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Composition and Diversity of Ant Species into Leaf Litter of Two Fragments of a Semi-Deciduous Seasonal Forest in the Atlantic Forest Biome in Barra do Choça, Bahia, Brazil

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Abstract

We present here the results of a study of leaf litter ant diversity in remnant areas of semi-deciduous seasonal forests in the Atlantic Forest biome. Standardized collections were made in 2011, using pitfall traps and Winkler sacks in two fragments of native forest in the municipality of Barra do Choça in the micro-region of the Planalto da Conquista, in southwestern of the state of Bahia, Brazil. A total of 107 species from 37 ant genera and 9 subfamilies was collected. The observed richness was high, and the diversity indices (Shannon-Wiener) of the two fragments suggest that in spite of being strongly impacted by anthropogenic actions, they maintained high faunal diversity levels, similar to those observed in other original Atlantic Forest sites in state of Bahia. Analyses of the species accumulation curves (Jackknife 2), however, indicated that survey effort was not sufficient to capture all of the species present. The high observed numbers of unique species, the shape of the species accumulation curves, and high values of estimated richness suggest that the survey areas were quite heterogeneous. These results provide new information concerning regional biodiversity that will be useful for continuing studies on fragmentation processes in the region.

Introduction

Ants (Hymenoptera: Formicidae) form one of the most diverse and ecologically important insect groups in terms of their diverse and essential functions in terrestrial ecosystems (Wilson & Hölldobler, 1990; Alonso & Agosti, 2000). Their predominance can be attributed in part to their eusocial nature, which favors their dispersal and successful occupation of new habitats (Wilson & Hölldobler, 2005). Since the Cretaceous period, these animals have demonstrated successful radiation throughout almost all terrestrial habitats, with numerical and biomass predominance in most of them (Fernández & Ospina, 2003; Wilson & Hölldobler, 2005).

Ant diversity in forest ecosystems is particularly high in the leaf litter (Alonso & Agosti, 2000; Silva & Brandão, 2010), although community composition is influenced by numerous factors, including the nature of the surrounding plant formations, soil composition and the local microclimate (Schowalter & Sabin, 1991). Ant community structures respond directly and quickly to both quantitative and qualitative environmental changes, and have therefore been the focus of stu-dies investigating the effects of environmental disturbances on ecological communities (Veiga-Ferreira *et al.,* 2005; Delabie *et al.,* 2006, 2007).

Ants maintain numerous biotic associations with other organisms in their environments (Wilson & Hölldobler, 1990; Rico-Gray & Oliveira, 2007), rapidly respond to habitat alterations such as fragmentation (Peck *et al.,* 1998; Veiga-Ferreira *et al.,* 2005; Delabie *et al.,* 2006) and are relatively easily collected and identified (Peck *et al.,* 1998), making them ideal models for studying and monitoring global biodiversity and useful as bioindicators of disturbances caused by ecosystem size reductions

The Atlantic Forest biome has been a focal area for environmental conservation efforts (Dean, 2002). Studies of Atlantic Forest biodiversity have almost exclusively fo-

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cused on ombrophilous forests on the coastal plains of Brazil (Ivanauskas & Rodrigues, 2000; Costa & Mantovani, 1993; Martins, 1993). However, a number of diverse ecosystems are found in this biome (Brasil, 2000), including semi-deciduous and deciduous seasonal forests in the region of southwestern of the state of Bahia, and some have been poorly studied (especially those situated more inland) (Brasil, 2000). The semi-deciduous seasonal forest exhibits high biodiversity due to the confluence between Atlantic Forest, Caatinga (dryland vegetation), and Cerrado (Neotropical savanna) biomes (Soares-Filho, 2000; Daniel & Arruda, 2005; Dean, 2002). They are highly threatened and have experienced critical levels of fragmentation due to agricultural expansion, pasture formation, and urban occupation, among other factors (Campanili & Prochnow, 2006).

One of the most highly neglected regions in terms of studies of ant fauna diversity is the Atlantic Forest in the southwestern region of the state of Bahia, principally the Planalto da Conquista. These vegetation formations are considered "Inland Atlantic Forests of Bahia" (classified as semi-deciduous seasonal forests) The present study was designed to examine the ant fauna of this region and characterize the composition and diversity of ant species in the leaf litter of two remnant forest fragments situated in the municipality of Barra do Choça, in the Planalto da Conquista, state of Bahia State, Brazil.

Materials and Methods

Collection sites

The surveys were performed in two areas of Semi-Deciduous Seasonal Forest: "Remnant 1" (14°50'00"S 40°33'13"W; 86 hectares) and "Remnant 2" (14°48'29"S 40°35'23"W; 62 hectares) (Fig. 1). Both fragments were located in the municipality of Barra do Choça, in the state of Bahia, Brazil, within the transition zone between dense ombrophilous forests and seasonal deciduous forest areas (IBGE, 1993; 1997) in formations locally known as "mata de cipó" (Soares-Filho, 2000) ; between 20 and 50% of the trees there are large deciduous species (IBGE, 1993; 1997; Soares-Filho, 2000).

