the state of Minas Gerais, Brazil.
**Keywords:** Native stingless bees, Cerrado, biodiversity, Nests, *Tetragonisca angustula*.

## INTRODUCTION

Meliponines, popularly known as native stingless bees (NSB), belong to the class Insecta, family Apidae, and tribe Meliponini (Grüter, 2020). They are distributed with about 500 species in tropical and subtropical regions (Map 1), including Brazil, where about 244 species occur throughout the national territory. Of these, 58 are found in Minas Gerais, Brazil (Michener, 2007; Pedro, 2014).


**Map 1.** Stingless bee zone of the world (Kwapong et al., 2020)

Bees can live in groups (social) or they live as individuals (solitary). Regarding the external morphology of stingless bees (Figure 1), the body is divided into three body parts: Head, Corax and abdomen. The head has antennae, compound and simple eyes (spots) and jaws. Attached to the thorax are two pairs of wings and three pairs of legs. In most stingless bee workers, on the hind legs there is a modified structure, melliferous vesicle (pollen basket) for collecting and transporting pollen, nectar, water and other materials, and the abdomen (Kwapong et al., 2010; Martins et al., 2014). Furthermore, most parts of the external body of stingless bees are covered with hair (Kwapong et al., 2010).

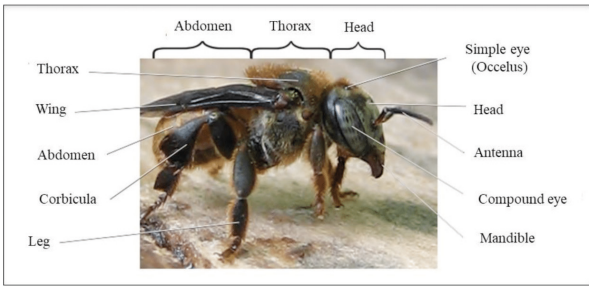



**Figure 1.** Morfologia externa de uma abelha operária sem ferrão da espécies *Meliponula bocandei* (Kwapong et al., 2010).

Native stingless bees have an organ called a "stinger" but it has atrophied and is no longer used (Figure 1). However, there are many defense strategies that this group has acquired

during evolution, such as attacks with the jaws, penetration of the facial openings (nose, ears, eyes), entrances made of wax and/or resin, and also the choice of more discrete places to nest (Oliveira et al., 2013).

Bees have a very close relationship with plants, i.e., they are important animals that enable the genetic exchange of several species of angiosperms and are responsible for almost 90% of the food consumed by humans (Barbosa et al., 2017). In particular, meliponines are considered efficient pollinators due to the frequency of their flower visits, and perhaps, for this reason, they are suitable for productive crop improvement (Roubik 1989; Slaa et al., 2006; Schuehli & Machado, 2014; Malagodi-Braga, 2018).

The Cerrado biome covers about 23% of the Brazilian territory and presents a great phytophysiognomic diversity, in addition to a considerable number of species, many of which are endemic. Therefore, it is considered the richest savanna in the world and a hotspot of biodiversity on our planet. It presents different phytophysiognomies, with the occurrence of savanna areas (clean fields and Cerrado sensu stricto) and wetter environments such as gallery forests and semi-deciduous seasonal forests (Klink & Machado, 2005). The floristic composition of these phytophysiognomies differs due to variations in moisture, fertility, and physical soil conditions (Durigan et al., 2000; Cardoso & Schiavini, 2002; Lira, 2014). Such a difference in structure may determine the local geographic distribution of bee species, as factors such as climate, vegetation structure, inter and intraspecific competition for nesting sites, and floristic resources may determine species occurrence (Wcislo & Cane 1996; Aguiar & Gaglianone, 2012).

