



## SHORT NOTE

## Opportunistic Occupation of Nests of *Microcerotermes* spp. Silvestri (Termitidae: Termitinae) by *Partamona seridoensis* Camargo & Pedro (Apidae: Meliponini) in the Brazilian Tropical Dry Forest

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### Abstract

Social bees make use of natural or animal-built structures to protect their colonies from environmental stressors. Here, particularly attractive shelters are active termite nests because they provide a stable climatic environment forinquilines. Several social bee species form obligatory associations with termites, among these the stingless bee *Partamona seridoensis* (Apidae: Meliponini), whose distribution is limited to the Tropical Dry Forest in the Brazilian Northeast. So far, colonies of this meliponine species have been found mainly in arboreal nests of the termite *Constrictotermes cyphergaster*, which suggests a tight relationship between these two social insect species. The present study was conducted in an area of the Tropical Dry Forest in the Brazilian State of Rio Grande do Norte, where *P. seridoensis* naturally occurs albeit the absence of *C. cyphergaster*. We registered 14 colonies of *P. seridoensis*, all occupying active arboreal nests of termites of the genus *Microcerotermes*. The only other termites with arboreal nests present in the study area, *Nasutitermes corniger*, never housed *P. seridoensis*. This selective preference of the bees for *Microcerotermes* nests might be due to differences between termites concerning defense mechanisms or concerning thermal stability within the nests. Our study indicates that the occurrence of *P. seridoensis* is not restricted to the presence of *C. cyphergaster* in the Brazilian Tropical Dry Forest, and suggests that the bees opportunistically use the best nesting substrates available in the environment.

Social bees have evolved a diversity of strategies to protect their colonies from environmental stressors, mainly climatic adversities and predators. Whereas the majority of bee species makes use of natural structures, such as cavities in trees or in the ground, some occupy animal-constructed shelters, often still inhabited by the builders (Wilson, 1971; Roubik, 2006). Among these, particularly inviting for many kinds of inquilines are active termite nests due to the stable climatic conditions of the intranidal environment (Greaves, 1964; Redford, 1984; Korb & Linsenmair, 2000; Dechmann et al., 2004). The reduced thermal variations inside of termite nests is probably the main attractive for colonies of stingless bees (Apidae, Meliponini), a group of highly eusocial bees comprising more than 500 species distributed in the tropical and southern subtropical regions around the globe (Michener, 2013). Due to a limited capacity to actively regulate the nest temperature,

these bees depend on nesting substrates that provide a stable microclimate to guarantee successful brood development and colony survival (Roubik, 2006; Jones & Oldroyd, 2007).

Several meliponine species obligatorily use termite nests as nesting substrate, among these *Partamona seridoensis* Camargo & Pedro 2003 (Camargo & Pedro, 2003; Roubik, 2006), whose occurrence is restricted to the Brazilian Tropical Dry Forest, the Caatinga, in northeastern Brazil (Camargo & Pedro, 2013). The climate of this biome is characterized through rare and irregular rainfall, high solar radiation, and elevated ambient temperatures throughout the year, with averages varying from 26 to 34 °C (Andrade-Lima, 1981). These abiotic conditions are among the principal causes for the reduced occurrence of social bees in the Caatinga as compared to the adjacent ecoregions, the Atlantic Rainforest, the Tropical Savanna (Cerrado), and the Amazon Rainforest



(Zanella, 2000). Nesting inside of termite nests, which provide a stable microclimate, might be a selective advantage for meliponine species facilitating colony survival in the Brazilian Tropical Dry Forest (Carvalho et al., 2014).

To this day, colonies of *P. seridoensis* have been found mainly in arboreal nests of *Constrictotermes cyphergaster* Silvestri 1901 (Termitidae, Nasutitermitinae) (Lorenzon et al., 1999; Barreto & Castro, 2007; Fernandes, 2011; Miranda et al., 2015), despite the abundant occurrence of two other termite genera with the same nesting habit, *Nasutitermes* Dudley 1890 (Termitidae, Nasutitermitinae) and *Microcerotermes* Silvestri 1901 (Termitidae, Termitinae), in the Caatinga (Martius, 1999; Vasconcellos et al., 2010; Viana Junior et al., 2014). This fact suggests a tight relationship between *P. seridoensis* and *C. cyphergaster*. However, what happens if *C. cyphergaster* does not occur at a certain location, either owing to the lack of adequate feeding- and nesting substrates (Leite et al., 2011; Bezerra-Gusmão et al., 2013), or due to its extermination in man-modified environments? Do the associated bees also not occur at these locations? Or do they opportunistically switch to other host species?