These once extensive native forest formations are currently represented only by remnant fragments that have experienced intense processes of environmental degradation from agro-pastoral activities and the selective extraction of commercially valuable trees (Soares-Filho, 2000; Projeto Mata Atlântica Interiorana da Bahia, 2002; Oliveira-Filho *et al*., 1994). The fragments studied here are embedded within monoculture and pasture matrices, and their interiors demonstrate clear evidence of selective cutting and cattle trails. The regional climate is classified as high-elevation tropical (IBGE, 1993; 1997), with a mean annual temperature of 19.8 ºC, and a mean annual rainfall rate of 734 mm.

Fig 1 - Satellite picture of the two forest remnant where the experiment was conducted. Barra do Choça, Bahia, Brazil (Source: Google Earth, 2011).

Collection methodology

Ant collections were made in January and April/2011 using 47 Winkler sacks and 47 pitfall traps (Bestelmeyer *et al.,* 2000) in each fragment (one Winkler sack was destroyed in fragment 1, Table 1) distributed at intervals of 30 m within an area of approximately 10 hectares – but always at least 100 m from the external edges of the fragment. A pitfall trap was installed at each collection point and left for two days. These traps consisted of cups of 7 cm diameter by 10 cm height containing only water and detergent. When the pitfall trap was removed, an additional sample of 1 m² of leaf litter was removed from the same site, passed through a sieve, and then processed in a Winkler extractor for 48 hours (Bestelmeyer *et al.,* 2000). This standardized methodology was adapted from the *Ants of the Leaf Litter Protocol* of Agosti & Alonso (2001).

Biological material

The biological material collected in the field was preserved in ethanol and then taken to the Laboratório de Mirmecologia (CEPLAC/CEPEC/SECEN) and Laboratório de Biossistemática Animal (UESB/DEBI) where ant specimens were sorted out from the samples, mounted and identified to species level. The nomenclature follows Bolton *et al*. (2011) and Wilson (2003). Representative materials of all of the species are deposited in the Myrmecology Laboratory Collection (CPDC) under the reference number #5729.

Data analyses

Data was recorded using Excel version 10 software (Microsoft, 2007) which was used to calculate the relative frequencies of the species and their species richness for each different area and for each type of trap. EstimateS software version 8.2 (Colwell, 1997) was used to generate species accumulation curves for each area and each type of trap in terms of the sampling effort employed (Santos, 2003). The estimated species richness was subsequently calculated for each area using the Jackknife 2 index – an index based on the numbers of species that occur only once in a sample (*singletons*) and those occurring twice (*doubletons*). To determine if there were significant differences between the occurrences of ant species between the different fragments and between the different types of traps utilized, two-way analyses of variance (ANOVA Factorial) were performed using PRIMER 5 software (Clarke & Gorley 2001). The Shannon-Wiener diversity index was used to calculate the alpha diversity of the two fragments using Bioestat 5.3 software (Ayres, 2011). This index was chosen as it gives the same weight to both rare and abundant species. The t test was used to determine if there were significant differences between the diversity index values (also using Bioestat 5.3 software).

Results and Discussion

Observed richness

A synoptic list of the species collected in the present study, and their occurrences as a function of the collection areas and types of trap utilized, is presented in the Appendix. A total of 107 ant species belonging to 36 genera and 9 subfamilies were observed, with 83 species found in fragment 1, and 67 in fragment 2 (Table 1). These results indicated that the fragments analyzed retained relatively high faunal richnesses – even greater than reports for other areas of semi-deciduous forests in the Atlantic Forest biome (Mentoni *et al.,* 2011; Dias *et al.,* 2008, Castillho *et al.,* 2011).

The only other study that has examined ant diversity in remnant seasonal semi-deciduous forests in the region around the Planalto da Conquista was undertaken in 2011 by Sofia Campiolo, Ivan Nascimento, and Jacques Delabie (personal communication, May 4, 2011). These investigators undertook collections during the dry season using Winkler sacks in five areas relatively close to the present research site (in the municipalities of Barra do Choça, Itambé, and Vitória da Conquista). Their collection efforts were very similar to those of the present study, and they found between 47 and 86 species belonging to between 23 and 33 genera in the five fragments examined – results that are reasonably close to those of the present study (Table 1).

