MAPPING OF STINGLESS BEE NESTS ON THE UNIMONTES CAMPUS: SPECIES, DISTRIBUTION AND SUBSTRATES

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ABSTRACT
The study mapped 41 nests of stingless bees on the Unimontes campus, Montes Claros, identifying six species, with a predominance of *Nannotrigona testaceicornis* (49%) and *Tetragonisca angustula* (32%). Most of the nests (73%) were found in masonry structures, showing adaptation to urban environments. The density of nests was 1 per 0.50 hectare, higher than other studies in anthropized areas. The results highlight the resilience of bees and the importance of conservation strategies.

Keywords: Stingless bees. Urban nesting.

INTRODUCTION

Native stingless bees, or meliponines, make up a group of Hymenoptera with more than 600 species, restricted to tropical and neotropical regions, with greater richness in the neotropical region (ROUBIK, 2023). They belong to the family Apidae and the subtribe Meliponinae. In Brazil, considering both the described species and those still in the description phase, more than 300 species are known (PEDRO, 2014).

Meliponines live in colonies, small or large, depending on the species. Like honey bees (*Apis mellifera*), native stingless bees are eusocial, with perennial colonies, caste differentiation, inability of the queen to found a nest alone, elaborate nest architecture, efficient communication system, effective thermoregulation, and ability to store large

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amounts of food (MICHENER, 2000; SAKAGAMI, 1982).

Most species of stingless bees build nests preferably in tree hollows, but they can also use cavities in the ground, termite mounds or anthills. Each species builds a peculiar characteristic architecture at the entrance to the nest, which can contribute to the identification of the species. The structure of the nests and the activities of the meliponines make it possible for successive generations to reproduce in the same place (ROUBIK, 2020). Bees collect nectars, pollens, and resins from plants for feeding and nest maintenance. The flavonoid compounds present in the resins have antimicrobial activities to protect the nests, while the terpenoids deposited in the inlet tube exert a repellent function against ants. These examples show that bees use various defense strategies against insects, microbes, and even vertebrates (ROUBIK, 2023).

Bees are effective pollinators, whose diet is basically composed of plant products and which, during the collection of resources, promote the pollination of flowers. Pollination is an essential environmental service, contributing to the maintenance of ecosystems, as well as to the agricultural production of various plant species. In addition, bees produce honey, propolis and pollen, which can be consumed as food due to their rich nutritional composition and the presence of bioactive compounds (MICHENER, 2000; VILLAS-BOAS, 2018).

The nesting habit of bees can be affected by environmental changes, such as urbanization, fragmentation, destruction and modifications of ecosystems, impacts that reduce biodiversity and reduce the availability of sites for the construction of new nests. The reduction of green areas in urban environments can negatively affect the populations and diversity of stingless bees. In addition, habitat fragmentation resulting from deforestation compromises the supply of resources that bees need for survival, such as food and quality water (ROSA *et al*., 2019).

The honeys of native bees were already appreciated by indigenous peoples even before the arrival of the Portuguese in Brazilian territory. Despite the large number of existing species and their unique characteristics, native bees are still little known.

Faunal and floristic surveys are effective methodologies for diagnosing the situation of bee populations at a given time. However, environmental changes caused mainly by anthropogenic actions can directly affect bee species, favoring the growth or reduction of their populations.

In urban areas there is a growing supply of artificial and man-made environments. As meliponines have different ways of building nests, many species demonstrate the ability to adapt to these new environments and substrates available, and are therefore found in anthropized areas. Taura and Laroca (1991) and Albernaz et al. (2022), as well as other studies, have already shown the importance of knowing the native social species that inhabit urban and/or anthropized areas, to understand how they are occupying these spaces. In this context, the objective of the present study was to survey the species of stingless bees on the campus of the State University of Montes Claros (Unimontes) in Montes Claros, and to contribute to the knowledge about the presence of meliponines species in the north of Minas Gerais.

OBJECTIVE

To carry out the mapping of nests of stingless bee species on the campus of the State University of Montes Claros (Unimontes), in Montes Claros - MG.

