



RESEARCH ARTICLE - ANTS

Canopy Ant Assemblage (Hymenoptera: Formicidae) in Two Vegetation Formations in the Northern Brazilian Pantanal

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Abstract

The landscape of the northern Pantanal region is a mosaic of fields and forests, distributed according to topography and hydrology of this floodplain, resulting in a particular pattern of vegetation distribution. Among the forest formations, mixed-species and monodominant landscape units can be found which are associated with floodable or non-floodable habitats. Our study tested the hypothesis that forest formations with greater tree richness and which are non-floodable (cordilheiras) maintain distinct richness and composition in canopy ant assemblages in relation to the seasonally floodable monodominant forests (cambarazais). Sampling was performed in 10 sample areas (five cambarazais and five cordilheiras) by means of canopy insecticide fogging during the dry and high water seasons of the Pantanal's hydrological cycle. The canopy ant assemblages revealed 105 species belonging to 30 genera and nine subfamilies. Myrmicinae (41 spp.), Formicinae (20 spp.) and Pseudomyrmecinae (17 spp.) predominated. Our results revealed that the composition of canopy ant assemblages varied between cambarazal and cordilheira forests, as well as between the dry and high water periods. Nevertheless, the richness was homogeneous between these forests and in the dry and high water periods. These results show the specificity of each forest, as well as its structure, in maintaining distinct compositions in ant assemblages in canopies in the Pantanal of Mato Grosso.

Introduction

Ants are social organisms that have a vast capacity for adaptation, exploration and colonization of a wide range of terrestrial environments (Hölldobler & Wilson, 1990; Baccaro et al., 2015). Ants have multiple feeding habits and spectra of interactions with other biological groups, which explains their high distribution and occurrence, especially in tropical regions (Longino et al., 2002; Wilson & Hölldobler, 2005; Lach et al., 2010; Castaño-Meneses, 2014; Del-Claro et al., 2018; Philpott et al., 2018), including wetlands such as the Brazilian Pantanal (Battirola et al., 2005; Marques et al., 2011; Soares et al., 2013; Meurer et al., 2015; Yamazaki et al., 2016).

Wetlands are ecosystems characterized by strong hydrological seasonality, influencing the distribution and availability of habitats and their use by fauna in an annual cycle (Junk et al., 1989; Wantzen et al., 2016). Thus, the Pantanal of Mato Grosso, the largest continuous floodplain on the planet, presents peculiar characteristics regarding its composition of habitats, influenced by the frequency, amplitude, duration and dynamics of the seasonal hydrological cycle (Junk et al., 2013; Nunes-da-Cunha & Junk, 2015).

The Pantanal of Mato Grosso is composed of a mosaic of vegetation formations including fields, savannas, pastures (native and exotic) and forest formations, incorporating into its floristic composition elements of adjacent phyto-



geographic provinces such as the Cerrado, Amazônia and Chaco (Adámoli, 1982; Silva et al., 2000; Junk et al., 2006; Nunes-da-Cunha & Junk, 2015). In the northern region of the Pantanal, among the forest formations, mixed-species and monodominant landscape units can be found (Alho et al., 2000). Monodominant forests are defined as vegetational formations in which a single species dominates more than 50% of the community (Connell & Lowman, 1989).

Among the available habitats in forest formations, the canopy stands out as being responsible for mechanisms that regulate key ecosystem processes involving both nutrient cycling and species interaction (Basset et al., 2002; Dial et al., 2006; Adis et al., 2010; Fotis et al., 2018). The trees, isolated at the canopy or connected to each other by lianas and branches, constitute the main element of this stratum in tropical forests, harbouring important communities for the maintenance of forest diversity, resilience and functioning, being considered important habitat models in the ecology of communities and populations (Nadkarni, 1994). Despite the high density and proximity of tree crowns as canopies in forests, trees can be considered insular habitats for some taxa (Adams et al., 2017), contributing to the complexity of this forest stratum.

