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SHORT NOTE

Ants that Frequently Colonize Twigs in the Leaf Litter of Different Vegetation Habitats

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Abstract

Ants often colonize twigs in the leaf litter, but some species use this resource more frequently than others. We analyzed the composition of the community and the diameter of colonized twigs to test if any species had a size preference. Samples were collected in different vegetation habitats (urban parks, eucalyptus plantations and native forests). In each site, all twigs with an ant colony in six 16-m^2 plots were collected and measured, and the ants occupying them were identified. For the analyses, we only included species recorded in 10 or more twigs; these species were considered "common inhabitants" of the twigs (approximately 19.7% of the fauna analyzed). Our results indicate that the community is richer and uses a larger number of twigs of different diameters in the native forest. In addition, some species colonized twigs of similar sizes in different vegetation habitats, suggesting possible selection by ants.

In tropical forests, the leaf litter harbors a number of resources for ant nesting (Hölldobler & Wilson, 1990), including twigs derived from fallen tree branches. This resource is colonized by different ant species, supporting the presence of workers, reproductives and brood (Souza et al., 2012; Fernandes et al., 2012), albeit for a short period of time (Byrne, 1994). Ant species that colonized 10 or more twigs in 2,880 m^2 of leaf litter in the Amazon Forest were considered "common inhabitants" of this type of resource by Carvalho and Vasconcelos (2002). However, there are no studies examining these communities in the Atlantic forest domain. Therefore, we analyzed the composition of "common inhabitants" and the diameter of colonized twigs in different vegetation habitats. Specifically, we tested if any species showed preference for a certain twig diameter, regardless of habitat.

Samples were collected from urban parks (n = 9), eucalyptus plantations with a developed understory (n = 9) and native forest sites (Atlantic Forest; n = 9); all sites were situated in the state of São Paulo, Brazil (Fig 1). At each site, six 16 m^2 leaf litter plots were established 50 m apart along a linear transect. All twigs occupied by ant colonies were collected, and their size was described by three diameter measurements, one at each end of the twig and one in the middle. Diameter has been identified as the variable that is most strongly associated with ant species richness in twigs (Carvalho & Vasconcelos, 2002; Souza-Campana et al., 2017) or with events of bamboo traps occupation by arboreal ants (Cobb et al., 2006). Ants were identified based on Suguituru et al. (2015). Ant vouchers of all the samples were deposited at Laboratório de Mirmecologia do Alto Tietê (Myrmecology Laboratory of Alto Tietê) of University of Mogi das Cruzes (São Paulo, Brazil). For the analyses, we only included ant species that were "common inhabitants" as defined by Carvalho and Vasconcelos (2002). First, we used a Kruskal-Wallis test, followed by Dunn's *post hoc* test, to analyze if the "common inhabitant" species occupied twigs of different diameters within each habitat (i.e., within-habitat comparisons of the local species pool). Next, we used a Mann-Whitney test to examine if each species (i.e., a common inhabitant) was occupying twigs of different diameters in different vegetation habitats (between-habitat comparisons of each "common inhabitant" species). The significance level used for both tests was 5%.

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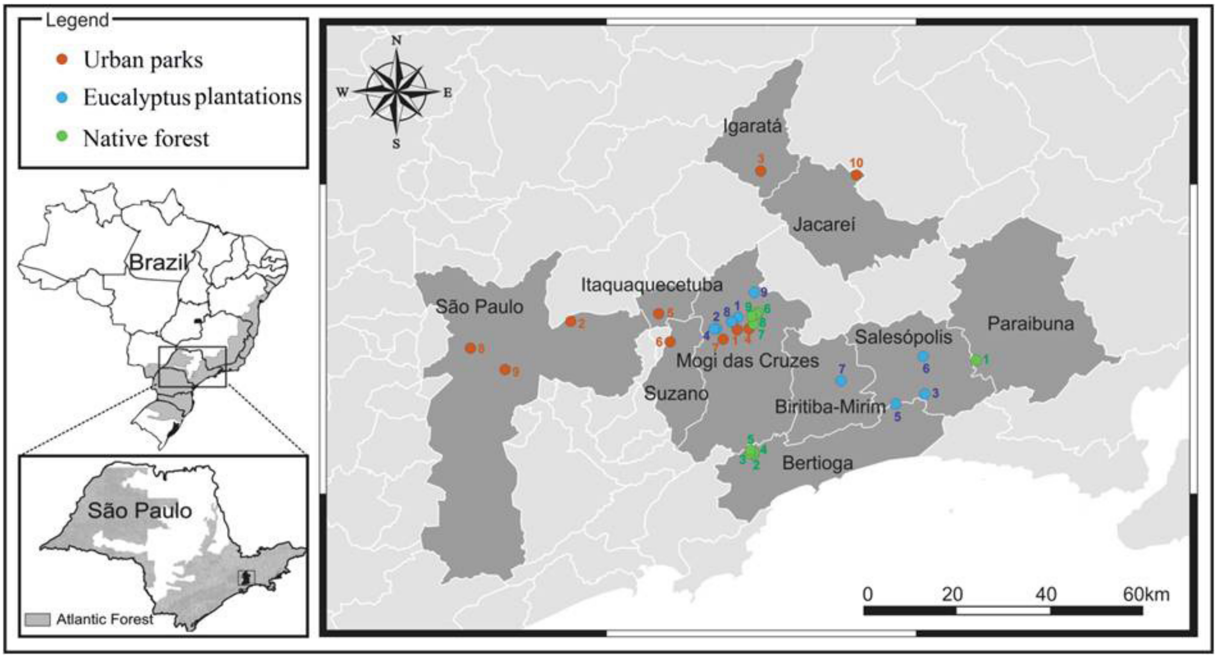