METHODOLOGY

The mapping of stingless bee nests was carried out in an urbanized area, on the campus of the State University of Montes Claros (Unimontes), which occupies 20.32 hectares (Figure 1). This campus is located in the municipality of Montes Claros, with the following coordinates: Latitude 16 43' 41", Longitude 43 51' 54" and Altitude of 638 meters; in the Upper Middle São Francisco Basin, in the north of the State of Minas Gerais. The predominant phytophysiognomy in the region is the deciduous Cerrado, with the presence of sub-deciduous cerrado and some occurrences of super-emifólio cerrado. The area also has a wide transition range between the Cerrado and Caatinga domains. The climate is hot and dry, with average annual temperatures ranging between 21ºC and 24ºC. Annual rainfall ranges between 900 and 1200 mm, with the highest rates recorded between the months of October and January (BRASIL, 2024).

Figure 1 – Map of the Unimontes campus, Montes Claros, MG, edited by Google Earth (ID 0A41248ED931471F801C).

Source: Google Earth.

The location and counting of nests were carried out between the months of April and June 2024, in a sampling period of 25 hours, from 9:00 am to 5:00 pm, on sunny days with little wind, to facilitate the location of nests from the external activity of the bees.

The nests were located through an active search. For this, the campus area was mapped, including buildings, buildings, walls, parking lots, streets and areas with vegetation (gardens and wooded areas). All mapped structures were inspected in search of stingless bee nests, observing from the foundation, the height of the roofs, and from the roots to the tree canopy.

For each nest found, a photographic record of the entry was carried out, observing the flow of entry and exit to confirm whether the nest was active. Then, the following data were recorded: height of the inlet tube in relation to the ground, type of substrate where the nest was installed and georeferencing using GPS (Global Positioning System). The measurements were made with the aid of a tape measure, Garmin eTrex portable GPS, Canon camera.

Trees with nests were also evaluated, with the measurement of trunk circumferences at breast height (CAP) at 1.30 m from the ground, in addition to photographic records and collection of material for later identification.

The identification of the nests was carried out for the most part, based on the structure of the entrance at the time of location, as each species has its own characteristics. For the nests in which this identification was not possible, samples were collected from five individuals from each nest for subsequent identification by a specialist. These specimens are stored in the collection of the Graduate Program in Biotechnology of the State University of Montes Claros (UNIMONTES).

DEVELOPMENT

41 nests of stingless bees were located on the campus of the State University of Montes Claros. The nests were marked on the map of the area, however, in some places, there are several very close together, so the markings were superimposed and only 27 nests appeared on the map - red dots (Figure 2). They are distributed among six species. Among these, *Nannotrigona testaceicornis* had the highest number of nests observed (n = 20), followed by *Tetragonisca angustula* (n = 13), *Scaptotrigona depilis* (n = 5), and the lowest number of nests was for *Scaptotrigona* sp1 (n = 1), *Leurotrigona muelleri* (n = 1) and *Lestrimelitta limao* (n = 1) (Figure 3).

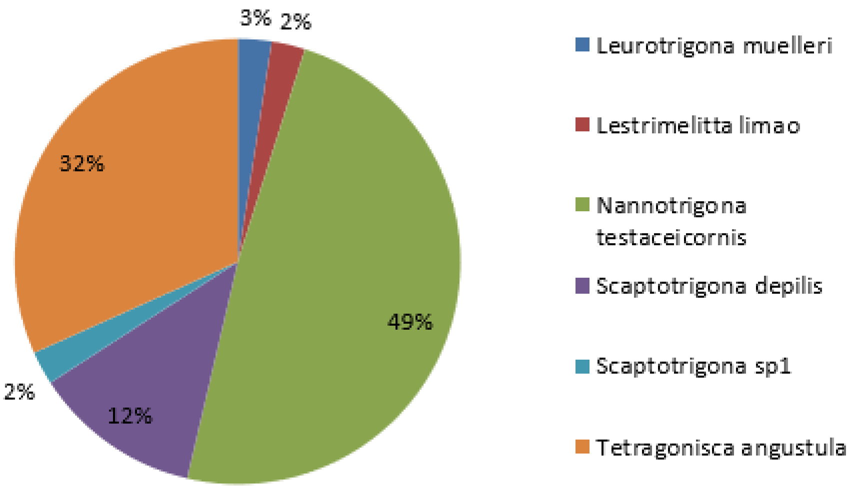
The most abundant species in the Unimontes Campus was *Nannotrigona testaceicornis* with a frequency of 49% of the nests, followed by *Tetragonisca angustula* with a frequency of 32% of the nests observed (Figure 3).