In both types of trap, fragment 1 demonstrated greater taxonomic richness than fragment 2 in terms of the species, genus, and subfamily levels. This result is somewhat surprising, as this fragment was 28% smaller than the other. In similar studies, and in accordance with the theory of island biogeography (MacArthur and Wilson, 1967), positive correlations have been found between species richness and fragment sizes (Morini *et al.,* 2007). One explanation for the observed discrepancy reported here could be that, in spite of the fact that the two fragments appeared to be phytosociologically similar (Avaldo de Oliveira Soares Filho, personal communication, January 10, 2011), the first fragment had more ecological niches available for ants. As such, and to better interpret the results, it would be interesting to quantify other diverse parameters in these forests fragments in future studies, such as the richness and diversity of their vegetation, their spatial structuring in terms of microhabitats, and available trophic resources.

Table 1 - Summary of the results found in two forest remnants at Barra do Choça, Bahia, Brazil. W: Winkler sack, P: pitfall trap.

	Remnant 1		**Remnant 2**	
	W	**P**	**W**	**P**
Number of samples	46	47	47	47
Number of species occurrences	349	201	382	231
Number of subfamilies	9	7	7	7
Number of genus	31	28	22	22
Number of species	66	54	50	44
Number of estimated species (Jackknife2)	109.6	94.9	66.6	73.3
Singletons	25	26	11	19
Doubletons	5	10	5	8
Shannon-Wiener	3.68	3.44	3.45	3.05

Table 2 – Variations fonts of ANOVA test (two-way analyzes of variance - Factorial ANOVA) for comparisons of samples collected in two forest remnants at Barra do Choça, Bahia, Brazil.

	SS	Degree of Freedom	MS	F	p
Intercept	6287.75	1	6287.75	140.653	0
Place/trap	209.446	1	209.446	4.6852	0.03156
Remnant	191.356	1	191.356	4.2805	0.03978
Remnant/trap	7.813	1	7.813	0.1748	0.67634
Error	9343.16	209	44.704		

Winkler sacks collected larger numbers of species in both fragments than did pitfall traps (Table 1), although these differences were not statistically significant (F = 4.69 and P = 0.032, Table 2). Most published studies have shown that Winkler sacks can collect greater numbers of species than most other techniques (Sabu *et al.,* 2011; Vargas *et al.,* 2009), although this assertion was recently challenged by Souza *et al.,* (2012) to the profit of pitfall traps. Nevertheless, both techniques complement each other for maximum sampling efficiency (Delabie *et al.,* 2000). Winkler sacks are most efficient for collecting smaller species with cryptic behavior and low activity levels (Agosti *et al*, 2000), while pitfall traps are better for collecting large, active foraging ants that are not easily collected through Winkler method, such as species of the genera *Camponotus*, *Pachycondyla* or *Odontomachus.*

Winkler sacks also harvested higher mean numbers of species per sampling point than pitfall traps (Table 3). These results are similar to those previously reported for native forest sites in the Atlantic Forest biome (Marinho *et al.,* 2002; Suguituru *et al.,* 2013). It is worth noting that there were differences between the two fragments studied here in terms of their mean species richness per sampling point, with this value being lower in fragment 2 (although these differences were not statistically significant) (Table 3).

Table 3 -Mean number of ant species (mean occurrence) observed in forest remnants in Barra do Choça, Bahia, Brazil. Values in the main diagonal of the matrix are means ± 1 SE. Differences between the pairs of ant species are based on Fisher post-hocTest. ns = not significant; * = *P*< 0.05; MW1 = species collected with Winkler sacks in first forest remnant; MW2 = species collected with Winkler sacks in second forest remnant; MP1 = species collected with pitfall traps in first forest remnant; MP2 = species collected with pitfall traps in second forest remnant;

		MW	MW	MP	MP
		1	2	1	2
MW	1	5.33±0.76	NS	NS	NS
MW	2		7.64±1.13	*	NS
MP	1			3.72±0.65	NS
MP	2				5.25±1.18

Richness estimates

Richness accumulation curves for each type of trap for each area are shown in fig 2A and 2B. Analyses of the accumulated richness curves indicated complete sampling of the ant fauna was not achieved in either type of trap, as none of the curves approached the asymptote. Thus, projected richness values were always greater than observed values (Table 1), which is the usual situation in biodiversity studies in the tropics (Martins & Santos, 1999; Feitosa & Ribeiro, 2005; Baccaro *et al*., 2011; Braga *et al.,* 2010; Leponce *et al*., 2004; Delabie *et al*., 2007), since many rare species continue to be encountered even after extremely intense sampling efforts (Santos, 2003).

The high estimated richness values could be explained by the study areas possibly having heterogeneous species distributions, because, according to Chao (1987), the greater the heterogeneity of the species' spatial distributions, the greater will be the observed divergences between observed and expected richness.

