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Short Communication

Twigs of *Albizia niopoides* (Spruce ex Benth.) Burkart as a nesting resource for ants (Hymenoptera: Formicidae)

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ABSTRACT

Ants can use twigs from fragments of tree branches as a nesting resource. The present study analyzed gatherings of ants in twigs of *Albizia niopoides*, a Fabaceae native to the Atlantic Forest that is used in landscaping in parks and squares in Brazil. Expeditions were performed in an urban park located in Atlantic Forest areas between February and June 2014. A total of 70 twigs with ants were collected and included 9357 workers, 2309 broods ants, 68 winged ants and 19 queens. Four subfamilies, 10 genera and 17 species/morphospecies were recorded. The species with the largest number of nests were *Nylanderia* sp.1, *Hypoponera* sp.4, and *Wasmannia auropunctata*. Ants of different species were found coexisting in the same twig, and *Pheidole* gr. *tristis* was the most common species found sharing a nest. Among the species recorded, only *Pseudomyrmex gracilis* and *P. phyllophilus* are arboreal; the others also live in litter. For some species, our results indicate that the twig occupation in the litter can be structured and not by chance. No correlation was found between the twig structure and the colony components.

Albizia niopoides (Spruce ex Benth.) Burkart (Fabaceae: Mimosoideae) is found in tropical and subtropical areas of Brazil. It is a deciduous tree that reaches up to 35 m in height and 40–60 cm diameter at breast height (DBH), but its wood has low market value (Rossi and Sartoretto, 2014). In ecological succession, it is classified as pioneer to early or late secondary and is frequently found in pastures because it does not develop under the canopy shade (Lorenzi, 2002; Arce et al., 2008). In urban areas, it is used in squares and parks; it has as a marked characteristic a smooth and powdery external bark, often showing holes made by wood boring beetles (Carvalho, 2009).

Usually, ants cannot excavate plant tissue to build their nests in tree twigs, with the exception of some *Pseudomyrmex* and *Azteca* species, which can bore into tree trunks when the plant is still young (Hölldobler and Wilson, 1990). Ants, including arboreal species, typically use cavities made by wood boring insects to maintain and expand their colonies (Deyrup et al., 2000). In the tropics, ants build their nests in different microhabitats, such as vegetation (arboreal ants), soil, and litter; other areas include under rocks, termite nests, twigs or trunks in different decomposition stages, dead vegetation, dry fruits, and galls (Hölldobler and Wilson, 1990; Byrne, 1994; Cereto et al., 2011; Nakano et al., 2012; Almeida et al., 2014). Many such places serve as peripheral nests for protection or to search for resources (Lanan et al., 2012).

The twigs resulting from the fragmentation of tree branches represent a resource for many arboreal or litter ants (Carvalho and Vasconcelos, 2002; Fernandes et al., 2012; Nakano et al., 2012) and contribute to the maintenance of species diversity in tropical forests (Armbrecht et al., 2004). The present study recorded ant communities that use *A. niopoides* twigs as a nesting resource. In addition, we discuss the relationship between the structure of the twig, the abundance and the morphological characters of individuals of the colony.

Five collection expeditions were conducted between February and June 2014 in the Max Feffer City Park. This area is an urban park that belongs to the town of Suzano (S 23°31′57″; W 46°19′24″) in the state of São Paulo, Brazil. The original vegetation is Atlantic Forest and is currently permeated by exotic species and an isolated grove (0.5 ha) composed only of 50 individuals of *A. niopoides* (DBH = 43.88 cm; SD = 6.44 cm). All twigs in the area were inspected, but we collected only those with ants in the area of *A. niopoides* and individually placed in plastic bags. The sampling effort lasted

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Table 1
Demographic data of ant colonies registered in *A. niopoides* twigs in the Atlantic Forest in southeast Brazil and the twig structure of the twigs.