The substrates most used by stingless bees were masonry structures, with the occurrence of 73% of the nests observed, in walls, walls and other masonry structures. Of the total number of nests found, 12% were observed in tree trunk cavities, and 15% in places such as electrical distribution boxes, air conditioning structures, or similar structures (Figure 4). The density of nests observed was 1 nest per 0.50 hectare.

Figure 2 – Locations of stingless bee nests (in red) on the Unimontes campus

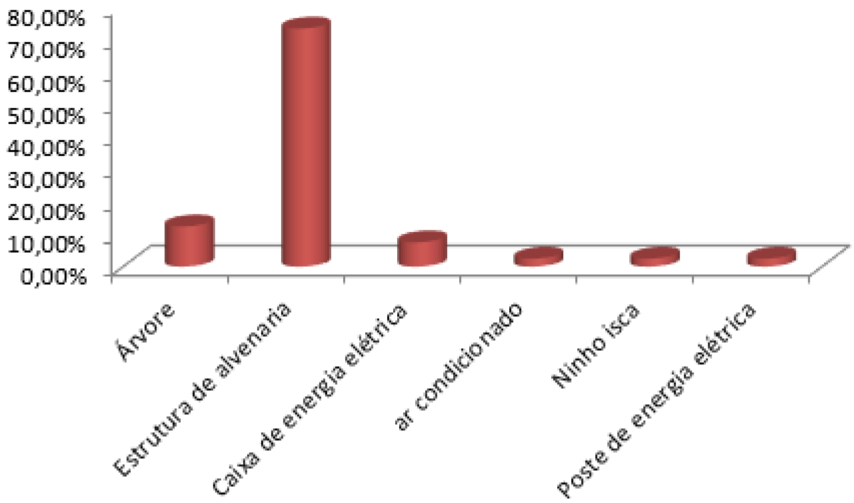
Source: Edited from Google Earth

Figure 3 – Proportion of nests of native stingless bee species found on the Unimontes campus in Montes Claros, MG



Source: The author.

Figure 4 – Nesting substrates used by stingless bees, found at the Unimontes Campus in Montes Claros, MG.



Source: The author.

