TREE SPECIES USED FOR NIDIFICATION BY STINGLESS BEES IN THE BRAZILIAN CAATINGA (SERIDÓ, PB; JOÃO CÂMARA, RN)

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Abstract

In Rio Grande do Norte, a caatinga region of North-eastern Brazil, the nesting opportunities that trees offer to stingless bees (Meliponinae) were studied. Samples consisted mostly of tree trunks, which were kept by Meliponinae beekeepers. Nearly 13 per cent of observed nests were in living trees in the field. Seven species of stingless bees, totalling 227 nests, were encountered in 12 tree species. More than 75.0% of stingless bees were found in two tree species being *Caesalpinia pyramidalis* (Caesalpiniaceae, 41.9%) and *Commiphora leptophloeos* (Burseraceae, 33.9%). Furthermore, all bee species nidify in *C. pyramidalis*. A great part of the nests in trunks were of *Melipona subnitida*, (N = 130) of which 50.0% was found in *C. leptophloeos* and 22.3% in *C. pyramidalis*. *M. asilvai* was predominantly found in *C. pyramidalis* (92.3%, N = 39). Besides this survey was mainly directed to bee species with beekeping importance, data shows the huge relevance of these two plant species for nesting by stingless bees in the caatinga.

Key words: *Stingless Bees, Nesting, Brazilian caatinga,* Caesalpinia pyramidalis*,* Commiphora leptophloeos.

Resumo

Foram feitas observações na caatinga, particularmente na região do Seridó (São José do Sabugi, PB) e em João Câmara, RN, com o objetivo de obter dados sobre as espécies vegetais utilizadas pelas espécies de abelhas sem ferrão (Meliponinae) para a construção de seus ninhos. As amostragens foram realizadas principalmente em ninhos transportados em seus troncos originais por meliponicultores da região. Cerca de 13% dos ninhos foram observados em árvores vivas no campo. Foram amostrados 227 ninhos, pertencentes a sete espécies de meliponíneos, nidificando em 12 espécies vegetais. Mais de 75% dos ninhos de meliponíneos foram observados nos ocos existentes em duas espécies de árvores: *Caesalpinia pyramidalis* (Caesalpiniaceae, 41,9% dos ninhos) e *Commiphora leptophloeos* (Burseraceae, 33,9%). Além disso, as cavidades dos troncos de *Caesalpinia pyramidalis* foram utilizadas pelas sete espécies de abelhas sem ferrão. A maior parte dos ninhos (N=130) foi de *Melipona subnitida*, dos quais 50,0% foram observados em *Commiphora leptophloeos* e 22,3% em *Caesalpinia pyramidalis.* Por outro lado, 92,3% (N=39) dos ninhos de *Melipona asilvai* foram observados em *Caesalpinia pyramidalis.* Desse modo, apesar de uma amostragem direcionada principalmente às espécies de interesse apícola, os dados destacam a enorme importância destas duas espécies de árvores na nidificação dos meliponíneos da caatinga.

Palavras-chave:*Abelhas sem ferrão, Nidificação, caatinga,* Caesalpinia pyramidalis, Commiphora leptophloeos.

Introduction

Stingless bees occur in tropical and subtropical regions of the world. Their colonies consist of perennial aggregates of many workers and, in general, one queen. The castes (queens and workers) are morphologically differentiated and a division of labour characterizes their social structure with an overlap in generations. Most stingless bees depend on trees to make nests in whereas a minority nest in the ground or make exposed nests (Nogueira-Neto 1970, Wille & Michener 1973, Sakagami 1982, Roubik 1989).

Stingless bees are important pollinators in tropical regions (Heard 1999) and, along with other pollinators, of great concern in conservation (Kearns et al. 1998). The food resources that they visit and use have been relatively well studied (Ramalho et al. 1990, Wilms & Wiechers 1997, Pinheiro-Machado et al. 2002). However, little is known about their preference for trees to nest and the impact of habitat disturbance on stingless bee populations, especially on the opportunities for nesting (Svensson 1991, Hill & Webster 1995, Moreno & Cardoso 1997, Aguilar-Monge 1999, Veen & Arche 1999).

In this paper we report about the use of tree species for seven species of stingless bees, which can be found in caatinga (an indian name for "white forest" related to the deciduous tree-shrub vegetation and physiognomy). Climate is semiarid with low rainfall, which is very erratic, and 7-9 dry months. Drought years and severe droughts are common. The studied area has one of the lowest precipitation (300-500 mm per year) of all ecosystems known for Brazil (Nimer 1979). Currently, caatinga suffers from two main human impacts: the cutting of trees for firewood and its use as cattle land. Some caatinga regions already have turned into desert.

