

# THE USE OF TREES FOR NESTING BY STINGLESS BEES IN BRAZILIAN CAATINGA

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## 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 morphological 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 being a part of this mutualism makes them, 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.*, in press). However, little is known about their preference for trees to nest in, let alone 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 & Arce 1999).

In this paper we report about the use of tree species for several species of stingless bees, which can be found in Caatinga (a Tupi-Guarani name for "white wood"). The studied area has 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 encountered in tree trunks 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. By this means, restoration programs of Caatinga biodiversity can be improved.

## Methods

A study on tree nesting bees was performed in the Seridó region, near the municipalities of São José do Sabugi (06°48'S; 36°47'W), Paraíba state, and Jardim do Seridó (06°35'S; 36°46'W) and João Câmara (05°32'S; 35°49'W), Rio Grande do Norte state, Brazil. Facts about nests were obtained directly from trees in the field or from trunks with living nests, which had been gathered by local Meliponine beekeepers. First, the species of bees and the species of tree in which it nested were determined. Next, the external perimeter 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 height 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 e Herbário Lauro Pires Xavier, of Federal University of Paraíba (UFPB).

## Results

### **Trees and bee nests**

For obtaining information about the bee nests, 198 trunks and 29 trees in the field were examined. Out of 227 bee nests encountered, seven species of stingless bees were observed of which *Melipona subnitida*, *M. asilvae* 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 aff. doederleini* (5.3%), *Plebeia flavocincta* (1.8%), *Plebeia sp.* (1.3%), *Scaptotrigona aff. depilis* (3.5%).

The seven stingless bees (most of them endemic) were found in 12 species of trees (Table 1). Of these, two species had more than 75% of stingless bees nests, being *Caesalpinia pyramidalis* (local name "Catingueira", Caesalpinaceae, 41.9%) and *Commiphora leptophoeos* ("Imburana", Burseraceae, 33.9 %) the most important.

In *C. pyramidalis* all seven-bee species (*Melipona subnitida*, *Melipona asilvae*, *Frieseomelitta varia dispar*, *Frieseomelitta aff. duoderleini*, *Plebeia flavocincta*, *Plebeia sp* and *Frieseomelitta aff. depilis*) were encountered. A great part of the nests in trunks were of *Melipona subnitida*, (n = 130) of which 50.0 % was found in *C. leptophoeos* and 22.3% in *C. pyramidalis*. *Melipona asilvae* was predominantly found in *C. pyramidalis* (92.3 %, n = 39).

### **Tree diameters and nest volumes**

The diameters of trees and trunks used by the bees reached from 9 up to 82 centimetres (mean = 20.7 cm, n = 227, Table 2). More than 80.0% of the nests were encountered in diameters above 13 centimetres, more than 56.0% were encountered in diameters above 16 centimetres. The larger diameters to be found were ranging from 39 up to 50 cm in diameter. One tree of *C. leptophoeos* had a diameter of 78 centimetres and contained three colonies of *Scaptotrigona aff. depilis*, and one tree of *Lycania rigida* had a diameter of 82 centimetres 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 leptophoeos* 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 height 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 litres (mean = 5.6 litres).

## 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 encountered in many different tree species, which in case of *M. subnitida* was eight species. Next to these species, Bruening (1990) mentions the importance of *Schinopsis brasiliensis* for nesting of *M. subnitida* as well for other stingless bees. Castro (2001) studied nest site preferences for eusocial bees in a Caatinga region in Bahia (12°53'S; 39°51'W). She observed 9 bee species (the larger being *Apis mellifera*, *Melipona quadrifasciata anthidioides* and *Melipona asilvae*) that used *Schinopsis brasiliensis* (29,7%), *Commiphora leptophoeos* (42,2%), *Myracrodum urundeuva* (7,8%) and *Caesalpinia pyramidalis* (7,8%) for nesting (52 bee nests in living trees). In this area, *Melipona subnitida* does not occur.

From our data, the natural distribution of bee nests amongst trees in Caatinga and a possible preference of certain bees for trees are impossible to point out. Firstly, it is unknown what the availability of nesting opportunities was in the area having the trees and the trunks from which the measurements were taken. This availability of nesting sites depends on the occupation by, for example, honeybees, that move from one place to other, according to environmental conditions. Castro (op. cit) found *Apis mellifera* nests hanging from *Schinopsis brasiliensis* branches, in tree trunks (*Caesalpinia ferrea*, *Caesalpinia pyramidalis*, *Commiphora leptophoeos*, *Spondias tuberosa*) and in an arboreal termite nest.

Availability of tree cavities can also be limited by a too small amount of trees related to alterations in vegetation like deforestation or natural disasters. Findings of Ferreira & Vale (1992) show that in their study site at Seridó, *C. pyramidalis* and *Aspidosperma pyrifolium* occurred most frequently whereas *C. leptophoeos*, the tree in which most of our *M. subnitida* nests were encountered, held the fourth position in density. This indicates that areas having a similar kind of vegetation can differ significantly in floral composition, which may reflect disturbance by human interference. The presence of only a small number of

very large trees in our study may reflect such alterations as well. A shortage of nesting places may also explain why *Melipona asilvae* nests were frequently encountered within the intact remains of the system of formerly cut trees.