Fig 1. Study sites in different vegetation habitats: urban parks (n = 9), eucalyptus plantation with a developed understory (n = 9) and native forests (n = 9).

We collected 496 twigs (0.19 twigs/m^2) in 2,592 m^2 of leaf litter, which were colonized by ants belonging to 60 species/morphospecies. Among them, only 12 species (19.7%) were considered "common inhabitants" (Table 1), being found in 274 twigs (0.10 twigs/m^2 of leaf litter). Although most of the "common inhabitants" were leaf-litter ants (Suguituru et al., 2015), 25% were arboreal species *Myrmelachista catharinae* Mayr, 1887, *Myrmelachista ruzskyi* Forel, 1903 and *Pseudomyrmex phyllophilus* (Smith, 1858) that may use the twigs to expand their colonies, forming polydomous nests (Davidson et al., 2006; Debout et al., 2007).

Our results show that different vegetation habitats strongly influence ant richness and the number of "common inhabitant" nests in twigs. None species was recorded in urban parks in 864 m^2 of leaf litter; in the eucalyptus plantations, four species (33.3%) were observed in 57 twigs (= 0.06 twigs/m^2 of leaf litter); and in the native forest, 11 species (91.7%) in 217 twigs (= 0.25 twigs/m^2 of leaf litter). Other studies on ants that colonize twigs in native forest and agroecosystems (Murnen et al., 2013; Souza-Campana et al., 2017) have also shown that the less the anthropogenic influence, for the best the ant diversity.

In addition to differences in species richness and number of nests, we found differences in species composition among vegetation habitats (Table 1). Ant community diversity is limited in areas with few nesting resources (Fowler et al., 1991). However, resource quality is also important, because decayed and hollow twigs with higher moisture content (Carvalho & Vasconcelos, 2002) and larger diameters (Souza-Campana et al., 2017) are colonized more often. In eucalyptus plantations, twigs are very rigid and dense (Pereira et al., 2007), making it more difficult for "common inhabitant" species to colonize them; as a result, these communities are poorer (Table 1). Even when the eucalyptus plantations have a developed understory, the structure of the twigs is homogeneous (Souza-Campana et al., 2017). Therefore, "common inhabitants" colonize twigs of similar diameters (KW = 3.9113; df = 3; p = 0.2712), in contrast with the native forest, where "common inhabitants" exploit a greater diversity of twig sizes (KW = 27.9747; df = 10; p = 0.0018), especially *Gnamptogenys striatula* Mayr 1884, *Linepithema neotropicum* Wild, 2007*, Pheidole sarcina* Forel, 1912 and *Solenopsis* sp.2 (Table 1).

Regarding the native forest, our results suggest that, in the Atlantic Forest, the "common inhabitants" colonize more twigs/m^2 of leaf litter compared to the Amazon forest, because we found 0.25 twigs/m^2 of leaf litter, while Carvalho & Vasconcelos (2002) found 0.16 twigs/m^2 of leaf litter. In addition, the "common inhabitants" in twigs collected by us may be considered richer (0.01 species/m^2) compared to the Amazon Forest (0.006 species/m^2), according to data from Carvalho and Vasconcelos (2002). Our results also show that, compared to the Amazon Forest, the pool of species classified as "common inhabitants" in the Atlantic Forest is more diverse and colonizes more twigs, despite the presence of a lower number of species by m^2 in the leaf litter. For instance, in the Amazon Forest, there is approximately 0.8 species/m^2 (Vasconcelos et al., 2000), but only about half of that in the Atlantic Forest, ca. 0.45 species/m^2 of leaf litter (Suguituru et al., 2013). This suggests that, in the Atlantic Forest, ants colonize more twigs due to a lower availability of other nesting resources.