Species/ morphospecies	Number					Month flight	Twig		
	Nest	Worker	Immature	Queen	Winged ant[a]		Length range (cm)	Diameter range (cm)	Area range (cm^2)
Brachymyrmex admotus Mayr, 1887	1	383	15	1	–		30	1.33	128.06
Camponotus sp.19	1	133	5	1	–		17.5	0.79	44.56
Camponotus sp.20	1	9[b]	34[b]	–	–		68	0.83	177.44
Camponotus sp.5	1	73	12	–	6	June	29	1.30	121.89
Crematogaster arata Emery, 1906	1	6[b]	28[b]	–	–		20.5	1.03	67.76
Crematogaster sp.17	5	27–93	12–145	1	–		24.04 (17–29)	0.97 (0.72–1.34)	72.74 (57.17–89.33)
Crematogaster curvispinosa Mayr, 1862	3	5–140	28–38	1	–		34 (13.5–20.5)	0.82 (0.60–1.03)	90.49 (26.26–67.76)
Crematogaster rochai Forel, 1903	1	29	–	–	–		23	0.76	55.50
Hypoponera sp.4	12	8–35	2–23	–	2–5	April	20.67 (7.5–28)	0.99 (0.72–1.45)	66.28 (21.73–133)
Nylanderia sp.1	22	10–254	2–74	1–4	1–17	February, April and June	20.23 (8–48)	1.11 (0.74–1.92)	72.11 (25–163.38)
Pachycondyla lenis Kempf, 1961	2	14–16	13	–	–		19.03 (14–24)	1.20 (1.08–1.32)	72.28 (61.11–83.46)
Pheidole pr. *aper*	1	132	–	–	1	June	12.5	0.85	34.62
Pheidole gr. *tristis*	7	6–868	2–95	1	–		21.67 (15–36)	1.09 (0.89–1.43)	75.79 (39.70–126.96)
Pseudomyrmex gracilis (Fabricius, 1804)	3	9–15	6–27	0–7	–		33.40 (25–48)	1.33 (0.73–1.68)	146.51 (63.45–240.03)
Pseudomyrmex phyllophilus (Smith, 1858)	5	5–50	5–51	–	–		22.40 (18–25)	1.12 (0.71–1.68)	83.40 (41.16–136.06)
Solenopsis sp.2	3	28–45	1–35	–	–		25.67 (18–37.5)	0.80 (0.62–0.98)	69.20 (35.82–116.78)
Wasmannia auropunctata (Roger, 1863)	7	171–2137	1–760	–	–		23.14 (9.5–38)	0.97 (0.71–1.42)	73.78 (38.06–173.22)

[a] Without distinction of sex.
[b] Shared nest.

for 4 h and was performed by two individuals at each collection event. To characterize the structure of the twig, it were measured the diameter, length, and total area. The diameter was obtained with a digital caliper, and the length was obtained with a simple ruler. The total area was calculated using the formula: At =twigs $2\pi r$ ($r + h$), where At = total area, r = radius, and h = twig length. We opened each twig and adult and broods (eggs + larvae) ants were counted. We defined the presence of a colony on a twig when the number of workers was 10 or more or when broods ants were present on the twig (Fernandes et al., 2012); except when the nest was shared by two species of ants. It were measured head width, head length, and Weber's length (Silva and Brandão, 2010). We chose only those species with ≥5 nests, being measured three to five workers per nest. Ants were separated into subfamilies (Brady et al., 2014) and identified at the genus (Palacio and Fernández, 2003) and species level, and morphospecies were named according to Suguituru et al. (2015). The vouchers were deposited at Mogi das Cruzes University (SP). Spearman correlations were used to assess the relationship between colony demographics (number of workers, broods or both), twig structure (diameter, length, and area) and character (head width, head length, and Weber's length). In all analyses, it was used the BioEstat 5.0 software (Ayres et al., 2007).

It was collected a total of 70 twigs, 9357 workers, 2309 broods ants, 68 winged ants, and 19 queens. It were registered four subfamilies, 10 genera, and 17 species/morphospecies. The species with the highest number of nests was *Nylanderia* sp.1 (20), followed by *Hypoponera* sp.4 (12) and *Wasmannia auropunctata* (Roger, 1863) (7). The colonies with the highest numbers of workers in total belonged to *W. auropunctata* (4257; mean: 608.14), *Nylanderia* sp.1 (2134; mean: 106.7), and *Pheidole* gr. *tristis* (1035; mean: 172.5). The twigs were an average of 1.04 cm in diameter (SD = 0.27 cm), 23.13 cm in length (SD = 11.32 cm), and 77.69 cm^2 in area (SD = 42.75 cm^2). It were found four winged species; *Nylanderia* sp.1 showed the highest number of winged ants/colony, including more than one queen per nest (Table 1).

Table 2
Demographic data of ant species that coexist with other species in *Albizia niopoides* twigs in the Atlantic Forest in southeast Brazil.

Species/morphospecies	Number of worker	Species/morphospecies	Number of worker	Number of brood[a]
Pseudomyrmex gracilis	50	*Pseudomyrmex phyllophilus*	14	27
Crematogaster arata	6	*Crematogaster curvispinosa*	5	28
		Pheidole gr. *tristis*	6	
Hypoponera sp.4	30	*Pheidole* gr. *tristis*	9	2
Nylanderia sp.1	104	*Hypoponera* sp.4	8	5
		Pheidole gr. *tristis*	9	
Camponotus sp.20	9	*Crematogaster curvispinosa*	72	34

[a] Without distinction of species.

Table 3
Correlation between colony demographics and structure of the twig dispersed in the litter of urban parks with *Albizia niopoides*.

