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Subterranean Nest Architecture and Colony Characteristics of *Meliponula* (*Meliplebeia) becarii* (Hymenoptera, Apidae, Meliponini) in Cameroon

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Abstract: Five nests of *Meliponula* (*Meliplebeia) becarii* were located and excavated in Bui Division of Cameroon to study their detail architecture. This paper describes the general nest structure of this species in terms of number, size, shape and area of combs, brood cells, pollen and honey pots. They construct their nests in secondary forests, eucalyptus plantations and open farm lands where numerous lateral roots are used as anchor for the nests. *Meliponula* (*Meliplebeia) becarii* is a subterranean stingless bee species made up of a brood area, involucrum layers and storage pots area. The combs are horizontal and the mode of comb building is concentric while cell construction is synchronous. The nests are connected to the exterior by a short outer entrance of 5-6cm above the soil with less than 0.1cm thick wall. A drainage tube of excess moisture measured 16.5cm long and 7-12m diameter was observed below the nests cavity. All the nests of *Meliponula* (*Meliplebeia) becarii* were found in subterranean cavities, built in the soils and exhibits architectural characters which are typical to all other genera of obligatory ground nesting bees in Africa like Plebeiella and Plebeina.

Keywords: Stingless bees, Meliponini, *Meliplebeia becarrii*, subterranean, architecture, Cameroon

INTRODUCTION

Stingless bees (Meliponini) are a group of small- to medium-sized bees with vestigial (nonfunctional) stings. They are found in tropical and subtropical regions of the world[1].They store honey and pollen and occur in perennial colonies. Stingless have attained the most advanced level of social organization which can only be comparable to that of honeybees[2].

Meliponini bees build their nests in several substrates such as subterranean cavities, tree trunks, branches of living trees, rock cavities, brick walls, abandoned termite nests, arboreal ants nests, subterranean chambers of abandoned by ants, active bird nests or empty nests attached to branches[3-8].

There are several hundred of species existing worldwide, which differ significantly in colour, body and colony size [9, 10]. In Africa stingless are distributed throughout the tropical and subtropical parts where they occur sympatrically with the honeybees[11]. They are often stated as generalist flower visitors (visits many different flowers) and important pollinators of crops though with little or no review on this assertion.