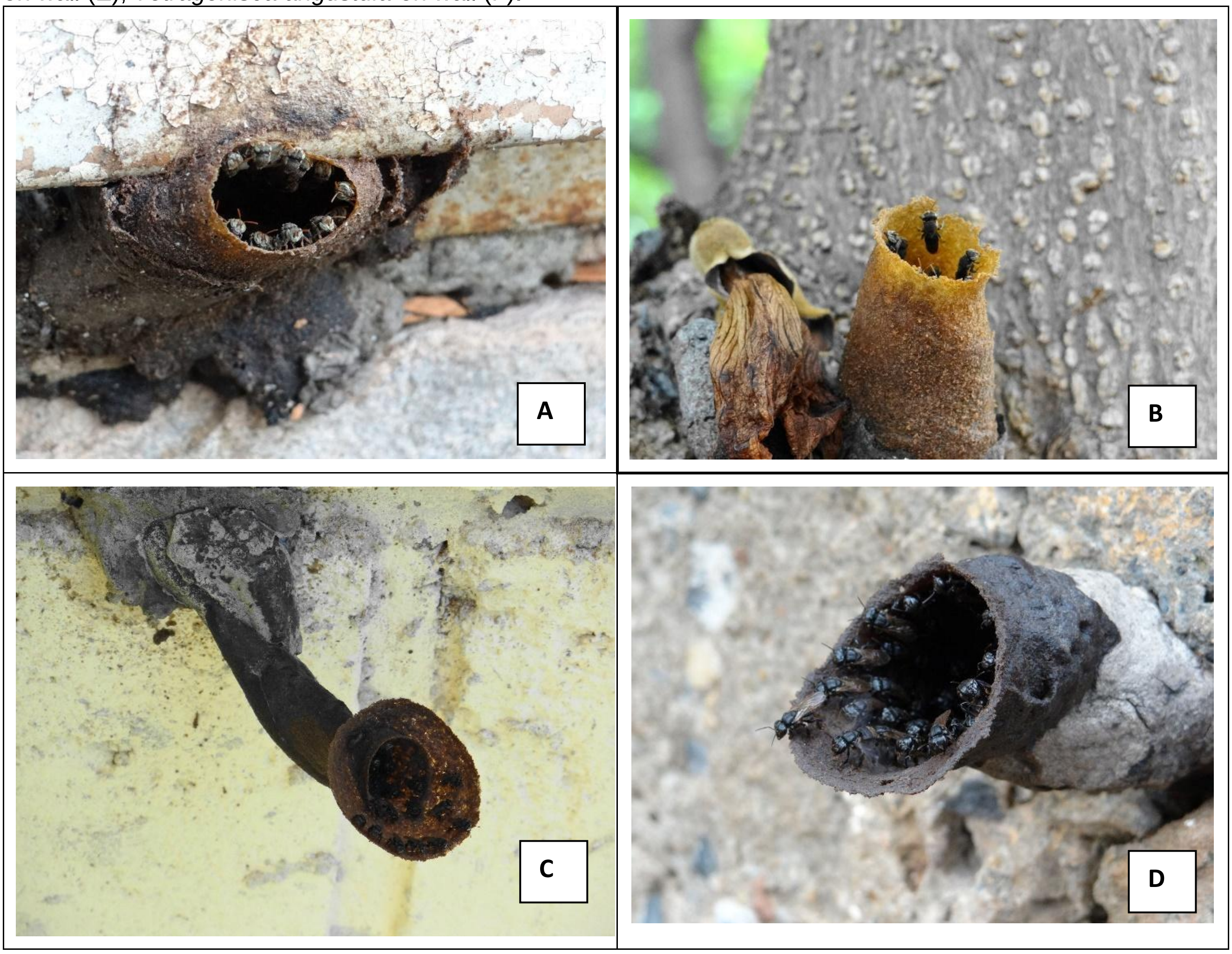
Five nests were observed in trees; one nest of *Scaptotrigona* sp on the trunk of an unidentified species and four nests of *Nannotrigona testaceicornis*, on the trunk of *Spathodea campanulata*. It is noteworthy that these nests were located in the trunk of the same tree. The stingless bee nests on the Unimontes campus had a height of 0.04 m to 6.0 m in relation to the ground. The greatest amplitude observed was in the species *Tetragonisca angustula with an* average height of 1.33 m at the entrance of the nests, with a maximum height of 6.0 m and a minimum of 0.20 m; however, the highest frequency of nests was at 0.50 m (Table 1). The nest of *Leurotrigona muelleri* found was 4.0 m high, as well as that of *Lestrimelitta limao*. The nest of *Scaptotrigona* sp1 was at 6.0 m, and very close to a nest of *T. angustula*. Each species of stingless bee has specific characteristics in the nest inlet tube (Figure 5). However, depending on the moment of development of the nest, there may be some variation, as an example, the nests of *Nannotrigona testaceicornis* in the wall – typical entrance, and in the tree – larger tube, as can be seen in Figure 5.

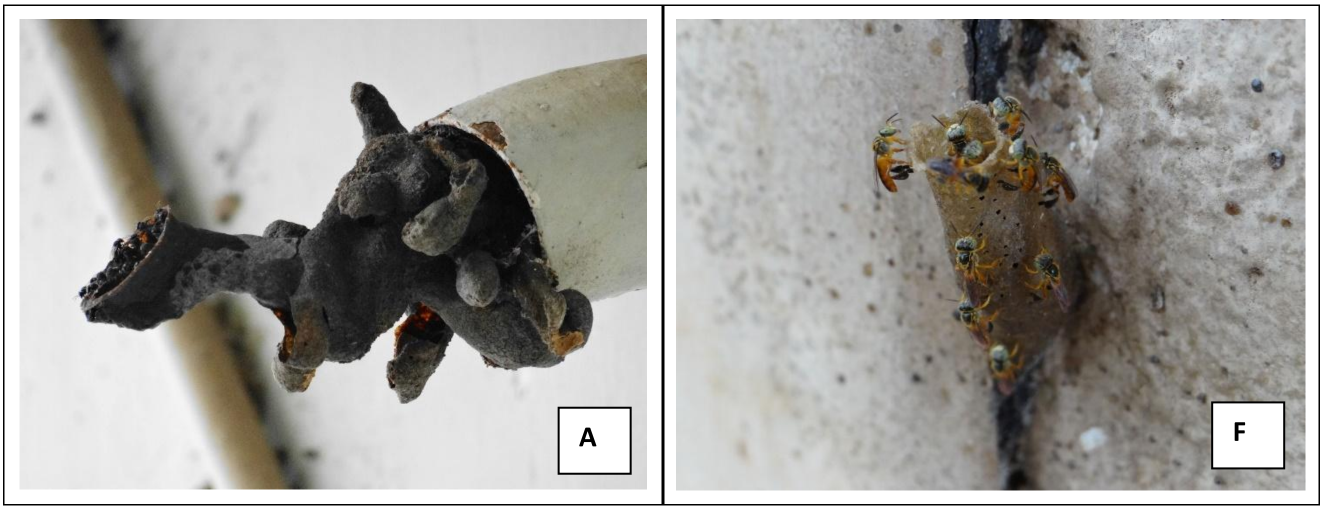
Table 1 – Nest height in meters (m) of stingless bees at the Unimontes campus, Montes Claros, MG