Correlations		rs	*p*
Twig	Colony components		
Area	Workers	0.11	0.33
	Broods	0.16	0.17
	Workers + broods	0.13	0.23
Length	Workers	0.14	0.24
	Broods	0.22	0.06
	Workers + broods	0.18	0.13
Diameter	Workers	−0.02	0.88
	Broods	−0.05	0.64
	Workers + broods	−0.05	0.68

It were also recorded nests shared by more than one species, and the presence of broods ants was noted. *Pheidole* gr. *tristis* was the species that most frequently shared nests, and *Crematogaster arata* (Emery, 1906) shared nests with two other species (Table 2); the species were sharing a single cavity. Only *Pseudomyrmex gracilis* (Fabricius, 1804) and *P. phyllophilus* (Smith, 1858) (Hymenoptera: Formicidae) are considered arboreal species. No relationship was found between colony demographics and twig structure (Table 3). Yet the nest size is related to the amount of components of the colony (Hölldobler and Wilson, 1990). One colonization strategy for ants that nest in twigs is to expand from the main nest featuring polydomic nests (Carvalho and Vasconcelos, 2002). Thus, we believe that the lack of correlation between the structure of the nest and the colony demographics is related to this strategy, since the presence of polydomic nests may account for most of the species recorded in this study, as workers and broods ants were observed (Debout et al., 2007; Lanan et al., 2011). Polydomy is fairly common among ants and has been registered in over 150 species (Debout et al., 2007), among them, *Nylanderia*, widely recorded in this study. It is an alternative for species for which the available nesting space seems to limit growth, but it is also related to an increase in foraging area (Santos and Del-Claro, 2009; Schmolke, 2009; Lanan et al., 2011) or to polygyny (Walin et al., 2001), which has been verified in *P. gracilis* and *Nylanderia* sp.1.

The rains represent an important stimulus for the synchronized release of winged species (Torres et al., 2001; Santos and Del-Claro, 2009), but despite the field expeditions being conducted in months considered rainy (Minuzzi et al., 2007), few species were recorded as winged. The results indicate that *Nylanderia* sp.1 has a longer period of winged production, which can be a cause of the abundance of the genus in the tropics (LaPolla et al., 2011).

With exception of the arboreal species, all of the other species recorded in the present study forage on the soil or on the soil-litter system of the Atlantic Forest (Suguituru et al., 2013, 2015). For some species, our results indicate that this occupation can be structured and not by chance (Table 4).

These ants are also found in dead *Actinocephalus polyanthus* (Bong) (Eriocaulaceae) plants in areas of sandbanks (Cereto et al., 2011), disperse twigs in the litter of *Eucalyptus* sp. and other trees (Carvalho and Vasconcelos, 2002; Fernandes et al., 2012; Souza et al., 2012), and bamboo compartments (Fagundes et al., 2010). Regarding the two arboreal species, there is the possibility that the twig already housed the colony when it fell, as Ketterl et al. (2003) described the presence of *P. phyllophilus* in *Araucaria angustifolia* (Bertol.) Kuntze (Araucariaceae) as well as in twigs that have fallen close to the tree.

Is very common to find colonies of different species on a single plant, but not on same twig (Byrne, 1994) and herbs (Cereto et al., 2011). Cereto et al. (2011) observed colonies of four species in the same plant but with a compartmentalized distribution in the plant. Ants of different species recorded in the present study were observed in the same cavity of the twig without forming individual clusters, suggesting that these species share the same nesting space. Twigs are transient resources, because besides the decomposition process (Byrne, 1994), the ants with simpler nests (as twigs) move more often than those with more complex nests (McGlynn, 2012). So these ants frequently recolonize new spaces (Byrne, 1994). The lack of resources, along with the amount of twigs available and with holes accessible to workers, can cause the sharing of nests with other species.

Studies show that the diversity of nesting resources affects the diversity of twig-nesting ants (Armbrecht et al., 2004), and our study shows that a relatively high number of ant species use a single species of plant as a nesting resource. Thus, given the scarcity of resources in urban areas, twigs coming from *A. niopoides*, which is a plant suitable for afforestation (Carvalho, 2009), represent an alternative to maintaining the diversity of ants in urban areas. We also show that some species can coexist on the same twig. However, the mechanisms for coexistence of adults and immature ants as well as the morphological and behavioral basis still need to be investigated. In addition, there is also a need to study the size of the holes made by wood boring insects and other invertebrates associated with the nest.

Table 4
Correlation between morphological characters of ants and structure of the twig of *Albizia niopoides*.

Species	Number of workers	Character[a]	Twig	rs	*p*
Hypoponera sp.4	60	HL (0.73 ± 0.06)	Area	0.337	0.008
Nylanderia sp.1	105	HW (0.74 ± 0.05)	Area	−0.212	0.030
		HL (0.80 ± 0.05)		−0.224	0.022
		WL (1.04 ± 0.08)	Diameter	−0.291	0.003
			Area	−0.204	0.037
Pheidole gr. *tristis*	22	HW (0.60 ± 0.04)	Area	0.728	<0.001
		HL (0.59 ± 0.03)	Length	0.571	0.006
				0.425	0.048
		WL (0.75 ± 0.05)	Area	0.7725	<0.001
			Length	0.648	0.001
P. phyllophilus	21	HL (1.10 ± 0.13)	Area	−0.509	0.018
			Diameter	−0.509	0.018
Wasmannia auropunctata	35	HW (0.44 ± 0.01)	Diameter	0.343	0.043

[a] HL, head length; HW, head width; WL, Weber's length (Silva and Brandão, 2010); mm ± SD.

Conflict of interest

The authors declare no conflicts of interest.

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