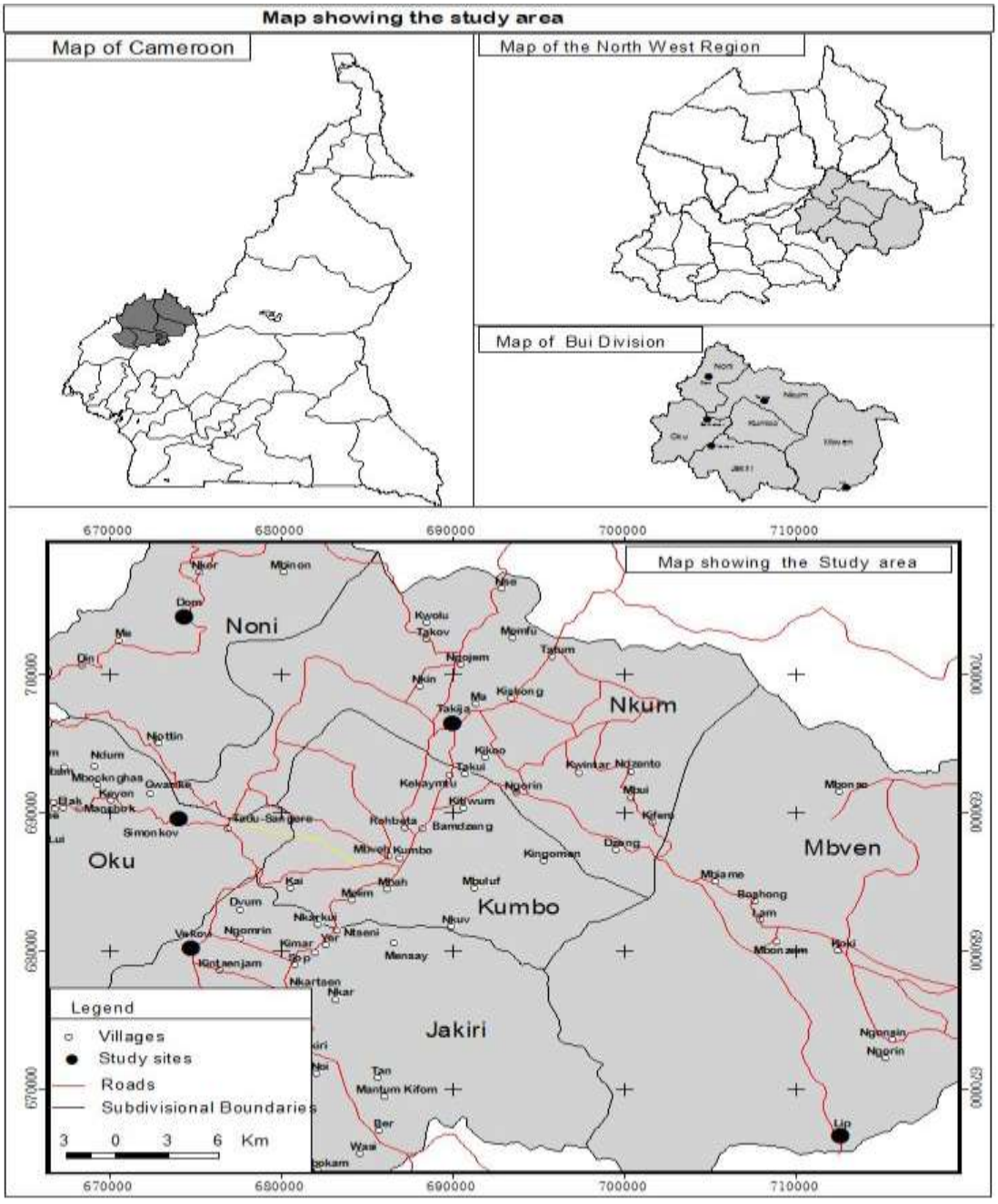
The materials used for nest building are mainly pure wax or cerumen (a mixture of wax and propolis), resins, plant fibres and clay[12]. Carmago[4] considers the nesting sites as the main factor for population growth in stingless bees. Due to recent scarcity in the number of the stingless bees' colonies, fewer people are interested in meliponiculture nowadays compared to years ago. In terms of restoration and preservation of the native flora, pollination is an important phenomenon that must be assessed. Kerr *et al.*[7] indicated that the maintenance in artificial nests and their reproduction and division of colonies are important in conservation.

The nesting biology of *Meliponula* (*Meliplebeia) becarii* was briefly described by Gribodo[13]and Vachal[14] in Latin America. This present study seeks to describe the detail nest architecture of *Meliponula* (*Meliplebeia) becarii* for better management of colonies and species conservation in Cameroon.

MATERIALS AND METHODS

This study was carried out in three different villages; Takija, Simonkov andVekowi, Bui Division, North West Region of Cameroon. Prior to this study a preliminary survey of bees in the region was carried out in 2007, during which time stingless bees where collected and identified. A sample collection was used as a guide to facilitate understanding and identification of *Meliponula* (*Meliplebeia) becarii* in the community. The sample collection was presented to local farmers, hunters and beekeepers that assisted in locating nesting sites and colonies of *Meliponula* (*Meliplebeia) becarii* colonies.

Five nests were found and excavated for measurements and detail studies. The description of the nests is done according to Willie and Michener[15]. The immediate surroundings of the nests were cleaned and the diameter of the nest entrance measured. The lateral part of the nest was excavated to measure the external part of the cavity and its depth measured using a measuring tape. The pollen and the honey pots were counted and the height and diameter measured with a caliper. We measured the volume of the honey pots using a graduated syringe.


Map showing the study area
Map of Cameroon
Map of the North West Region
Map of Bui Division
Map showing the Study area
Noni
Nkum
Oku
Kumbo
Mbven
Jakiri
Legend
Villages
Study sites
Roads
Subdivisional Boundaries
3 0 3 6 Km
670000
680000
690000
700000
710000

RESULTS

Nesting site: From the field studies, a total of twenty five (25) nests/colonies of *M. becarrii* were found in three villages: Takija, Simonkov and Vekowi, Bui Division, North West Region of Cameroon. Nine (36%) of the nests were located in Eucalyptus plantation, seven (28%) in farmlands and nine (36%) in secondary forests.