Species	N	Average	SD	Median	Min	Max
Nannotrigona testaceicornis	20	0,80	0,83	0,80	0,04	3,0
Tetragonisca angustula	13	1,33	1,76	0,50	0,20	6,0
Scaptotrigona depilis	5	0,68	0,60	0,60	0,15	1,70
Scaptotrigona sp1	1	6,0	0	0	6,0	6,0
Leurotrigona muelleri	1	4,0	0	0	4,0	4,0
Lestrimelitta limao	1	4,0	0	0	4,0	4,0

N: total number of nests; SD: standard deviation; Min: minimum nest height; Max: maximum nest height
Source: The author.

Figure 5 - Entrance tubes of stingless bee nests on the campus of the State University of Montes Claros (Unimontes): *Nannotrigona testaceicornis* in masonry structure (A); *Nannotrigona testaceicornis* in the trunk of *Spathodea campanulata* (B); *Scaptotrigona sp* in wall (C); *Scaptotrigona depilis* in wall (D); *Lestrimelitta limão* on wall (E); *Tetragonisca angustula* on wall (F).





Source: The author.

DISCUSSION

The six species of native stingless bees found on the Unimontes campus were also observed in other surveys in urban and anthropized areas; in another survey carried out in an area with characteristics similar to the Unimontes area (FREITAS & SOARES, 2003). Some species found in this study were also observed in other surveys, such as *Nannotrigona testaceicornis* and *Tetragonisca angustula* and *Scaptotrigona* spp (SOUZA *et al*., 2005.; VIEIRA *et al*., 2016.; SANTOS *et al*., 2023.; ALBERNAZ *et al*., 2022.; NETTO *et al*., 2007). It is interesting to note that the species *Nannotrigona testaceicornis* and *Tetragonisca angusula* were common in all the aforementioned studies. Another detail observed is that all species found generally occur in environments with different levels of anthropogenic interference, as well as in natural environments. The species present in the Unimontes Campus are naturally occurring in the state of Minas Gerais (SILVEIRA *et al.*, 2002).

According to Antonini et al. (2013), the most common genera in urban environments are *Tetragonisca*, *Trigona* and *Paratrigona*; In addition to these, ZANETTE et al. (2005) cite the species *Nannotrigona testaceicornis* as abundant in surveys. The density of nests in an area can be modified by deforestation, fires, or any changes that modify the number of sites available for nesting. The density of stingless bee nests per area found on the Unimontes Campus was higher than the density of nests/area of other surveys in anthropized environments (Table 2).

This fact can be explained by the supply of artificial cavities, in which small bees have built nests, such as *Nannotrigona testaceicornis* and *Tetragonisca angustula*; species that have great plasticity and have adapted very well to urbanized environments. Areas with food resources and the capacity to shelter small species, even if modified by humans such as green areas, can shelter small species such as bees (LEMES *et al*., 2015).

When observing the vegetation cover of the Unimontes campus (Figure 1), it is evident that there is a low density of tree species, a fact that may explain the small number of nests in cavities in tree trunks and branches. It was observed in this work that most trees do not have cavities in the trunks, even among those with larger diameter, older. Changes in the availability of substrates for bees to nest can alter the dynamics of the species in the region, favoring the population increase of some and even the disappearance of others, also considering that floral resources must be available within the flight radius of the bees to maintain the populations (CANE, 2001). In the survey conducted in an anthropized area (ALBERNAZ *et al*., 2022), but with greater vegetation cover, 83.18% of the nests were in trees; the authors state in their study that stingless bees prefer trees as a nesting substrate (ALBERNAZ *et al*., 2022). This situation is opposite to that found on the Unimontes Campus, where more than 70% of the nests were in masonry substrates and 12% nest in trees. In the survey carried out by Mesquita *et al*., (2017) at the Tapajós Campus and in the Mekdece Forest in Santarém, PA, about 75% of the nests were found in trees.