The large number of unique species encountered (Table 1) corroborated the results of the observed richness curves and diversity estimators. Unique species may be present in the area only as foragers ("tourist" species, according to Belshaw & Bolton, 1993), as rare species, as generalist species occasionally feeding in the locality, or as specialist that feed exclusively on plants occurring only in a single site in the study area. Also, the surveys may have been undertaken using inadequate methodologies (particularly an issue with small populations) (Novotny & Basset, 2000). The proportions of unique species in the present work were always greater than 30% of the total numbers of species collected – reaching up to almost 50% in the case of pitfall traps in the first fragment. Such high proportions of unique species are consistent with other biodiversity studies of arthropods in tropical regions (Coddington *et al*., 2009) and with other ant studies undertaken in Atlantic Forest areas (Pacheco *et al*., 2009).

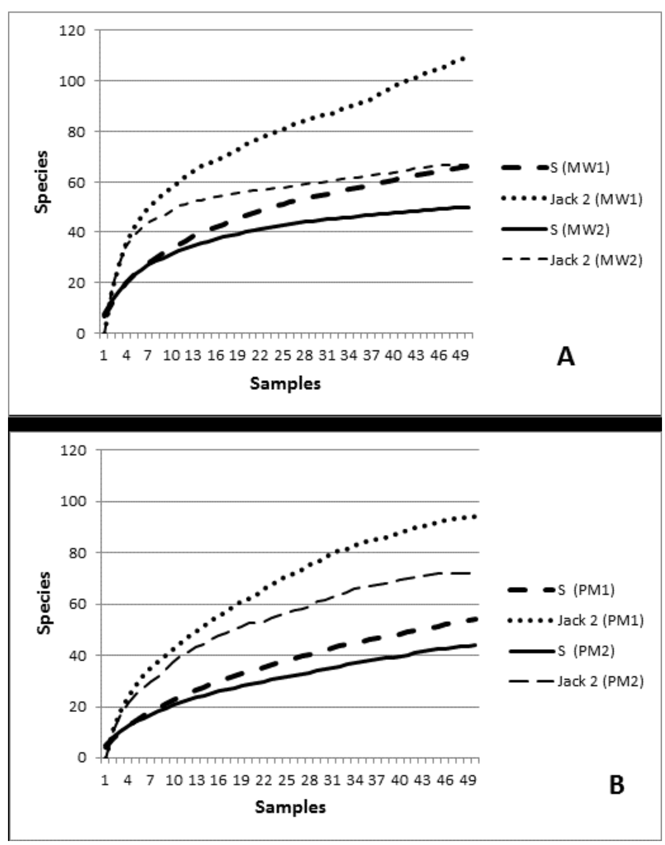

Fig 2 - Species accumulation curves for ant species collected in Winkler sacks (A) and pitfall traps (B) in two forest remnant in Barra do Choça, Bahia, Brazil. MW1: first forest remnant, MW2: second forest remnant, MP1: first forest remnant, MP2: second forest remnant, S: observed richness, Jack 2: richness index estimated by Jackknife 2.

Analyses of faunal composition

The richest subfamilies at the species level in fragment 1 were: Myrmicinae (59% of the total number of species), Formicinae (15.7%), and Ponerinae (13.3%). The same tendency was observed at the genus level: Myrmicinae (52.6% of the total number of genera), Formicinae (13.2%), and Ponerinae (10.5%) (Appendix). The richest subfamilies at the species level in fragment 2 were: Myrmicinae (58% of the total number of species encountered), Ponerinae (14.5%), and Formicinae (14.5%), while at the generic level, the richest subfamilies were: Myrmicinae (44.4% of all of the genera encountered), Formicinae (18.5%), and Ponerinae (11.1%) (Appendix).

The observation that the subfamily Myrmicinae was the richest in both fragments at both the genus and species levels, while the subfamilies Formicinae and Ponerinae demonstrated similar species richness, had been reported in other surveys of forested areas in the Neotropical region (Miranda *et al.,* 2012).

A particularly interesting find in fragment 1 was the capture of two specimens of *Ochetomyrmex* (*Ochetomyrmex* sp_LBSA_14010266) (very similar to *Ochetomyrmex semipolitus* but possibly distinct) – a new record for this genus in the state of Bahia, and extending the geographical distribution of this species by more than 2,380 km to the east (referring to the map given by Fernandez, 2003). A new species of *Oxyepoecus* Santschi, 1923 was also encountered (six specimens in fragment 2), which is now being described (Sebastien Lacau, personal communication, June 4, 2012). Another important collection was the capture of three specimens of *Monomorium delabiei* Fernandez, 2007 in fragment 2 – a species up to now only known from the holotype, described from Guaratinga, Bahia, Brazil (Fernandez, 2007).