The structural complexity of the canopy resulting from the variety of tree species, as well as their architecture, tends to maintain high species richness associated in this forest stratum due to a greater diversity and distribution of microhabitats, food resources and niches available to fauna (Farrel & Erwin, 1988; Pianka, 1994; Erwin, 2013; Yamazaki et al., 2016; Yusah et al., 2018), which are important factors in the structure and composition of animal assemblages, including those of ants (e.g. Battirola et al., 2005; Ribeiro et al., 2013; Meurer et al., 2015; Yusah & Foster, 2016).

The structure of vegetation in monodominant and mixed-species habitats associated with seasonal flooding makes both, fauna and flora, present specific adaptations which allow for their survival in this type of habitat (Adis et al., 2001; Arieira & Nunes-da-Cunha, 2006; Battirola et al., 2007, 2009, 2017a,b; Rebellato et al., 2013; Tissiani et al., 2015). In the northern Pantanal region of Mato Grosso, specific strategies were recorded for different species of arthropods, including ants, involving vertical displacement to higher habitats such as tree trunks and canopies, horizontal displacement along the flood line (Adis et al., 2001; Wantzen et al. 2016), and temporary displacement between terrestrial habitats (Meurer et al., 2015; Yamazaki et al., 2015, 2016, 2017).

Considering the habitats specificity present within the flood plains of the northern Pantanal region of Mato Grosso, we tested the hypothesis that the forests' formations with greater tree richness and non-floodables (cordilheiras) maintain distinct richness and composition in canopy ant assemblages in relation to the seasonally floodable monodominant forests (cambarazais), influenced by the hydrological cycle of the Pantanal as well as the structure

of the vegetation. So, we compared the composition and richness of canopy ant assemblages between cambarazal and cordilheira during dry season and high water season, with the aim of revealing the habitats' species richness, as well as the relationship between habitat structure and the maintenance of canopy ant assemblages in these habitats.

Material and methods

Study area

This study was carried out in the floodplain of the northern Pantanal region of Mato Grosso, Poconé-MT, in areas between the Bento Gomes (16°18'S and 56°32'W) and Cuiabá (16°30'S and 56°24'W) rivers. The region's climate is described as tropical savanna, type Aw under the Köppen climate classification system, characterized by dry winters and rainy summers, with temperatures oscillating between 22°C and 32°C. Annual rainfall ranges from between 1,000 to 1,500 mm (Hasenack et al., 2003). The seasonality of the region is determined by four well-characterized periods (dry, rising water, high water and receding water seasons) that define the alternation between the terrestrial and aquatic phases of this region (Heckman, 1998).

Sampling was performed in monodominant (cambarazais) and mixed-species (cordilheiras) forest formations. The monodominant areas correspond to seasonally flooded forests with predominance of *Vochysia divergens* Pohl. (Vochysiaceae), regionally known as cambará, a tree species considered invasive to the Pantanal's natural fields (Pott & Pott, 1994; Arieira & Nunes-da-Cunha, 2006; Signor et al., 2010; Uriu et al., 2017). This kind of forest is 5-19 m high and it is common to find other tree species such as *Calophyllum brasiliense* Cambess. (Calophyllaceae), *Alchornea discolor* Poepp. (Euphorbiaceae) and *Licania parvifolia* Huber (Chrysobalanaceae) (Arieira & Nunes-da-Cunha, 2006).

The areas of mixed-species formations, locally known as cordilheiras, are areas located in the upper parts of the floodplain and are therefore not subject to inundation during the seasonal high water and rising water periods. These areas are characterized by dense arboreal savanna vegetation composed of different species (3-17 m high), dominated by *Astronium fraxinifolium* Shott. (Anacardiaceae), *Attalea phalerata* Mart. ex Spreng. (Arecaceae), *Qualea grandiflora* Mart. (Vochysiaceae) and *Protium heptaphyllum* (Aubl.) Marchand (Burseraceae) (Silva et al., 2000; Nunes-da-Cunha et al., 2010; Morais et al., 2013).

Formicidae assemblage sampling

The sampling of ant assemblage was carried out in all 10 areas (five areas of cambarazal and five of cordilheira), throughout the dry season in September 2012 and 2013,

and in the high water periods in March 2013 and 2014. These 10 areas are located in the same region, but they are not connected (minimum distance of 3 km). In each of these 10 areas, three independent 5x5 m sample quadrats were delineated (minimum distance of 200m), totalling 15 quadrats per forest formation in each seasonal period. The phytosociological information (richness of trees, relative density and relative vegetation dominance data), were obtained for each of the sample quadrats, and was estimated based on plants with a height above 2m and DBH above 1cm.