Figure 1: Nesting site of *Meliponula (Meliplebeia) becarii* in a tomato farm

Figure 2: Nesting site of *Meliponula* (*Meliplebeia) becarii* in Eucalyptus plantation

NEST ARCHITECTURE

Nest cavity: The nests of *Meliponula* (*Meliplebeia) becarii* are constructed in open farm areas or in secondary forests with very scanty undergrowth with less dense canopy trees which allows ample light to reach the forest floor. These bees prefer soils with moderate size roots which can use as anchor for their nests. Four (1 6%) of the colonies were found in existing cavities of other social insects like ants or termites to build their nests.

The ceiling and the inner walls of the soil are hardened and smoothed by the bees so that the nest cavity can easily be separated from the surrounding soil. The entire nests fitted to the shape and size of the cavity, supported by protruding secondary roots passing through the nest, and the batumen lamellae and the pillars spanning the gap between the batumen layer and the cavity wall. The nest cavities are 14-16cm high and 12-13cm in diameter.

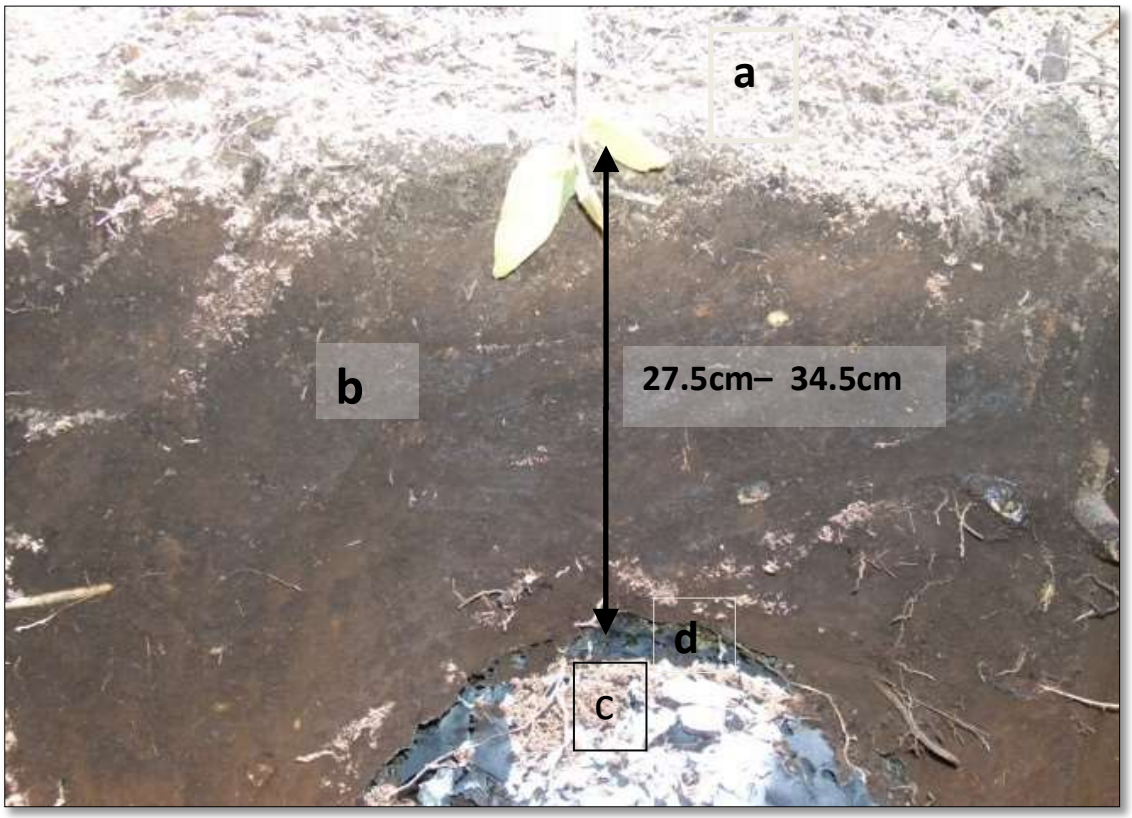


Figure 3: Excavation of subterranean nest of *M. becarrii* revealing the depth of the nest underground: **a** =top soil layer, **b** = underground soil layer - B-horizon, **c** = nest cavity, .**d**=ceiling