Table 2 – Density of nests by area in surveys in anthropized areas

Local	Nests	Area (hectare)	Density Nests/ha	Anus
Cataguases	51	-	-	Netto *et al*., 2007
Cruz das Almas	107	116,74	1/1,09	Albernaz *et al*., 2022
Salvador	94	57	1/0,60	Souza *et al*., 2005
Ribeirão Preto	566	574,63	1/1,01	Freitas and Soares, 2003
Juiz de Fora	34,88	132,58	1/3,80	Sousa *et al*., 2002
Inconfidentes	13	33,43	1/2,57	Menino *et al*., 2023
Ubá	28	111,8	1/3,99	Araújo *et al*., 2016
Guarapuava	46	-	-	Marcondes and Buschini, 2007
Poços de Caldas	26	0,225	1/0,01	Santos *et al*., 2023
Montes Claros	41	20,32	1/0,49	Present work

The bee *Tetragonisca angustula* is found throughout the country and is generally the most abundant species in urban environments, as found in some anthropized areas, in Ribeirão Preto (FREITAS & SOARES, 2003), in Salvador (SOUZA *et al*., 2005), Cataguases (NETTO *et al*., 2007), and Ubá (ARAUJO *et al*., 2016) and Guarapuava (MARCONDES & BUSCHINI, 2007). In these surveys, most of the nests of *T. angustula* were also in artificial substrates, as well as the nests of this species were found on the Unimontes Campus. This nesting behavior demonstrates a preference or setting for new ecological niches resulting from human intervention in the environment.

The bee *Tetragonisca angustula*, popularly known as jataí, jatí, golden bees, and in some places in the north of Minas Gerais, is also called February. It is a small, golden-colored bee with long hind legs, green compound eyes. It is found from Mexico to the south of Brazil, so it can be found AM, AP, BA, CE, ES, GO, MA, MG, MT, PA, PB, PE, PR, RJ, RO, RS, SC and SP (SILVEIRA *et al*., 2002). The honey produced by jataí bees is good for consumption, and is appreciated by many populations, both indigenous, riverside, native peoples, rural and urban.

Due to its wide distribution and ease of adaptation and nesting in different environments, the species *Tetragonistica angustula* is found in several other studies, and its nests are present in different locations (ANTUNES *et al*., 2012). De Souza *et al*., (2005), found 94 nests on the campus of the Federal University of Bahia, 76.6% of which were of the species *Tetragonisca angustula*. As in the present work, trees were not the main nesting substrate chosen by the species found, being in second place.

It was observed in the work carried out that *Nannotrigona testaceicornis* was the most abundant species in the survey carried out at Unimontes; a similar result was found in anthropized areas in Cruz das Almas (ALBERNAZ *et al*., 2022), in Juiz de Fora (SOUSA *et al*., 2002.; VIEIRA *et al*., 2016). However, at Unimontes, most nests were in masonry substrates, unlike what was found in Salvador (ALBERNAZ *et al*., 2022) where the highest abundance of *N. testaceicornis* nests was in tree substrates, even though the survey was in an anthropized area. However, in the survey carried out in Juiz de Fora (SOUSA *et al*., 2002) and in the reassessment of nests in this area, after eight years (VIEIRA *et al*., 2016), the authors also found a greater abundance of *N. testaceicornis* nests in artificial substrates, as observed in the present study. These authors even observed the growth of this population during the eight-year interval. *N. testaceicornis* was also one of the most abundant species in the survey in Ribeirão Preto (FREITAS & SOARES, 2003), where a higher relative frequency of nests in masonry substrates (75%) was also observed.

The stingless bee *Nannotrigona testaceicornis* is popularly known as iraí. It is a species widely found in cities, in walls, walls, trunks and pipes. They are small bees, have a dark brown and opaque thorax, are very tame and usually hide when someone approaches or some movement considered strange by them occurs. They are bees that close the inlet pipe at night. It has a tasty honey that can be consumed, however, there is still little information about its products. This species can be found in the following states of Brazil: BA, ES, GO, MG, RJ, SP (SILVEIRA *et al*., 2002).