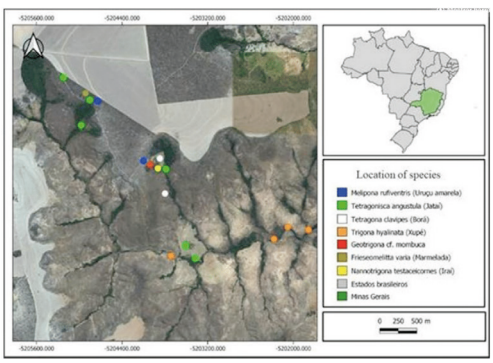
Native stingless bees nest primarily in cavities of woody plants, but nests can also be found in termite mounds and rock walls. There are also species of native stingless bees that build exposed hives, not only in rural areas but also in urban areas in places such as walls and posts (Werneck & Faria-Mucci, 2014).

Therefore, the objective of this work was to locate and identify the species of native stingless bees in their respective nests (checklist) and compare their preference for habitats distributed in different phytophysiognomies of a Cerrado area at Fazenda Veredas do Cerrado in the municipality of Buritis, Minas Gerais, Brazil.

## MATERIAL AND METHODS

Native stingless bees nest records were conducted between May 2020 and May 2021 at the Veredas do Cerrado farm (15º27'13"S and 46º 45'43º W) in the municipality of Buritis, Minas Gerais, Brazil. The farm is private and has a total area of 300 hectares. It is located in the Cerrado biome, which has characteristic and diverse phytophysiognomies, such as: typical Cerrado, gallery forests, dry forest, Cerradão, dense Cerrado and Veredas (Map 2).

This property is surrounded by water and hosts a source of the Santo Antônio River, which flows into the São Vicente River, then into the Urucuia River and finally into the São Francisco River. Along the watercourse are rock walls and waterfalls that provide ideal habitats for some species of bees.




**Map 2.** Distribution of bees' nests in the map of Fazenda Veredas do Cerrado, Minas Gerais Brazil. (Source: Authors)

The method used was active searching, conducted in pairs by two researchers, searching every 15 days during the study period of May 2020 and May 2021.

The nests found were mapped and resident species were identified. The locations and species of nests were noted descriptively, and if they were in trees, they were identified to species level. In addition, the height (relative to the ground) of the entrances to each nest was measured as shown in the figures (Figures 3 A, B, C, and D).

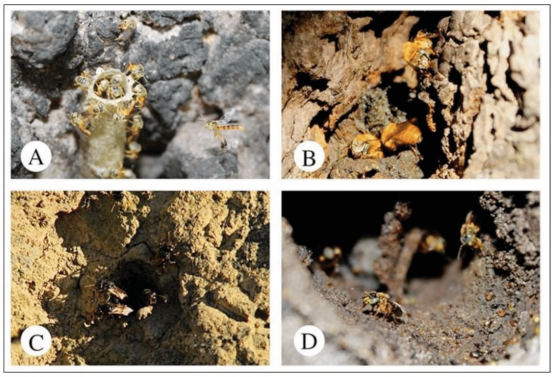



**Figure 3.** Stingless bees recorded in this study: (A) *Tetragonisca angustula;* (B) *Melipona rufiventris;* (C) *Geotrigona mombuca;* (D) *Frieseomelitta varia,* at Veredas do Cerrado farm, municipality of Buritis, Minas Gerais, Brazil. (Source: Authors, 2022).

## RESULTS

Nineteen nests of native stingless bees were found and identified throughout the farm. Of these, a total of seven bee genera and seven species were identified (Table 1), with Tetragonisca angustula, popularly known as Jataí, being the species with the highest number of identified nests.

In terms of classification, the native stingless bees belong to the family Apidae, subfamily Apinae, tribe Meliponin. The species are listed in Table 1.

The species *Tetragonisca angustula* had the most nests with a total of six, followed by the species *Trigona hyalinata* (Xupé) with four nests. Two nests each were counted for *Melipona rufiventris* (Uruçu-Amarela) and *Tetragona clavipes* (Borá). For the species *Frieseomelitta varia* (Marmelada-amarela), *Nannotrigona testaceicornes* (Iraí) and *Geotrigona mombuca* (Guira), only one nest was found each, and the percentage of species found is shown in the figure (Figure 2).