Nest Entrance: This subterranean species provides just a single entrance into their nest cavity. The nest entranceis usually hidden under dry leaves and grasses (**Fig. 4**). The external entrance tubes measured 5-6 mm high and a 1mm thick walls that project upward directly above the underground nest. The external tube diameter was more or less the same in size to the diameter of the tunnel leading to the nest.

Figure 4: Nest entrance (external tube; arrow pointing to wall of external tube)

Figure 5: Nest entrance with guard bees

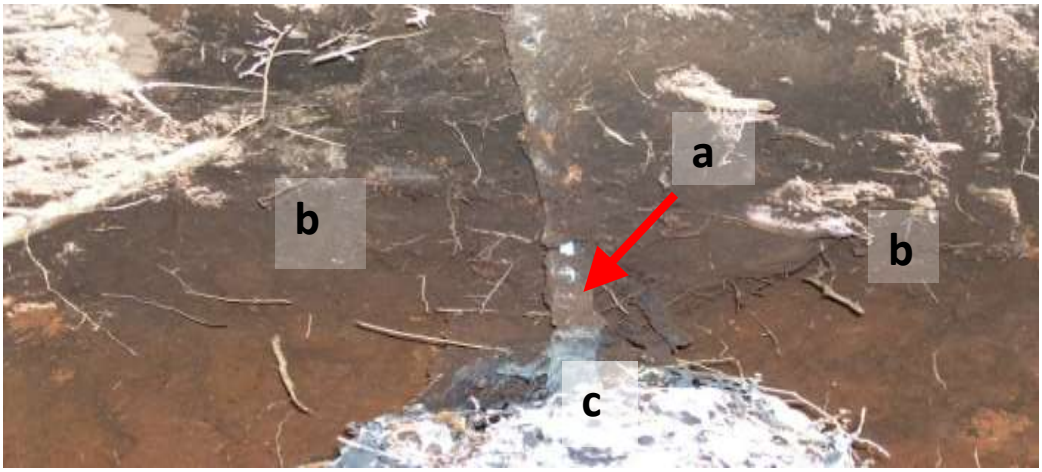


Figure 6: a = external nest entrance tube, **b** = soil horizon, **c** = nest cavity

Batumen Layer and Involucrum Sheets: The nest of *M. becarii* is enclosed by a black and brittle 2-3 layers batumen. The batumen or external involucrum is about 1mm thick from which short pillars protrudes to the unlined walls of the cavity. The nest cavities are 14-16cm high and 12-13cm in diameter. The shape of the nests could be oval or roughly rounded and flattened at the bottom.

At the lower part of nest, the batumen layer is partly opened by horizontal slits so that the basal layers of the involucrum and the storage pots are in direct contact with the substrate. The involucrum is attached to the batumen by tiny pillars. The brood chamber is surrounded by 6-8 layers of involucrum each measuring less than 0.5cm thick. The involucrum is made up of very sticky substances containing propolis, resin and sometimes plant materials. The involucrum sheets are brown and shiny and arranged in alternating layers that allows bees to move in between the layers and to the brood area.