Zanella (2000) made a survey of the bee fauna of Serra Negra de Norte, a caatinga region that is nearby our site of study.

Our survey was done in two caatinga regions of North-eastern Brazil and involved stingless bees nests found in tree trunks with beekeepers and in trees in the field. In this way, the distribution of the different bees over different species of trees was determined. The obtained information is a first step towards a better conception of the use of trees by stingless bees and will help to analyse the effects of alterations in the composition of vegetation on bee populations and to improve restoration programs of caatinga biodiversity.

Materials and methods

A study on tree nesting bees was performed in the Seridó region, near the municipalities of São José do Sabugi (06S48', 36W47'), Paraíba state, and Jardim do Seridó (06S35', 36W46') and João Câmara (05S32', 35W49'), Rio Grande do Norte state, Brazil. Data about nests were obtained directly from trees in the field or from trunks with living nests, which had been gathered by local Meliponinae beekeepers. The species of bees and the species of tree in which it nested were identified. The external perimeter of trees and trunks was measured through which the diameter could be calculated. In case a tree or trunk was not evenly cylindrical, two measurements were taken, one at its smallest and one at its biggest perimeter, together rendering an average perimeter value. Length of trunks was measured as well and these lengths delineated indirectly the dimension of the nest they hooded as trunks were always cut off near the top and bottom end of nests. In the cases where a colony was transferred from its trunk to a rational hive, it was possible to measure the internal trunk diameter and precise length of the nest. This consequently made it possible to calculate the volume a colony occupied.

Voucher specimens of bees and plants were deposited in the Coleção Entomológica do Departamento de Sistemática e Ecologia and Herbário Lauro Pires Xavier, of Federal University of Paraíba (UFPB).

Results

Trees and bee nests

A total of 227 bee nests in 198 trunks and 29 in trees in the field were examined. Seven species of stingless bees were observed of which *Melipona subnitida*, *M. asilvai* and *Frieseomelitta varia dispar* made up the majority, 57.3, 17.2 and 13.7 per cent respectively (Table 1). The other species found were *Frieseomelitta doederleini* (5.3%), *Plebeia flavocincta* (1.8%), *Plebeia* sp. (1.3%) and *Scaptotrigona aff. depilis* (3.5%).

The bees nests (most of them endemic, Zanella 2000) were found in 12 species of trees (Table 1). Of these, two species had more than 75.0% of nests, being *Caesalpinia pyramidalis* (local name "Catingueira", Caesalpiniaceae, 41.9%) and *Commiphora leptophloeos* ("Imburana", Burseraceae, 33.9%) the most important (Figure 1).

All seven bee species were found nesting in *C. pyramidalis*. A great part of the nests in trunks were of *Melipona subnitida*, (N = 130) of which 50.0% was found in *C. leptophloeos* and 22.3% in *C. pyramidalis*. *Melipona asilvai* was predominantly found in *C. pyramidalis* (92.3%, N = 39).

One tree of *C. pyramidalis* had seven nests of *Frieseomelitta varia dispar* and two nests of *Scaptotrigona aff. depilis* (Figure 2). This tree, accordingly to local residents, is at least a hundred years old and some of the nests have more than 40 years. Another tree species, *Schinopsis brasiliensis*, had 10 nests of *Frieseomelitta varia dispar*.

Bee species	Ms.	Ma.	Fd.	Fv.	Pf.	Psp.	Sd.	TOTAL	%
Tree species									
Commiphora leptophloeos	65	3		6			3	77	33.9
Caesalpinia pyramidalis	29	36	9	12	4	3	2	95	41.9
Piptadenia communis	11							11	4.8
Cnidoscolus phyllacanthus	9							9	4.0
Spondias tuberosa	3		1	1			1	6	2.6
Anadenanthera collubrina	2							2	0.9
Aspidosperma pyrifolium	2							2	0.9
Lycania rigida	1							1	0.4
Tabebuia caraiba			1				2	3	1.3
Mimosa acutistipula			1					1	0.4
Myracrodruon urundeuva				2				2	0.9
Schinopsis brasiliensis				10				10	4.4
Others	8							8	3.5
TOTAL	130	39	12	31	4	3	8	227	
%	57.3	17.2	5.3	13.7	1.8	1.3	3.5		

Table 1. Tree species used for nesting by stingless bees in the caatinga (NE, Brazil). Ms.= Melipona subnitida, *Ma.=* *Melipona asilvai*, *Fd.=* *Frieseomelitta doederleini*, *Fv.=* *Frieseomelitta varia*, *Pf.=* *Plebeia flavocincta*, Psp.= *Plebeia sp*. *e Sd=* *Scaptotrigona aff. depilis*.