The present study was performed to answer this question. Surveys were conducted between February and November of 2015 at the Experimental Field-Station Rafael Fernandes of the Brazilian Federal University at Mossoró (UFERSA), Rio Grande do Norte, Brazil (5° 03' S, 37° 24' W). The field-station comprises a total area of 416 ha, divided into a central area for experimental agriculture surrounded by a belt of native Caatinga vegetation, partly in regeneration after destruction by fire in the 1980ies. In the course of a bee survey at the field-station, various specimens of *P. seridoensis* had been collected at flowers (Airton Torres Carvalho, personal communication, April of 2012), indicating the presence of colonies of this meliponine species in the vicinity.

We located colonies of *P. seridoensis* through active search in the areas with native Caatinga vegetation (total sampling effort: 60 hours). The termite nests housing meliponine colonies were identified to the species-level based on species-specific external morphological characteristics of the nests (Constantino, 1999). In total, we found 14 colonies of *P. seridoensis*, all nesting in active arboreal nests of termites of the genus *Microcerotermes*, 13 associated with *Microcerotermes indistinctus* Mathews 1977 and one with *Microcerotermes strunckii* Sörensen 1884.

To evaluate whether this observed association between *P. seridoensis* and *Microcerotermes* spp. was related to the dominance of this termite genus in the study area, we estimated the abundance of arboreal nests of all termite species present in the area. For this, we chose randomly five transects of 200 m each within the area covered by native Caatinga vegetation. All arboreal termite nests within 10 m to the left and right of the transect (total sampling area = 20,000 m<sup>2</sup>) were identified to the species level according to Constantino (1999). In total, we located 34 nests of *M. indistinctus* and 5 nests of *Nasutitermes*

*corniger* Motschulski 1855. The estimated abundance of *M. indistinctus* nests in the study area (17 nests/ha) was almost seven times that of *N. corniger* nests (2.5 nests/ha), pointing to a strong dominance of *Microcerotermes* at the university's field-station. We found no nests of *C. cyphergaster* within the sampling area.

Our study is the first report of an association between *P. seridoensis* and termites of the genus *Microcerotermes*, therewith demonstrating that the occurrence of this meliponine species is not at all restricted to the local availability of *C. cyphergaster*. Apparently, the bees occupy nests of other termite species, selecting opportunistically the best nesting substrates available in the respective environment.

Despite the presence of *N. corniger* in the study area, the absence of *P. seridoensis* nests associated with this termite species suggests that some feature other than availability of arboreal termite nests affects the choice of the nesting substrate by the bees. Here, differences between termites concerning their defense mechanisms might impose different levels of difficulty for nest invaders. The defense secretions of *Nasutitermes* soldiers together with the pheromone-mediated coordination of aggressive attacks compose a much more efficient defense strategy than that of *Microcerotermes*, which relies mainly on biting and piercing the opponents with the mandibles (Prestwich, 1979; Prestwich, 1984; Leponce et al., 1999; Quinet et al., 2005). Second, it might be more difficult for invaders to isolate themselves successfully from the termites in *Nasutitermes* nests, given that the openings between chambers are much wider than in nests of *Microcerotermes* (Deligne & Pasteels, 1982). These facts taken together suggest that invasions by *P. seridoensis* may be easier in *Microcerotermes* nests than in *Nasutitermes* nests.

Additionally to differences in nest defense, differences between *Microcerotermes* and *Nasutitermes* concerning the physical nest characteristics might influence the choice by *P. seridoensis*. Owing to the bees' need for nesting substrates that minimize the thermal stress of the outside environment (Jones & Oldroyd, 2007), differences between termite nests concerning their quality of thermal insulation may bias the bees' nest-site selection. Whereas *Nasutitermes* build carton nests using wood particles in the construction, *Microcerotermes* use mainly soil and sand particles for building their nests (Emerson, 1938). This inclusion of mineral material results in an increased material density (Amelung et al., 2002) and, consequently, in an increased heat capacity of the material used for nest construction (John et al., 2005). Hence, in environments with elevated ambient temperatures, as is the case in the Brazilian Tropical Dry Forest, *Microcerotermes* nests may be more attractive for inquilines owing to the fact that more thermal energy is necessary to heat-up the building material as compared to *Nasutitermes* nest. Thus, the observed selective preference for *Microcerotermes* over *Nasutitermes* nests by *P. seridoensis* in the study area may be a result of both the ease of invasion and thermal stability.

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