For the collection of ants, canopy fogging with insecticide was used, in accordance with procedures adapted from Adis et al. (1998) and Battirolo et al. (2004). Canopy fogging was carried out for five minutes, commencing at 6:00 a.m., when air circulation is less intense (e.g. Adis et al., 1998). The Swingfog SN50 fogging machine was used with 0.5% Lambda-cyhalothrin (Icon®) insecticide, a non-residual synthetic pyrethroid, diluted in diesel oil at a concentration of 1%, and combined with the synergist (0.1% DDVP). For each sample quadrat, arthropods were collected in 25 nylon collecting funnels (1m² area each), with 92% alcohol at the base of the collection flasks.

Samples were collected two hours after insecticide application. When removing collection flasks, the funnel walls were manually shaken and washed with a spray containing 92% alcohol. All collected material was packed in flasks containing 92% alcohol and transported to the Acervo Biológico da Amazônia Meridional (ABAM) of the Universidade Federal de Mato Grosso, Sinop campus, where the testimonial material is deposited. Ants were separated from the other arthropods and identification was conducted following the Bolton (2015) and Fernandez (2003) classification.

Data analysis

The composition of canopy ant assemblages was evaluated based on data ordination through Non-Metric Multidimensional Scaling (NMDS) and Jaccard dissimilarity measurement, using a presence-absence species matrix (qualitative data). For the Multivariate Analysis of Variance (MANOVA), the scores of the two NMDS dimensions were used to identify variations in ant assemblage composition in relation to the variables (i) forests (cambarazal and cordilheira) and (ii) seasonality (dry and high water periods). The significance level for each variable, as well as for the assumed models was $\alpha < 0.05$, through Pillai Trace test. Normality of the data was evaluated by the Shapiro-Wilk test. In order to evaluate the effect of plant richness, relative density and relative vegetation dominance on the composition of canopy ant assemblages, multiple regressions were applied.

The analysis of variance (ANOVA) was used to evaluate variation in ant species richness between cambarazal and cordilheira and between dry and high water

seasons. The Jackknife 1 estimator was applied to analyse the sampling efficiency of canopy ant richness. All analyses were performed using the free software R, version 3.0.1 (R Core Team, 2013) in conjunction with the Vegan (Oksanen et al., 2013) and Car (Fox et al., 2013) packages.

Results

Assemblage composition

Canopy ant assemblages in areas of cambarazal and cordilheira were represented by 105 species belonging to 30 genera, 12 tribes and nine subfamilies. Myrmicinae presented 41 species (39.1%), followed by Formicinae (20 spp.; 19.1%), Pseudomyrmecinae (17 spp.; 16.2%) and Dolichoderinae (11 spp.; 10.5%) (Table 1). Ponerinae (8 spp.; 7.6%), Ectatomminae (4 spp.; 3.8%), Dorylinae (2 spp.; 1.9%), Amblyoponinae (1 sp.; 0.9%) and Paraponerinae (1 sp.; 0.9%) corresponded to subfamilies with lower species richness (Table 1). The estimated species richness for the cordilheira according to the Jackknife 1 estimator was 81 ant species for dry and 92 for high water season, however, 79% was sampled in the dry season and 77% during the flood season. In cambarazal Jackknife 1 estimated 78 ant species for dry and 85 for high water season, with our sampling representing 81% and 82%, respectively.

Analysing each forest individually, a total of 85 ant species were collected in cordilheira areas (27 genera, 12 tribes and nine subfamilies), and 82 species were recorded in the cambarazal areas (25 genera, 11 tribes and eight subfamilies). In these samplings, 23 ant species occurred exclusively in cordilheira (21.9%) and 20 in cambarazal (19.1%), while 62 species occurred in both areas (59.0%) (Table 1). Of the 82 species recorded in cambarazal areas, 49 occurred in both the dry and high water periods (59.8%), with 16 restricted to the dry (19.5%) and 17 to the high water period (20.7%). In the cordilheira areas, 49 ant species were common to the dry and high water periods (57.6%), 19 occurred only in the dry (22.4%) and 17 were sampled only during the high water period (20.0%).