Bee species	*M. subnitida*				*M. asilvai*				*F. doederleini*				*F. varia dispar*			
Tree species	**N**	**Range**	**X**	**SD**	**N**	**Range**	**X**	**SD**	**N**	**Range**	**X**	**SD**	**N**	**Range**	**X**	**SD**
Commiphora leptophloeos	65	9-47	17.4	5.15	3	12-33	21	10.9					6	10-25	13.8	5.64
Caesalpinia pyramidalis	29	9-33	15.8	4.74	36	12-40	22.9	6.30	9	9-17	13.7	2.87	12	10-40	28.4	13.06
Piptadenia communis	11	12-30	17.5	3.75												
Cnidoscolus phyllacanthus	9	14-34	18.4	4.51												
Spondias tuberosa	3	12-20	16.0	4.00					1	22	22.0	-	1	22	22.0	-
Anadenanthera collubrina	2	15-28	21.5	9.19												
Aspidosperma pyrifolium	2	32-39	35.5	4.95												
Lycania rigida	1	82	82.0	-												
Tabebuia caraiba									1	50	50.0	-				
Mimosa acutistipula									1	31	31.0	-				
Myracrodruon urundeuva													2	26	26.0	0.00
Schinopsis brasiliensis													10	20-40	29.0	8.75
Others	8	10-18	14.2	2.60												
TOTAL	130	9-82	17.7	7.79	39	12-40	22.7	6.60	12	9-50	18.8	11	31	10-40	25.4	11.22

Table2. continuation...

Bee species	*S. aff. depilis*				*Plebeia flavocincta*				*Plebeia* sp.			
Tree species	**N**	**Range**	**X**	**SD**	**N**	**Range**	**X**	**SD**	**N**	**Range**	**X**	**SD**
Tabebuia caraiba	2	40-50	45.0	7.10								
Caesalpinia pyramidalis	2	20	20.0	0.00	4	12-19	15.7	2.98	3	9-16	13.3	3.78
Commiphora leptophloeos	3	78-78	78.0	0.00								
Spondias tuberosa	1	28	28.0	-								
TOTAL	8	20-78	49.0	26.00	4	12-19	15.7	2.98	3	9-16	13.3	3.78

Table 2. Diameters (in cm) of trees and trunks used for nesting by stingless bees in the caatinga. N= sample size, X= media e SD= standard deviation.

Figure 1. Commiphora leptophloeos (Burseraceae) tree. People of North-eastern Brazil call C. leptophloeos "pau de abelha" (bee stalk).

Figure 2. Caesalpinia pyramidalis tree with seven nests of Frieseomelitta varia dispar *and two nests of Scaptotrigona aff. depilis.*