Figure 7: Exposed nest showing outer and inner sheets of batumen (arrows)

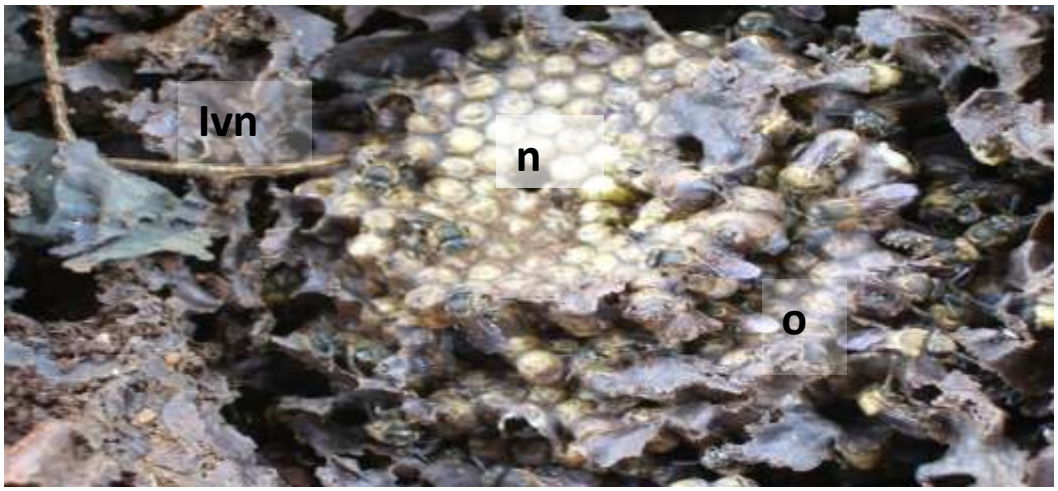


Figure 8: Involucrum and combs: **Inv**=involucrum,**n**=new comb cells, **o**=older cells

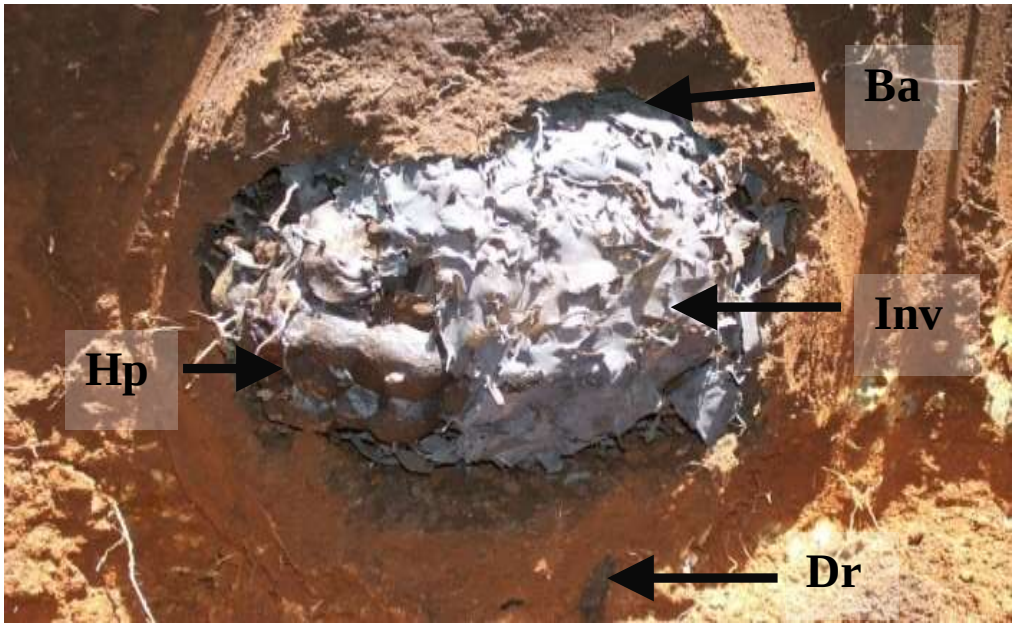


Figure 9: Nest showing most of the external features as seen underneath the soil surface
Ba= Batumen, **Inv** = Involucrum, **Hp** =honey pot, **Dr** = Drainage tube

Figure 10: Structure revealing pillars attaching honey pots to ceiling (arrow)

Brood area: The brood area is surrounded with sticky soft 6-8 sheets or layers of involucrum. The brood combs are horizontally arranged though they may appear concave at some points. The mode of construction of combs is concentric, that is, each comb is constructed from the centre outward towards the peripheries of the comb. Combs are firmly connected to one another or with involucrum by means of tiny pillars of about 2mm length. The area with old cerumen is immediately below the old brood comb and of the same diameter. Brood cells are cover with wax. The older cells and combs are found below while the newly constructed cells are above as shown in fig. 10.