The two NMDS ordination axes captured 70% of the variation in ant species composition (stress = 0.22). The indirect ordination, with presence and absence data of the ant species, showed differences between cambarazal and cordilheira areas (MANOVA: $F = 20.18$; $df = 1$; $p < 0.001$) (Fig. 1A) and between dry and high water seasons (MANOVA: $F = 4.42$; $df = 1$, $p = 0.018$) (Fig. 1B).

Species richness

Ant species richness did not vary between cambarazal and cordilheira forests (ANOVA, $F = 3.73$; $df = 1$; $p = 0.06$). Also, no variation was observed between dry and high water periods, both in the cambarazal (ANOVA,

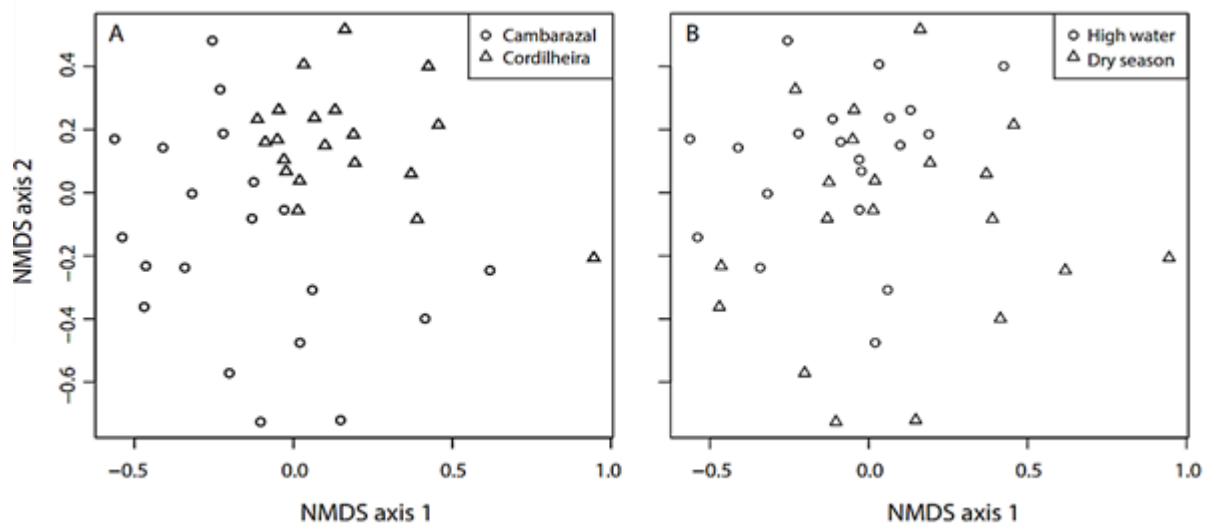


Figure 1. Evaluation of the composition of Formicidae assemblage based on the comparison between scores generated by NMDS from species presence/absence data between different vegetation formations (A) and between the dry and high water periods (B) in the northern Pantanal region of Mato Grosso, Brazil.

$F = 3.37$; $df = 1$; $p = 0.082$) as well as in the cordilheira (ANOVA, $F = 3.68$; $df = 1$; $p = 0.07$). Multiple regression analysis including phytosociological variables and canopy ant species richness in cordilheira revealed an effect of vegetation dominance on ant assemblage ($r^2 = 0.41$; $df = 16$; $p = 0.006$), while plant richness ($p = 0.12$) and vegetation density ($p = 0.19$) were not significant. The cambarazal areas did not reveal any effect of phytosociological variables on ant species richness.

Discussion

The composition of canopy ant assemblages varies according to the monodominant (cambarazal) and mixed-species (cordilheira) forests, as well as to the dry and high water periods. However, the richness of ant species was similar between these forests formations, and in the dry and high water periods. Studies carried out in the same region of the Pantanal showed similar results in relation to the species composition variation, but different for richness of ant assemblages throughout the seasonal periods (Marques et al., 2011; Yamazaki et al., 2016), as well as for other taxonomic groups of canopy arthropods (Battirola et al., 2016, 2017a,b).