Of all species recorded in 10 or more twigs from the study sites, only *L. neotropicum*, *P. sarcina* and *Pheidole sospes*

Table 1. Taxonomic diversity based on vegetation habitat, number of colonized twigs, and twig diameter (median with range in parentheses). In bold, common inahbitants species.

Species/Morphospecies	Urban parks		Eucalyptus plantations		Native Forest	
	Number of nests	Twig diameter (mm)	Number of nests	Twig diameter (mm)	Number of nests	Twig diameter (mm)
Acanthognathus rudis	-	-	1	27.82	-	-
Acanthognatus ocellatus	-	-	-	-	1	9.2
Brachymyrmex admotus	7	13.49 (7.27-19.12)	9	13.8 (5.66-32.41)	3	11.56 (7.53-21.36)
Brachymyrmex heeri	5	17.56 (11.15-21.13)	-	-	-	-
Camponotus crassus	4	13.75 (11.05-14.97)	-	-	-	-
Camponotus novogranadensis	-	-	-	-	3	15.35 (12.72-42.82)
Camponotus sp.2	-	-	-	-	4	14 (9.41-21.68)
Camponotus sp.5	-	-	4	16.46 (14.69-32.44)	4	19.74 (15.85-33.55)
Camponotus sp.9	-	-	-	-	2	10.77 (7.6-13.94)
***Camponotus* sp.10**	-	-	-	-	**19**	**14.31 (10.26–17.18)** [a]
Cardiocondyla wroughtonii	1	17.94	-	-	-	-
Cephalotes pusillus	2	10.49 (9.43-11.55)	-	-	-	-
Crematogaster curvispinosa	-	-	-	-	6	11.56 (6.14-20.82)
Crematogaster rochai	1	14.86	-	-	-	-
Crematogaster sp.1	1	8.2	-	-	6	11.58 (8.82-23.96)
Crematogaster sp.17	2	10.29 (7.18-13.39)	-	-	-	-
Crematogaster sp.18	-	-	2	19.61 (19.54-19.69)	3	12.28 (10.13-32.77)
Crematogaster sp.20	-	-	2	12.96 (11.4-14.52)	-	-
Gnamptogenys striatula	5	22.6 (17.04-29.13)	5	14.34 (10.32-22.1)	**17**	**20.97 (9.76–46.19)** [ab]
Heteroponera dentinodis	-	-	-	-	3	15.59 (14.38-22.74)
Heteroponera dolo	-	-	-	-	1	37.49
Heteroponera mayri	-	-	2	9.38 (7.54-11.23)	6	15.48 (5.67-21.23)
Hylomyrma reitteri	-	-	1	20.33	-	-
Hypoponera sp.4	1	11.98	-	-	1	19.88
Hypoponera sp.7	-	-	2	17.45 (13.06-21.85)	5	12.69 (10.9-20.69)
Hypoponera sp.8	-	-	-	-	1	12.71
Hypoponera sp.10	-	-	1	33.1	2	39.61 (37.02-42.21)
Linepithema iniquum	2	12.56 (12.13-12.98)	6	13.79 (7.53-21.43)	2	16.37 (16.19-16.55)
Linepithema leucomelas	-	-	1	6.8	-	-
Linepithema neotropicum	2	21.56	**11**	**13.18 (8.12–24.19)**	**18**	**20.88 (10.58–42.93)** [ab]
Megalomyrmex goeldii	1	26.66	-	-	-	-
Megalomyrmex iheringi	-	-	1	14.77	-	-
Mycetarotes parallelus	-	-	1	28.9	1	26.29
Myrmelachista catharinae	1	12.76	1	16.02	**19**	**16.83 (6.36–25.98)** [a]
Myrmelachista nodigera	1	5.14	-	-	-	-
Myrmelachista ruzskyi	-	-	3	8.94 (6.91-18.35)	**15**	**13.26 (6.23–17.76)** [a]
Neoponera crenata	-	-	3	15.85 (13.56-17.41)	1	12.13
Nylanderia sp.1	3	15.52 (10.65-15.52)	3	17.43 (11.19-22.93)	-	-
Pheidole cf. *dione*	1	24.37	-	-	-	-
Pheidole flavens	1	13.52	-	-	**11**	**11.68 (4.18–26.83)** [a]
Pheidole sarcina	2	14.13 (12.13-16.14)	**11**	11.41 (6.1–26.79)	**47**	**19.51 (7.87–42.52)** [ab]
Pheidole sigillata	8	13.49 (7.66-19.69)	-	-	**15**	**11.91 (9.29–22.50)** [a]
Pheidole sospes	1	13.45	**16**	12.67 (6.86–24.28)	**14**	**13.2 (6.79–33.89)** [a]
Pheidole sp.9	-	-	-	-	3	30.03 (20.66-38.44)
Pheidole sp.37	1	17.44	-	-	-	-