The major use of trunks (n = 198) may have presented another 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 leptophoeos*, *Caesalpinia pyramidalis*, *Anadenanthera collubrina*, *Piptadenia communis*, *Aspidosperma pyriformis* and *Lycania rigida*) and cattle food (*Caesalpinia pyramidalis*, *Cnidocolus phyllacanthus*, *Spondias tuberosa* and *Anadenanthera collubrina*) (Castro, 2001).

In contrast to *M. subnitida*, *M. asilvae* was encountered predominantly in one species of tree, being *C. pyramidalis*. Castro (op. cit.) found *Melipona asilvae* exclusively in hollows of *Commiphora leptophoeos*. It can mean that where *M. asilvae* occurred these trees were the most abundant or that it had a preference for these kinds of trees. The latter explanation can give support to a notion of Roubik (1989) who states that some Meliponinae which have colonies with prolonged longevity and low swarming frequency will be selected to choose trees which give good protection to predators and parasites for a large number of years.

Most bees preferred living trees to nest in which probably illustrates how they, in general, prevent living in a locality being devastated by termites rapidly. Along with the use of many different tree species, the bees also used a large range in tree diameters. The fact that some stingless bees can minimize the cavity they are nesting in by constructing batumen plates, layers of hardened material of wax, resin and mud (Roubik, 1983) can explain the frequent use of relatively large tree holes. The minimum diameter for bees, including the relatively large bee *M. subnitida*, to nest in was found to be around 9 centimetres. In many of the trunks having such a small diameter, the bees had their nest extended. For ten tree species containing bee nests Castro (2001) found diameters ranging from 9,8 cm up to 53 cm.

The sizes of the transferred *M. subnitida* nests not only are conforming to those presented by Roubik (1979, 1983). *M. subnitida* is a frequently used bee for the production of honey in the Northeast of Brazil (Nogueira-Neto, 1998). In the region where this study was executed, the rational hive used for its keeping has a space of about 5.5 litres which is close to the mean of 5.6 litres 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.

## **Prospects for future surveys on stingless bees 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. Only then it can be found out why the people of North-eastern Brazil call *Commiphora leptophoeos* "pau de abelha" (bee stalk); is it because this tree is the most abundant, is it because people prefer the tree for woodcutting and so encounter bee nests frequently, or is it because bees prefer this tree over other trees for nesting?

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Table 1.

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

Bee species	Ms.	Ma.	Fd.	Fv.	Pf.	Psp.	Sd.	TOTAL	%
<b>Tree species</b>									
<i>Commiphora leptophloeos</i>	65	3		6			3	77	33,9
<i>Caesalpinia pyramidalis</i>	29	36	9	12	4	3	2	95	41,9
<i>Piptadenia communis</i>	11							11	4,8
<i>Cnidoscolus phyllacanthus</i>	9							9	4,0
<i>Spondias tuberosa</i>	3		1	1			1	6	2,6
<i>Anadenanthera collubrina</i>	2							2	0,9
<i>Aspidosperma pyriformium</i>	2							2	0,9
<i>Lycania rigida</i>	1							1	0,4
<i>Tabebuia caraiba</i>			1				2	3	1,3
<i>Mimosa acutistipula</i>			1					1	0,4
<i>Astronium urundeuva</i>				2				2	0,9
<i>Schinopsis glabra</i>				10				10	4,4
Other	8							8	3,5
<b>TOTAL</b>	130	39	12	31	4	3	8	227	
<b>%</b>	57.3	17.2	5.3	13.7	1.8	1.3	3.5		

**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= standart desviation.**

Bee species	<i>M. subnitida</i>				<i>M. asilvae</i>				<i>F. aff. doederleini</i>				<i>F. varia dispar</i>			
	N	Range	X	SD	N	Range	X	SD	N	Range	X	SD	N	Range	X	SD
<i>Commiphora leptophloeos</i>	65	9-47	17.4	5.15	3	12-33	21	10.90					6	10-25	13.8	5.64
<i>Caesalpinia pyramidalis</i>	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
<i>Piptadenia communis</i>	11	12-30	17.5	3.75												
<i>Cnidocolus phyllacanthus</i>	9	14-34	18.4	4.51												
<i>Spondias tuberosa</i>	3	12-20	16.0	4.00					1	22	22.0	-	1	22	22.0	-
<i>Anadenanthera collubrina</i>	2	15-28	21.5	9.19												
<i>Aspidosperma pyriforme</i>	2	32-39	35.5	4.95												
<i>Lycania rigida</i>	1	82	82.0	-												
<i>Tabebuia caraiba</i>									1	50	50.0	-				
<i>Mimosa acutistipula</i>									1	31	31.0	-				
<i>Astronium urundeuva</i>													2	26	26.0	0.00
<i>Schinopsis glabra</i>													10	20-40	29.0	8.75
Outros	8	10-18	14.2	2.60												
<b>TOTAL</b>	<b>130</b>	<b>9-82</b>	<b>17.7</b>	<b>7.79</b>	<b>39</b>	<b>12-40</b>	<b>22.7</b>	<b>6.60</b>	<b>12</b>	<b>9-50</b>	<b>18.8</b>	<b>11</b>	<b>31</b>	<b>10-40</b>	<b>25.4</b>	<b>11.22</b>

Table 2. continuation.

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

# THE USE OF TREES FOR NESTING BY STINGLESS BEES IN BRAZILIAN CAATINGA

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