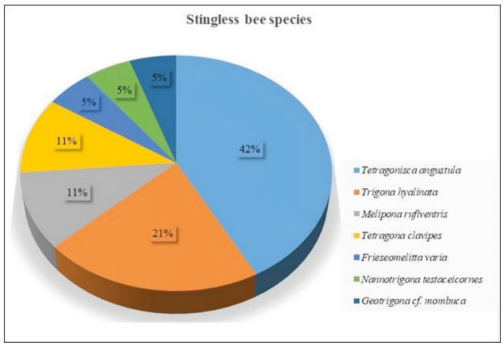



**Figure 2**. Percentage of stingless bee species in the Cerrado biome at the Veredas do Cerrado farm, Buritis municipality, Minas Gerais, Brazil.

The bee species *M. rufivrentris, T. angustula and T. hyalinata* showed preferences in terms of nesting sites, since the majority, or all for *M. rufivrentris* and *T. clavipes*, were found in the phytophysiognomy of the Cerrado stricto sensu, and for *T. angustula* three nests were recorded in gallery forests. *T. hyalinata* nested only on rock walls, with a large part of the nest exposed, near the farm watercourses, that is, in the phytophysiognomy of riparian forests. In *N. testaceicornes* and *G. mombuca*, the only identified nests were built in termite mounds on the ground and near the path. The bee species *F. varia*, for which a nest was found, was found in the Cerradão area. The distribution of the bees was mostly concentrated near phytophysiognomies with higher vegetation and/or near watercourses (Map 2).

| Number of nests | Species | Popular name in Brazil | Sites |
|---|---|---|---|
| Two (02) | *Melipona rufivrentris* | Uruçu-Amarela/ Tujuba | *Caryocar braziliense* |
| Four (04) | *Tetragonisca angustula* | Jataí-Amarela | *Caryocar braziliense* |
| One (01) | *Tetragonisca angustula* | Jataí-Amarela | *Mauritia flexuosa* |
| One (01) | *Tetragonisca angustula* | Jataí-Amarela | *Vochysia thyrsoidea* |
| One (01) | *Tetragonisca angustula* | Jataí-Amarela | *Sclerolobium paniculatum* |
| One (01) | *Tetragonisca angustula* | Jataí-Amarela | Rafter |
| One (01) | *Tetragona clavipes* | Borá | *Astronium urundeuva* |
| One (01) | *Tetragona clavipes* | Borá | Dead tree |
| Four (04) | *Trigona hyalinata* | Xupé/Guaxupé | Rock wall |
| One (01) | *Geotrigona mombuca* | Guira/Guiriçu | Termite mound |
| One (01) | *Frieseomelitta varia* | Marmelada-amarela | *Caryocar brasiliense* |
| One (01) | *Nannotrigona testaceicornes* | Iraí | Termite mound |

**Table 1**. List of stingless bee species recorded in their respective nests and their preferences in substrate or host plant species at the Veredas do Cerrado farm in the municipality of Buritis, Minas Gerais, Brazil. (Source: Authors, 2022).

## DISCUSSION

The nests found belong to bees that are widely distributed in the Cerrado. These results are consistent with the data published in the literature, which demonstrate the presence of these bee species in this biome (Carvalho 2009; Pedro 2014). Although the focus of the study was on native bee species, no other nest was neglected. However, no exotic bee swarm was found, although specimens were sighted.

The bee species found nesting in trees (Jataí, Uruçu, Marmelada and Borá) accounted for about 70% of the total number of nests found, demonstrating the preference for nests in this type of substrate. Five species of medium and large trees were found in the identification of the plants, namely: *Astronium urundeuva*, *Caryocar brasiliense*, *Mauritia flexuosa*, *Sclerolobium paniculatum* and *Vochysia thyrsoidea*.

A study conducted by Rego et al. (2008) indicated that there may be a preference for native stingless bees in nest building in the species *C. brasiliensis*. Its trunk is thicker than that of other typical Cerrado trees, a fact that could influence the choice of the plant as a shelter, since this characteristic meets the needs of some bee species (Cortopassi-Laurino et al., 2009). In the present study, this preference was also observed, since seven of the eleven nests found in stems belonged to this species. However, only studies with a larger number of samples and more detailed evaluation/comparison tests can confirm and conclude our observations and the suggestions made in the literature (Macedo et al., 2020).