Differences existed in the composition of the species encountered in the two study areas, with only 38% of the species common to both areas – indicating considerable differences in the compositions of their respective species communities (Appendix). There was also a relationship between the global richness of each remnant at the species level and its degree of exclusivity, with fragment 1 being the most species rich (83 species) and having the most exclusive faunal composition (with 50.6% of the species and 36.8% of the genera being exclusive to that fragment), while fragment site 2 was the least rich (67 species) and had the least exclusive faunal composition (with 34.3% of the species and 7.6% of the genera being exclusive to that fragment).

Relative frequency and dominance

To determine if the ant communities are organized into defined structural patterns, we examined the species relative frequencies in the two areas according to the types of traps in which they were caught. In the case of Winkler sacks, it was observed that 10 species were responsible for half of the occurrences in fragment 1 (fig 3A), and eight species for half of the occurrences in fragment 2 (fig 3B). Four of those species (*Hypoponera sp.* 3, *Nylanderia sp.* 2, *Gnamptogenys striatula* and *Solenopsis sp.* 6) only were common to both areas. In the case of the pitfall traps, eight species were responsible for half of the occurrences in fragment 1 (fig 3C) and five species in fragment 2 (fig 3D), with three species (*Pheidole radoszkowskii*, *Gnamptogenys striatula,* and *Nylanderia* sp. 2) being encountered in both fragments.

The overall results demonstrated that the three most frequent species (*Hypoponera sp.* 3, *Octostruma sp.* 1, and *Strumigenys sp.* 4) were exclusively collected with Winkler sacks, suggesting that they have cryptic lifestyles, and nest and forage below the leaf litter surface.

The same types of frequency analyses were performed to determine the identities and relative frequencies of the genera responsible for 50% of the total occurrences in the collections. In the case of the Winkler sacks, five genera (*Pheidole, Solenopsis, Hypoponera, Nylanderia*, and *Strumigenys*) were responsible for 50% of the occurrences in fragment 1 (fig 4A), while four genera (*Solenopsis, Hypoponera, Nylanderia* and *Pheidole)* were responsible for this same percentage in fragment 2 (fig 4B). Four genera (*Pheidole*, *Solenopsis*, *Hypoponera,* and *Nylanderia*) were encountered in both areas.

In the case of the pitfall traps, three genera (*Pheidole, Gnamptogenys,* and *Ectatomma*) were found to be responsible for 50% of the occurrences in fragment 1 (fig 4C), and four genera in fragment 2 (*Pheidole, Pachycondyla, Linepithema*, and *Solenopsis*) (fig 4D). Only one genus (*Pheidole*) was encountered in both fragments.

These results emphasize the notable dominance of the genera *Pheidole, Solenopsis*, and *Nylanderia*. The genus *Pheidole* has been observed to be the most dominant in many studies of ant diversity, with two of its species consistently appearing among the most abundant arthropod representatives in the leaf litter. *Pheidole* is the most diversified genus in the family Formicidae (Wilson, 2003) and its species are encountered in all soil microhabitats, have wide ranges of feeding habits (most are omnivores), and demonstrate great efficiency in recruiting workers to exploit many trophic resources (Fernández, 2003). Some *Pheidole* species are rather aggressive in their relationships with competitors, are opportunists and can colonize a wide diversity of environments (Wilson, 2003). The observed dominance of this genus in the present study therefore corroborates the recognition of this genus as the most abundant and diversified in the Neotropical region (Majer & Delabie, 1994; Marinho, *et al.* 2002; Vasconcelos, 1999).

In the same sense, the high abundance of *Solenopsis* species observed in the present study confirms previous observations in the literature. Some species of this genus are common throughout the world (Fernandéz, 2003), principally in the leaf litter, with many of them being generalists in terms of their habitats and diets (Fowler *et al.,* 1991). These species