Figure 11: Horizontal combs with each layer separated by pillars

Figure 12: Gyne cell at the edge of comb

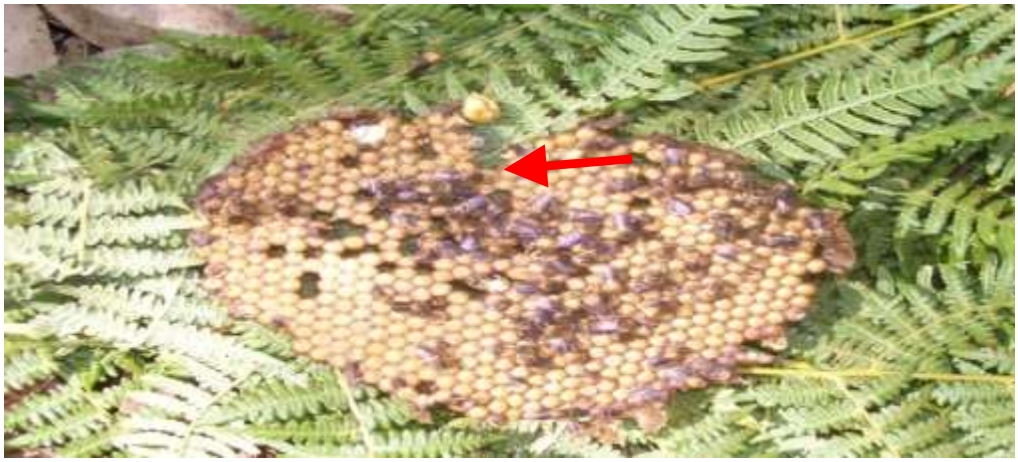


Figure 13: Heart shaped comb with gyne cell

Storage pots: The pollen and honey pots cover the lateral part of the brood area. Each pot is on an average of 3-4cm high and 2.5 to 3.2 cm in diameter. Pollen pots are placed closer to the brood area than the honey pots. The pollen and honey pots are found to be arranged in clusters and are equal in shape and size. The pots are found on the lower sides of the comb area not at the bottom.

Figure 14: Honey and pollen pots

Drainage tube: The drainage tube is 16.5cm long and has a diameter of between 7- 12 mm in diameter. The drainage is very irregular in width. Some areas appeared narrower while others appeared broader. Tube also diverged into two in some areas.

Figure 15: Walls of drainage tube lined with layer of propolis

Figure 16: Drainage tube and nest cavity in soil

Behavior of *Meliponula* (*Meliplebeia) becarii:* *M. becarii* do not manifest any aggressive reactions when nest is disturbed. The nest entrance is mostly guarded by 3-5 bees which are positioned slightly underneath the opening and retreats whenever a foraging bee is leaving or entering the nest. When the nests were excavated and opened, some of the bees left and flew around the nest and its closed vicinity but did not exhibit any form of aggressive reactions. The bees exhibited a kind of absconding characteristics when forced to live in artificial nest. A few weeks after introduction into an artificial nest, all bees disappeared together with the queen. The gyne cells are almost 3-4 times the normal cells.

Table 1: Summary of measurements of *Meliponula (Meliplebeia) becarii*

	Parameters measured	Number sampled	Range (cm)	Average (cm)	Shape	Colour
Nest entrance	Height of external entrance	5	0.5 - 0.6	0.52	Circular	Dark brown (propolis +soil particles)
	Thickness of wall and resin lining	5	1.5 - 2	1.7		
	Diameter of nest entrance	5	1 – 1.4	1.2		
	Length of internal entrance tubesubteranean	5	27.5 – 34.5	30.3		
Nest cavity	Height	5	14 - 16	15		