Table 1. Taxonomic diversity based on vegetation habitat, number of colonized twigs, and twig diameter (median with range in parentheses). In bold, common inahbitants species. (Continuation)

Species/Morphospecies	Urban parks		Eucalyptus plantations		Native Forest	
	Number of nests	Twig diameter (mm)	Number of nests	Twig diameter (mm)	Number of nests	Twig diameter (mm)
Pheidole sp.39	1	26.14	-	-	-	-
***Pheidole* sp.43**	6	15.23 (10.01-19.44)	-	-	**27**	**18.09 (5.65–23.36)** ^{a}
Pheidole sp.44	5	15.98 (10.47-29.50)	-	-	-	-
Procryptocerus sp.1	3	13.84 (11.32-25.37)	-	-	7	12.91 (10.46-16.32)
Procryptocerus sp.2	-	-	2	18.52 (15.91-21.14)	2	13.84 (12.32-15.36)
Procryptocerus sp.4	-	-	5	18.35 (8.77-20.38)	-	-
Pseudomyrmex gracilis	2	16.22 (15.67-16.77)	-	-	-	-
Pseudomyrmex phyllophilus	3	15.83 (9.28-16.77)	**19**	**11.54 (4.33–16.92)**	3	11.33 (9.84-23.64)
Pseudomyrmex sp.8	-	-	2	9.20 (6.54-11.85)	6	11.12 (8.92-23.8)
***Solenopsis* sp.2**	2	10.29 (8.62-11.96)	1	11.74	**15**	**8.81 (3.32–18.79)** ^{ac}
Solenopsis sp.3	-	-	-	-	2	17.74 (9.19-26.29)
Solenopsis sp.4	-	-	1	9.57	-	-
Solenopsis sp.5	-	-	-	-	3	5.62 (5.58-11.26)
Strumigenys crassicornis	1	16.5	-	-	-	-
Wasmannia auropunctata	7	19.88 (8.32-22.53)	-	-	-	-
Kruskal-Wallis	-	-	3.9113; df = 3; $p = 0.2712$		27.9747; df = 10; $p = 0.0018$	

*Different letters: $p<0.05$ according to Dunn's *post-hoc* test.

Forel, 1908 were found both in the eucalyptus plantations and the native vegetation (Table 1). Of these, only *L. neotropicum* (Mann-Whitney = 1.7401; $p = 0.0818$) and *P. sospes* (Mann-Whitney = 0.0985; $p = 0.9215$) colonized similar-diameter twigs in different vegetation habitats (Fig 2), although the leaf litter in the native forest shelters a higher twig diversity (Murnen et al., 2013) compared to eucalyptus plantations (Pereira et al., 2007).

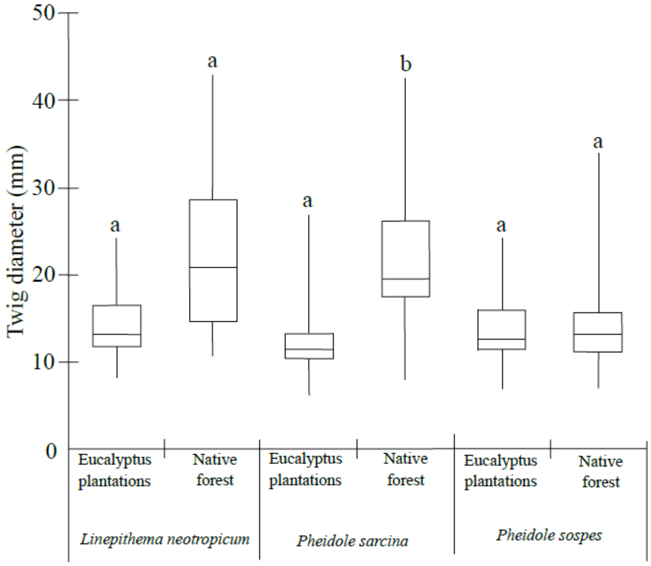

Fig 2. Diameter of colonized twigs in a colony of the same ant species in different vegetation habitats. The lines inside each box indicate the median, and same letters indicate non-significant differences between vegetation habitats (Mann-Whitney test).

Our study is the first to compare "common inhabitants" of twigs among different vegetation habitats in the Brazilian Atlantic domain, demonstrating that these communities are affected by habitat structure, as shown by Souza-Campana et al. (2017) for other twig-colonizing ant species. By finding that 25% of the "common inhabitants" were arboreal ants, and that some species colonized similar twigs in different vegetation habitats, our results contribute to the knowledge of the biology of these ants in the leaf litter.

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