Nannotrigona testaceicornis nest in different substrates, results also observed in the Cruz das Almas survey (ALBERNAZ *et al*., 2022). These same authors also located nests of *N. testaceicornis* in trunks of the species *Spathodea campanulata*, as observed in this work. This is an interesting result since *Spathodea campanulata* is an exotic tree species, whose pollen and nectar are toxic to bees (PORTES *et al*., 2019.; TRIGO & SANTOS, 2000.; SOUZA *et al*., 2021). Even the planting of the species has been prohibited in several cities and states in Brazil. The state of Santa Catarina is an example, with the approval of Law 17.694 of January 14, 2019, which prohibits the planting and commercialization of the species. The reason for the ban is the mortality that nectar causes in insects and hummingbirds.

Published articles evidence the antimicrobial and anti-yeast activity of *Spathodea campanulata stem bark extracts* (OFORI-KWAKYE *et al*., 2009). One question that remains is whether, in some way, *N. testaceicornis bees* benefit from the plant's substances for some protection of the nest. Studies conducted in India have shown that several chemical compounds such as flavonoids and carotenoids have been isolated from *Spathodea campanulata,* compounds that may contribute to antioxidant, antifungal, and anti-inflammatory biological activities (PADHY, 2021).

The genus *Scaptotrigona* has a wide distribution in the Neotropical region and at least six species occur in Minas Gerais, in addition to having a great diversity of forms, many of which form complexes that are difficult to separate (SILVEIRA *et al*., 2002). On the Unimontes campus, five nests of bees of the genus Scaptotrigona were found, four of which were in masonry structures, and one nest in trunk; unlike two surveys carried out (SANTOS *et al*., 2023.; MENINO *et al*., 2023), in which the highest relative abundance was of nests of stingless bees Scaptotrigona, but all located in trees.

Two species were found on the Unimontes Campus, *Scaptotrigona* sp1 and *Scaptotrigona* sp2, so named because the specific names have not yet been confirmed. However, they are different due to the peculiar characteristics of the inlet pipes of each one, differentiating between them. Some species of *Scaptotrigona* are called by the common name of canudo, that is, different species may have the same popular name, even in very different regions; therefore, it is important to know the scientific name to know how to differentiate the species. The honeys of the *Scaptotrigona* species are usually consumed by humans, but more studies are still needed to better understand their characteristics. According to Vossler (2012), climatic conditions and the diversity of flora present in the environment are related to and interfere with the diversity of stingless bees present.

Leurotrigona muelleri is a small species, less than 3 millimeters long. The common name of this species is eye-lickers, because they fly towards the eyes to collect tears or sweat, to obtain salts. It is found in the states of BA, ES, MG, PR, SC, SP (SILVEIRA *et al*., 2002).

Lestrimelitta limao is popularly known as lemon bee, iratim, irati, lemon, seven-door. This species has a citrus smell, very similar to lemon, which can be perceived when it approaches the nest. This bee is kleptoparasitic, that is, it pillages the nests of other species of meliponines to obtain honey and pollen for food. This species is not usually found in the surveys of nests of stingless bees, however, four nests were identified on the campus of the University of São Paulo (FREITAS & SOARES, 2003), in the municipality of Ribeirão Preto, and on the Unimontes Campus one nest was also observed. This species is found in the states of BA, MG and SP (SILVEIRA *et al*., 2002).

The presence of bee species in an urban environment reinforces the need for environmental education in the knowledge and management of native bees present in the various places found (TEIXEIRA *et al*., 2022).

FINAL CONSIDERATIONS

In a study carried out on the campus of the State University of Montes Claros, 41 nests of native stingless bees were observed, distributed among six species, with emphasis on *Nannotrigona testaceicornis* and *Tetragonisca angustula*. Most of the nests (73%) were found in artificial substrates, such as masonry structures, which shows the adaptability of the observed bee species to urban environments.

The identification of the presence of native bees in urban and anthropized environments highlights the resilience and adaptability of stingless bees. The results obtained can be used as knowledge for the establishment of strategies for the conservation of species and also for their management in urban habitats. In addition, the work developed gives an indication of species that are more resistant to be raised in these environments. And it can still be a suggestion to plant more trees and herbaceous species on campus to offer more resources for bees, both social and solitary, in addition to contributing to the maintenance of their nests.

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