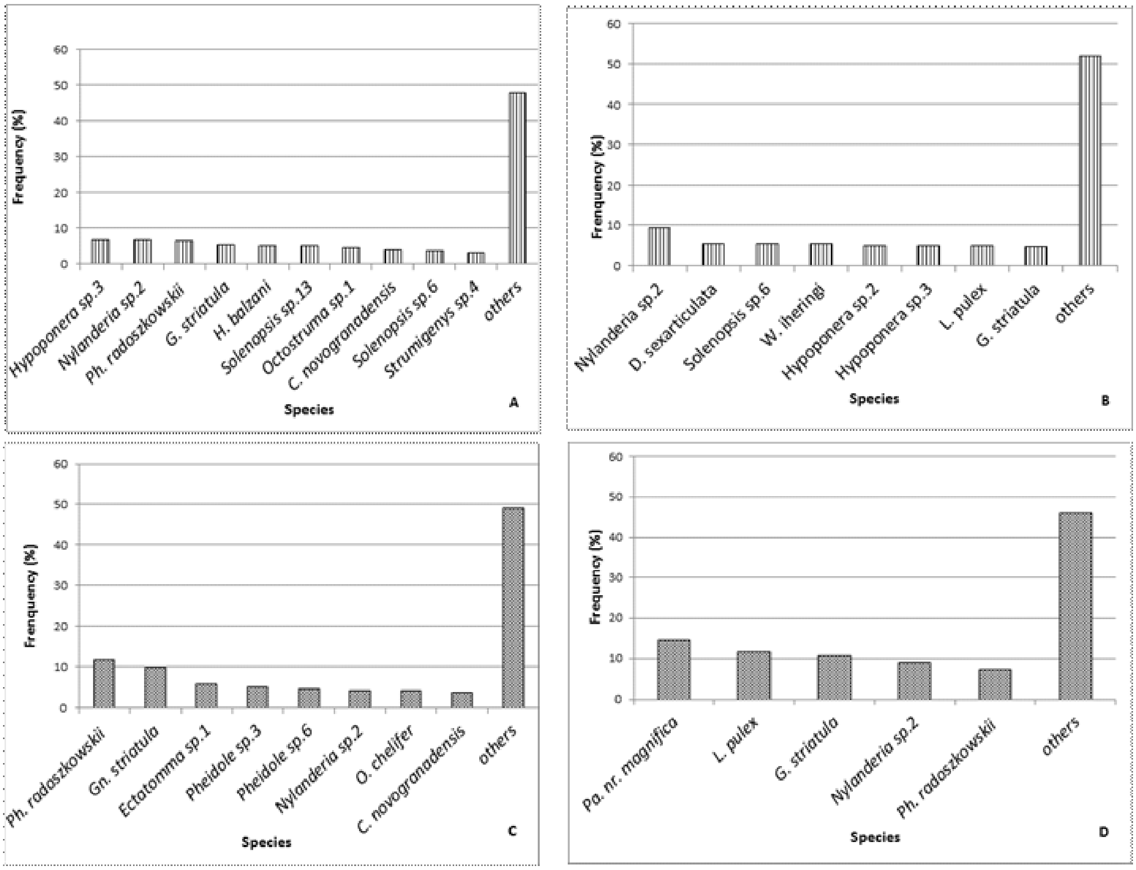

Fig 3 - Relative frequency of the species more collected in two forest remnant at Barra do Choça, Bahia, Brazil. (A) Samples collected with Winkler sacks in the first forest remnant; (B) Samples collected with Winkler sacks in the second forest remnant; (C) Samples collected with pitfall traps in the first forest remnant; (D) Samples collected with pitfall traps in the second forest remnant;