The species *T. hyalinata* was the only one that nested only on rock walls, with entrances more than three meters high in all swarms and with external construction of the nest. They also showed more defensive behavior than the other identified species. These data are consistent with observations from a study by Shackleton (2015), which showed that simply passing in front of the colony is a sign of threat to them, and this prompts the workers to attack aggressively.

Of the total number of nests observed, only one was built by *T. angustula* on a fence post, confirming its somewhat timid attitude toward human interference (Castro, 2009), 46 cm above the ground. *T. angustula* was also the species that showed the most variation in terms of the height of the nest entrance and the

tree species chosen for the nest, reinforcing its generalist habit.

Among the *T. angustula*, the extreme height of the entrance to their nests was 40 cm in *C. brasiliensis* and 542 cm in *M. flexuosa*. There was also a relevant difference in *T. clavipes*: one flock nested near the ground in mastic and the other flock nested 163 cm above the ground in a dead tree. *M. rufivrentris* nested at similar heights, between 120 and 130 cm, both in *C. brasiliensis* trees. The species *F. varia*, *N. testaceicornes*, and *G. mombuca* could not be compared because they each had only one nest.

The distribution of nests showed a definite pattern for the choice of site, since all the nests recorded were located near the phytophysiognomy of gallery forests, riparian forests and/or vereda associated with water resources essential for the bird's life. In a study conducted by Coelho (2003), the presence of dense forests also influenced the number of species recorded in the area, highlighting the need to conserve these forest typologies.

Regarding the distribution of the nests, one of *T. angustula* and *M. rufivrentris* was located in an area very close to the boundary of the farms (Figure 2), thus close to the large neighboring plantations and also more vulnerable to the effects of the chemicals used. However, both colonies showed a great movement of bees throughout the study period, proving that they were healthy.

Biodiversity can be affected by the presence of large plantation areas around the farm, leading to the use of pesticides and the loss of native floral resources. Paim and Oliveira (2015) reported that desertification directly affects the biodiversity of bees in the region and that they can be used as bioindicators of environmental quality.

The species suffer from various threats such as: Deforestation, fires and the extensive use of pesticides. Studies show that the use of pesticides on crops is one of the major threats to bees, currently causing the global phenomenon "Collapse of hives" (Freitas et al., 2017).

The Cerrado biome has a great wealth of fauna and flora, but it has suffered a great loss of biodiversity due to the loss of areas and/or fragmentation of the remaining areas, affecting even small organisms such as bees.

In the present study, individuals visiting the flowers were not considered. Therefore, we propose to apply a sweeping method and/or the use of nets on the flowers of plants that are attractive to bees, which would allow us to record other species, such as some species identified in this way like *Leurotrigona muelleri*, *Trigona spinipes* and others.

Thus, working with collections of individuals in flowers is likely to yield better results than the number of species found. In studies such as this, aimed at finding bee nests, it is advisable to spend more hours in the field, since the time available for searching for nests can be influenced by determining the number of samples in the whole area studied or by conducting a survey.

## CONCLUSIONS

In the fragment of the Cerrado biome used for the study, there was a low diversity of native bee species, but a good number of nests. The farm has vegetation with a variety of potential phytophysiognomies that could host more bee groups and species. However, the property is surrounded by large areas designated for monocultures, resulting in the absence of adjacent areas that could be considered "meliponic pastures", as well as the effects of overuse of pesticides that could kill bees.

So the data tells us that the farm still has great potential and refuge for wildlife, and may have species that are better able to withstand the changes in nature. It is believed

that with a proper management plan, the area can be a great place that would contribute to the biodiversity of the Apidae family.

## DECLARATIONS

**Conflict of interest:** The authors have declared that no competing interests exist.

**Ethical approval**: Not applicable.
**Financial support:** Own resources

## ACKNOWLEDGMENTS

We thank Mr. Caio Gabriel de Freitas for the opportunity to use the farm Veredas do Cerrado, municipality of Buritis, Minas Gerais, Brazil, to conduct this study.

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