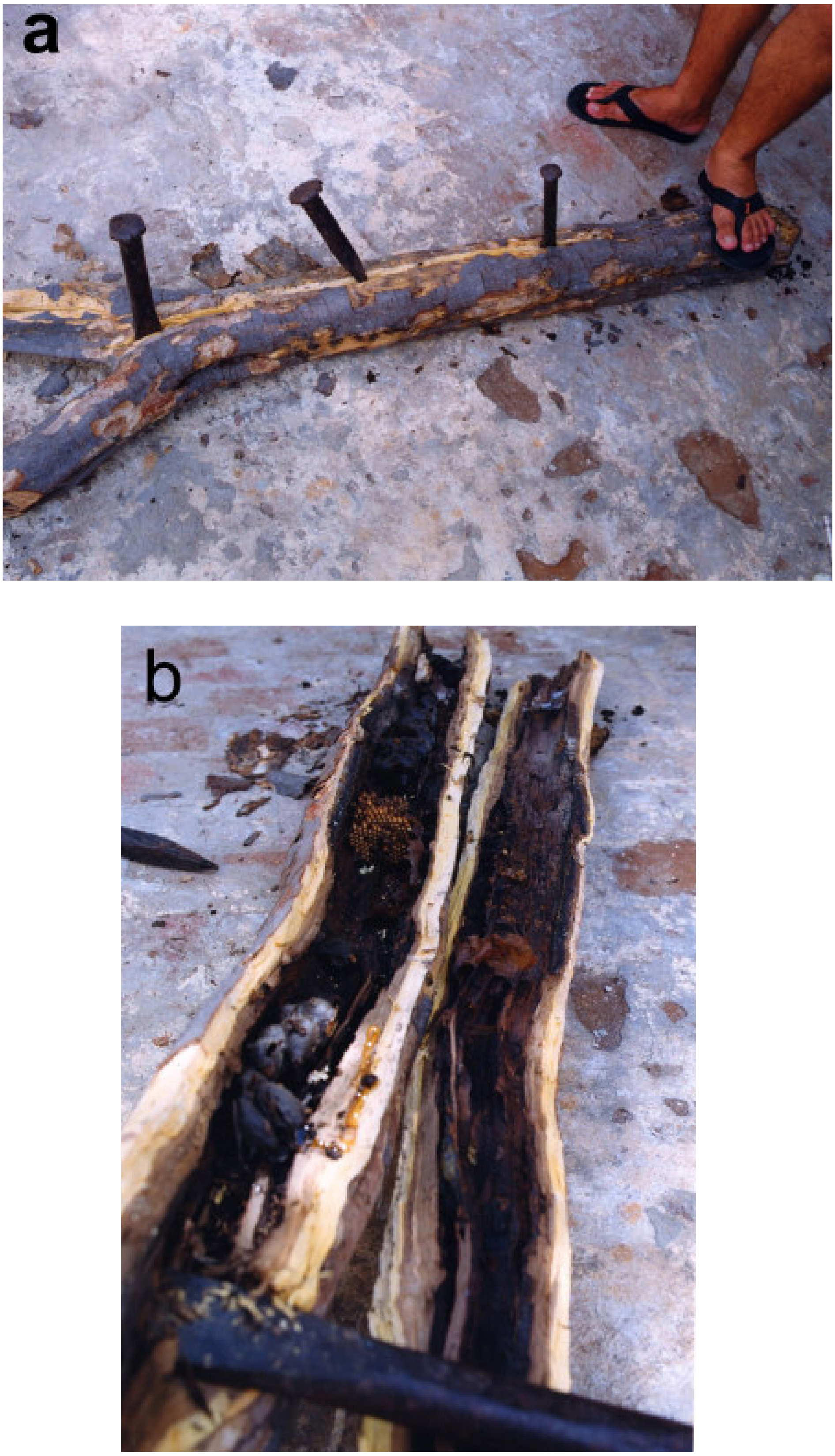

Figure 3. Opening a Caesalpinia pyramidalis trunk (a) with a nest of Melipona subnitida (b).

Tree diameters and nest volumes

The diameters of trees and trunks used by the bees reached from 9 up to 82 centimeters (mean = 20.7 cm, N = 227, Table 2). More than 80.0% of the nests were encountered in diameters above 13 centimeters, more than 56.0% were encountered in diameters above 16 centimeters. The larger diameters to be found were ranging from 39 up to 50 cm in diameter. One tree of *C. leptophloeos* had a diameter of 78 centimeters and contained three colonies of *Scaptotrigona aff. depilis*, and one tree of *Lycania rigida* had a diameter of 82 centimeters and contained a colony of *M. subnitida.*

The 130 nests of *M. subnitida* were found in trees having a mean diameter of 17.7 cm (SD = 7.79). The 65 nests of *M. subnitida* found in *Commiphora leptophloeos* had a mean diameter of 17.4 cm (SD = 5.15, range 9-47 cm) and 29 nests in *Caesalpinia pyramidalis* had a mean of 15.8 cm (SD = 4.74, range 9-33 cm). Trunk diameter and length were negatively correlated in a significant way ($R = -0.34$, $p < 0.01$, $N = 130$).

Internal diameter and length of six *M. subnitida* nests varied from 5 up to 13 cm (mean = 8 cm) and from 63 up to 150 cm (mean = 112 cm), respectively, representing volumes of 2.4 up to 8.6 liters (mean = 5.6 liters) (Figure 3 a, b).