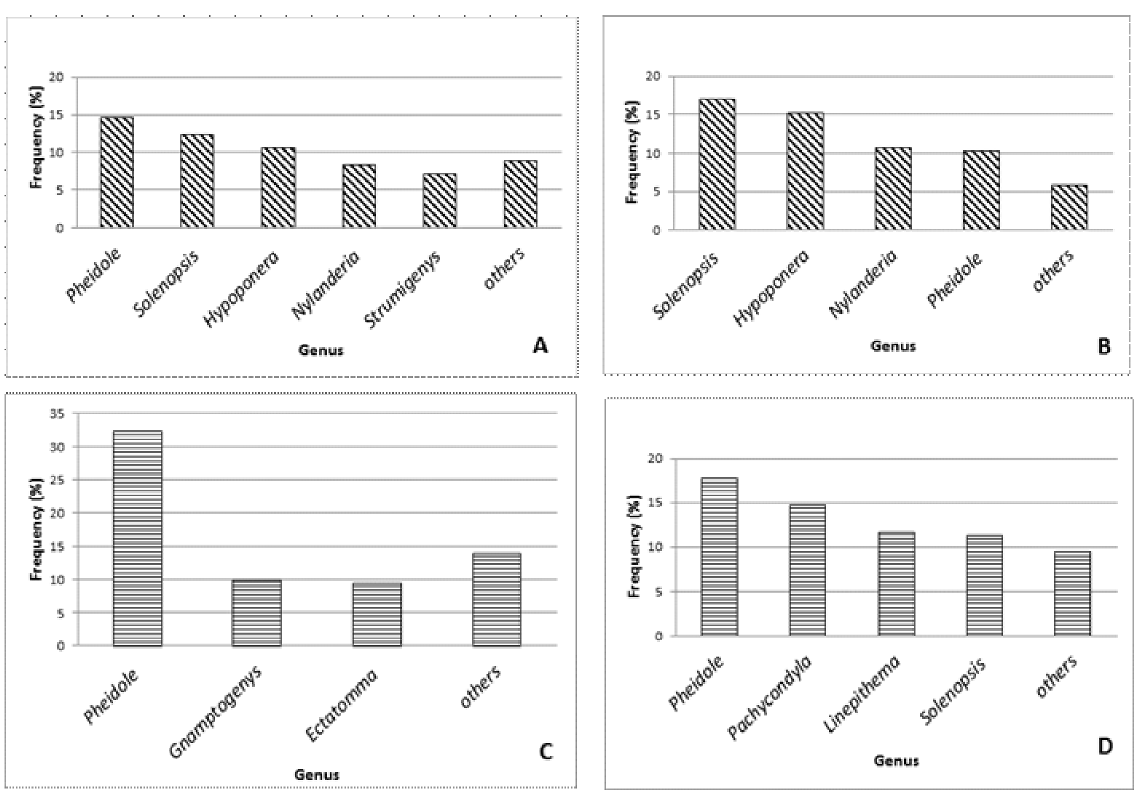

Fig 4 - Relative frequency of the most frequently collected genera in two forest remnants at Barra do Choça, Bahia, Brazil. (A) Samples collected with Winkler sacks in the first forest remnant; (B) Samples collected with Winkler sacks in the second forest remnant; (C) Samples collected with pitfall traps in the first forest remnant; (D) Samples collected with pitfall traps in the second forest remnant.

are also encountered with relatively high frequencies in agricultural areas (Dias *et al.,* 2008).

The genus *Nylanderia* was also very frequent in the present study, and previous publications have shown that the relatively small individuals that are characteristic of this genus are quite abundant (Mentone, 2011), being terricolous or arborous, or occupying the leaf litter, in both natural and disturbed environments (Fernández, 2003).

Diversity indices

The alpha diversity estimates for the fragments, as calculated by the Shannon and Wiener index, can be found in Table 1 and are comparable to other biodiversity studies of ants in the Neotropical region (Lopes *et al.,* 2010; Lutinski *et al.,* 2008). The greatest alpha diversity was observed in fragment 1, corroborating the hypothesis that fragment 1 had the best phytosociological quality and favored the occurrence of a wider diversity of species. The situation in fragment 2 apparently represents a simplification of the original community structure. The differences between fragments were not, however, statistically significant ($t = 1.3291$; $P = 0.1576$).

Concluding comments

The results obtained in the present study are totally original, and no similar research has previously been undertaken in the Planalto da Conquista region. It was observed that while the two fragments analyzed had both been subjected to anthropogenic modifications, they still maintained high natural faunal diversities typical of inland Atlantic Forest sites in state of Bahia. The diversity and species richness observed in this study were actually greater than those reported in the literature for other semi-deciduous forests of the Atlantic forest biome (Mentoni *et al.,* 2011; Dias *et al.,* 2008, Castilho *et al.,* 2011).

When the two fragments were compared, it could be seen that the numbers of species, genera, and sub-families were greater in fragment 1. This result suggests that although the two fragments were superficially similar, the first was better preserved in terms of the ecological niches available for the ant fauna and therefore better reflected the original community structures of the Formicidae in this ecosystem; the second fragment represented a greater simplification of the more complex original community.

The results presented here will hopefully be useful to future conservation plans for remnant forest areas in the Planalto da Conquista, as ants can be easily used as biological indicators of the degradation (or preservation) of areas subjected to anthropogenic impacts (or management). Additionally, it is hoped that this study will serve as a baseline for further investigations about regional biodiversity, as this region is desperately lacking this kind of information.

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Appendix - List of ant species and their frequency of occurrence collected by two sampling methods and in two forest remnants in Barra do Choça, Bahia, Brazil: MW1 and MP1 represent the species collected with Winkler sacks and pitfall traps in first forest remnant; MW2 and MP2 represent the species collected with Winkler sacks and pitfall traps in the second forest remnant.

Subfamilies	Species	MW1	MP1	MW2	MP2
Dolichoderinae	*Azteca sp. 1*		1	7	
	Azteca sp. 2	1			
	Dolichoderus attelaboides (Fabricius, 1775)	1	1		
	Linepithema pulex Wild, 2007			20	27
Ecitoninae	*Eciton burchelli* Westwood, 1842		1		
	Labidus praedator (Smith, 1858)		1		
Ectatomminae	*Ectatomma edentatum* Roger 1863	1	7		
	Ectatomma sp. 1		12	1	
	Ectatomma sp. 3				10
	Gnamptogenys striatula Mayr, 1884	19	20	19	25
Formicinae	*Acropyga guianensis* Weber, 1944				1
	Acropyga sp. 1		1		
	Brachymyrmex patagonicus Mayr, 1868	4		6	
	Brachymyrmex sp. 1			7	
	Brachymyrmex sp. 3		2		6
	Brachymyrmex sp. 4	8			
	Brachymyrmex sp. 5	6	1		
	Camponotus cingulatus Mayr, 1862		7		4
	Camponotus novogranadensis Mayr, 1870	14	8	5	5
	Camponotus renggeri Emery, 1894	1			
	Camponotus sp. 3	2			
	Camponotus (Tanaemyrmex) sp. 5		1		
	Nylanderia sp. 1	5	1	2	1
	Nylanderia sp. 2	24	9	37	21
	Nylanderia sp. 4			2	
	Nylanderia sp. 5			1	
	Paratrechina longicornis (Latreille, 1802)		1		
Heteroponerinae	*Heteroponera mayri* Kempf, 1962		3		6
Myrmicinae	*Acanthognathus sp 1*	1			
	Acromyrmex aspersus (Smith, 1858)	1			
	Acromyrmex sp. 1		1		1
	Apterostigma pilosum Mayr, 1865	3			