	Diameter at brood area	5	12 - 13	12.3		
Batumen lining	Number	5	2 - 3	2.2		Brittle black
	Thickness	5	0.1	0.1		
Combs	Number of layers	5	6 - 8	7	Oval, round or heart	
	Diameter	5	5.5-12.0	11		
	Pillars	40	0.1-0.2	0.12		
Involucrum	Sheets of involucrum	5	8-12	10		Sticky light brown
	Thickness of involucrum	2	0.1	0.1		
Brood cells	Height	5	0.3 – 0.4	0.32	Spherical, oval	Dark yellow
	Diameter	60	0.2 – 0.3	0.21		
	Wall thickness	60	0.1	0.1		
Storage pots	Height of honey pots	50	3 –4	3.5		
	Diameter of honey pots	50	2.5 – 3.2	2.7		Shiny brown
	Height of pollen pots	50	3 –4	3.3		
	Thickness of wall	50	0.1	0.1		
	Diameter of pollen pot	50	2.5 – 3.2	2.7		
Drainage tube	Length	5	16–16.7	16.5		
	Diameter	5	7 – 7.2	7.4		

CONCLUSION

The nest of *Meliponula* (*Meliplebeia) becarii* is similar to that of other ground nesting species. They build their nests in a variety of habitats including areas where intense agricultural activities are being practice. This coupled with poor harvesting techniques has often resulted in colony lost and decline of bees. This study will go a long way to create awareness in concerned communities and help conserve bees.

REFERENCES

1. C.D. Michener, The bees of the world. 2. ed. Jonhs Hopkins University Press, Baltimore, 2007.
2. S.F.Sakagami, Stingless Bees. In: Social Insects. Vol. 3. Edited by H.R. Herman (ed) Academic Press, New York, USA: 262-372, 1982.
3. H.F. Schwarz, Stingless bees (Meliponidae) of the western hemisphere. Lestrimellita and the following subgenera of Trigona: Trigona, Paratrigona, Schwarziana, Parapartamona, Cephalotrigona, Oxitrigona, Scaura and Mourella. Bull. Am. Mus. Nat. Hist., 1948, 90:1-546.
4. J. M. F. Camargo, Ninhos e biologia de algumasespécies de Meliponídeos (Hymenoptera: Apidae) da região de Pôrto Velho, Território de Rondônia, Brasil. Revista de Biologia Tropical, 1970, 16: 207–239.
5. A.Wille, Biology of the stingless bees. Ann. Rev. Entomol. 28:41-64. http://dx.doi.org/10. 1146/ annurev.en.,1983,28.010183.000353
6. L.A.O. Campos, Abelhasindígenassemferrão: o quesão? Info. Agrop., 1987, 13(147).
7. W.E. Kerr, G.A. Carvalho& V.A. Nascimento, Abelhauruçu: biologia, manejoeconservação. FundaçãoAcangaú, Belo Horizonte, 1996.
8. D.W. Roubik, Stingless bee nesting biology. Apidologie, 2006, 37:124-143. http:// dx.doi. org/ 10.1051/apido:2006026
9. DW.Roubik, Order and chaos in tropical bee communities.In: Anais do II EncontroSobreabelhas, 1996, 122-132. RibeirãoPreto, SP, Brazil.
10. C.D.Michener, *The bees of the world*. Johns Hopkins univ. Press, Baltimore, Maryland, 2000.
11. R.Kajobe, Botanical sources and sugar concentration of the nectar collected by two stingless bee species in a tropical African rain forest. *Apidologie, 2006b, 38:1*–12.
12. C.Rasmussen, & J.M. Camargo, A molecular phylogeny and the evolution of nest architeture and behavior in Trigonas.s. (Hymenoptera: Apidae: Meliponini). Apidologie, 2008, 39:102-118. http://dx.doi.org/10.1051/ apido:2007051
13. G.Gribodo, Note imenotterologiche. Annalidel Museo Civico di Storia Naturale di Genova1879, 14: 325-432.

14. J .Vachal, Hyménoptères du Congo Francais Rapportésparl'ingénieur J. Bouyssou. Mellifera. Annales de la Société entomologique de France, 1903, 72, 358–400.

15. A.Wille, & C.D. Michener, The nest architeture of stingless bees with special reference to those of Costa Rica (Hymenoptera: Apidae). Rev. Biol. Trop., 1973, 21:1-278.

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