Discussion

Tree species for nesting

In accordance with the findings of Hubbell & Johnson (1977) and Roubik (1989), many stingless bees are opportunists in their use of tree cavities for nesting. This study shows that stingless bees nests can be found in different tree species, however, more than 75.0% of nests were found in two tree species. In case of *M. subnitida*, half of the nests were found in *Commiphora leptophloeos.* Besides *C. pyramidalis* and *C. leptophloeos*, Bruening (1990) mentions the importance of *Schinopsis brasiliensis* for nesting of *M. subnitida* and other stingless bees. Castro (2001) observed 52 eusocial bees nests (nine species) in living trees in a caatinga in Bahia state. *Commiphora leptophloeos* (42.2%) and *Schinopsis brasiliensis* (29.7%) were the most important for nesting. It is interesting to note that in Puebla, Mexico, another species of Burseraceae (*Bursera simaruba*) is said to be preferred for nesting by the stingless bees *Scaptotrigona mexicana* (Javier Ortiz, unpublished data).

Antonini (2002) also observed that stingless bees used a relatively small number of tree species for nesting. In a Brazilian savanna area 77.0% of nests were constructed in living trees of *Caryocar brasiliense* and the author concludes that the data suggests an active nest site selection by *Melipona quadrifasciata.*

Because the natural distribution of bee nests among trees in caatinga and the availability of cavities is not known a possible preference of certain bees for tree species is difficult to point out. This availability of nesting sites depends on the occupation by, for example, africanized honeybees, that move from one place to other, according to environmental conditions.

Availability of tree cavities can also be limited by a too small amount of trees related to alterations in vegetation like deforestation. A phytosociological study of Ferreira & Vale (1992) showed that in a secondary growth caatinga at Seridó region, *C. pyramidalis* had the highest density and frequency whereas *C. leptophloeos*, the tree in which most of our *M. subnitida* nests were found, held the fourth position. Araujo et al (1995) observed similar results in three areas of caatinga at Pernambuco state. This may reflect disturbance by human interference. The presence of only a small number of very large trees in our study area may reflect such alterations as well. A shortage of nesting places may also explain why *Melipona asilvai* nests were frequently encountered within the intact remains of the root system of formerly cut *C. pyramidalis* trees.

Melipona asilvai was found predominantly in one species of tree, being *C. pyramidalis*. However, Castro (op. cit.) found *M. asilvai* exclusively in hollows of *Commiphora leptophloeos*. It can mean that at this area this tree species was the most abundant. Furthermore, if Ferreira & Vale (1992) data is also valid in our study area, which are very close from each other, that is *Caesalpinia pyramidalis* is the most frequent plant species and *Commiphora leptophloeos* occupies the fourth position, our results would suggest that *M. asilvai* nested in *C. pyramidalis* because it is more available while the 50.0% nests of *M. subnitida* in *C. leptophloeos* actually shows a preference of the later bee species for this tree species.

The major use of trunks (N = 198) gathered by beekeepers may have presented a bias in our search for a natural relationship between bee species and tree species. It is possible that the bee/tree gatherer had a specific search image when hunting in the field. In this respect, several of the caatinga tree species have a local economic value for construction and firewood (*Commiphora leptophloeos*, *Caesalpinia pyramidalis*, *Anadenanthera collubrina, Piptadenia communis, Aspidosperma pyrifolium* and *Lycania rigida*) and cattle food (*Caesalpinia pyramidalis*, *Cnidoscolus phyllacanthus*, *Spondias tuberosa* and *Anadenanthera collubrina*).

The sizes of the transferred *M. subnitida* nests not only are conforming to those presented by Roubik (1979, 1983) for other bee species. *M. subnitida* is a frequently used bee for the production of honey in the Northeast of Brazil (Nogueira-Neto 1997). In the region where this study was executed, the rational hive used for its keeping has a space of about 5.5 liters which is close to the mean of 5.6 liters found for wild nests. Another element in the keeping of this bee that reflects the natural dimension of their nests is that the hives have a characteristic elongated shape. This is in accordance with the fact that in many of the trunks having a small diameter, the bees had their nest extended resulting in the negative correlation between trunk diameter and length.

Prospects for future surveys on stingless bees nests in caatinga

The here presented information serves to a better understanding of native social bee nesting in caatinga. In order to formulate adequate recommendations about habitat management, also considering the slow growth of certain trees, the current data on bee nesting have to be compared with those from a similar but undisturbed caatinga ecosystem. However, at the moment, accordingly to available data, owing to the greater number of bee nests in *Commiphora leptophloeos* and *Caesalpinia pyramidalis*, together with the information that both are preferred by stingless bees for nesting (*C. leptophloeos* is indeed called "pau de abelha"or bee stalk), we suggest that management and reforestation programs in the caatinga consider the use of these species as they are important for bee nesting and also have an economic value.

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