Myrmicinae (cont.)	*Basiceros disciger* (Mayr, 1887)	1			
	Carebara sp. 1	6		4	1
	Carebara sp. 2	4			
	Crematogaster distans Mayr, 1870	2	1		
	Crematogaster sp. 2	1		5	1
	Crematogaster sp. 3	1			
	Cyphomyrmex transversus Emery, 1894	7	2	5	1
	Cyphomyrmex strigatus gp. sp. 1	1			
	Hylomyrma balzani (Emery, 1894)	18	7	19	3
	Megalomyrmex drifti Kempf, 1961		1		
	Megalomyrmex goeldii Forel, 1912	7	8		
	Monomorium delabiei Fernández, 2007			1	
	Myrmicocrypta sp. 1		1		
	Myrmicocrypta sp. 2	4			
	Ochetomyrmex sp. 1 (LBSA 40 10 266)	1	1		
	Octostruma sp. 1	16		3	
	Oxyepoecus myops Albuquerque & Brandão, 2009			5	
	Oxyepoecus sp. 2 (LBSA_ 1 40 10 26 4)			4	2
	Pheidole radoszkowskii Mayr, 1884	23	24	8	17
	Pheidole tristis gp. sp. 1		1		
	Pheidole sp. 2			1	
	Pheidole fallax gp. sp. 3	1	1 1	6	9
	Pheidole tristis gp. sp. 4	5	1	2	
	Pheidole sp. 5	6	4	1	
	Pheidole flavens gp. sp. 6		10	7	6
	Pheidole tristis gp. sp. 7		2	4	2
	Pheidole sp. 8	1	1	1	1
	Pheidole diligens gp. sp. 9	1	1		
	Pheidole diligens gp. sp. 10	1	2	1	2
	Pheidole fallax gp. sp. 11	1	3		
	Pheidole sp. 12	5	1		
	Pheidole tristis gp. sp. 13	4	1		
	Pheidole diligens gp. sp. 15	1	1		2
	Pheidole sp. 17	1	1		
	Pheidole sp. 18			7	
	Pheidole sp. 21			1	2
	Pheidole transversostriata Mayr, 1887	1	1		
	Procryptocerus hylaeus Kempf, 1951		1		
	Solenopsis sp. 3	2			2
	Solenopsis sp. 4			17	
	Solenopsis sp. 6	1 3	2	22	1 3
	Solenopsis sp. 7			1	

Myrmicinae (cont.)	*Solenopsis sp. 8*				3
	Solenopsis sp. 9	8	6	14	3
	Solenopsis sp. 10				1
	Solenopsis sp. 11				1
	Solenopsis sp. 12	2	1	4	1
	Solenopsis sp. 13	18	2	5	1
	Solenopsis sp. 14				1
	Strumigenys appretiata (Borgmeier, 1954)			2	1
	Strumigenys denticulata Mayr, 1887	2			
	Strumigenys sp. 1			2	
	Strumigenys sp. 2	9	2		
	Strumigenys sp. 3	5			1
	Strumigenys sp. 4	11		8	
	Trachymyrmex sp. 1	1			
	Wasmannia auropunctata (Roger, 1863)	4	2	6	2
	Wasmannia iheringi Forel, 1908	8	2	22	2
	Wasmannia sp. 3	4			
Ponerinae	*Anochetus simoni* Emery, 1890	3			
	Hypoponera foreli (Mayr, 1887)	5		5	2
	Hypoponera sp. 1	3			
	Hypoponera sp. 2	5	2	20	1
	Hypoponera sp. 3	24		20	
	Hypoponera sp. 5			1	
	Hypoponera sp. 6			9	
	Hypoponera sp. 7			3	
	Odontomachus chelifer (Latreille, 1802)		9		8
	Odontomachus sp. 2	3	3		1
	Odontomachus sp. 3	1			
	Pachycondyla crenata (Roger, 1861)	1			
	Pachycondyla moesta Mayr, 1870	1		1	
	Pachycondyla nr. magnifica		7		34
Proceratiinae	*Discothyrea sexarticulata* Borgmeier, 1954	1		22	1
Pseudomyrmecinae	*Pseudomyrmex tenuis* (Fabricius, 1804)	1	1		1