The presence of greater tree richness in cordilheira areas was not preponderant in relation to the richness of ant species, showing that only variations in composition of the ant assemblage may be related to the habitat structure and seasonality in these forests formations. Distinct from our results, studies evidenced that ant assemblages associated with canopies may respond positively to an increase in tree richness, which is related to the greater availability of food and nesting resources, consequently determining which species and how many will occupy these habitats (e.g.

Hölldobler & Wilson, 1990; Maudsley, 2000; Ribas et al., 2003; Ribas & Shoemaker, 2007). Klimes et al. (2012) showed in a comparative study between primary and secondary forests that reduction in plant taxonomic diversity in secondary forests is not the main driver for the reduction in canopy ant species richness, indicating that the majority of arboreal species losses in secondary tropical forests are attributable to simplification of the vegetation structure.

Due to the monodominance of *V. divergens*, the cambarazais demonstrate distinct conditions in relation to the cordilheira forests. The lower number of tree species characteristic of these forests leads to changes in the variety and distribution of resources available to fauna (e.g. Tavares et al., 2001). Due to the smaller number of tree species and a canopy stratum dominated by *V. divergens*, the distribution of food and nesting resources, for example, becomes further homogenized and less diversified, as well as more concentrated in regard to species adapted to these conditions (e.g. Southwood, 1961; Root, 1973).

Additionally, canopy ant assemblages were influenced most likely by the phenology and seasonal variations in these habitats (Basset et al., 2003). Variations in plant phenology are directly related to the availability of food resources for ants, considering, for example, the increase of these resources during fruiting and flowering events, as well as the reduction in leaf fall and renewal periods (Basset et al., 2003; Castaño-Meneses, 2014). Besides this the phenology of *V. divergens* depends on the Pantanal's hydrological regime, with flowering during the dry period, fruiting during the rising water and high water periods, and foliage renewal during the receding water and dry periods (Nunes-da-Cunha & Junk, 2001; Uriu et al., 2017). The occurrence of the flowering, fruiting and foliage exchange stages may directly or indirectly impact assemblages in canopies, as well as

that observed for other arthropod groups in the Pantanal (Battirola et al., 2009; Marques et al., 2006, 2014; Meurer et al., 2015; Yamazaki et al., 2016).

In cambarazal areas, it is possible to suppose that the *V. divergens* phenology influences the distribution of associated arthropod assemblages, as well as the seasonal flooding causing the soil in these areas to remain waterlogged for up to four months, preventing its use by edaphic fauna (Battirola et al., 2009, 2010), requiring the organisms to develop survival strategies for these conditions (Adis et al., 2001; Soares et al., 2013; Marques et al., 2014; Battirola et al., 2017a,b). It is common to observe the migration of soil-dwelling ant species to tree trunks and canopies in these floodplain formations (Adis et al., 2001; Battirola et al., 2005; Meurer et al., 2015). This displacement, even if temporary, alters the structure of canopy assemblages (Battirola et al., 2009), either by greater competition for resources or for niches available to ants (Ribas et al., 2003; Ribas & Shoeder, 2007). Among the species of ants captured exclusively during the high water period, some are commonly associated with the edaphic environment, such as *Neivamyrmex diana* (Forel, 1912), *Ectatomma brunneum* Smith, 1858, *Gnamptogenys moelleri* (Forel, 1912) and *Atta sexdens rubropilosa* Forel, 1908, indicating a possible temporary displacement from the soil to the canopy of this monodominant forest.

Unlike the cambarazais, the cordilheiras located on higher portions of land in the Pantanal floodplain are not subject to inundation during the high water season, and can be used as areas of refuge for local fauna (Guarim-Neto, 1992; Silva et al., 2000; Nunes-da-Cunha et al., 2011; Morais et al., 2013). In addition to permanent stability due to the absence of seasonal flooding, the higher diversity of tree species gives rise to a greater variety and distribution of resources in comparison to monodominant forests (e. g. Maudsley, 2000). This stability is associated with the fact that the different plant species have distinct phenological phases, providing fauna with various resources throughout different periods of the year. This succession in the supply of resources allows for a greater number of generalist species and opportunistic exploitation. The fact that these forests do not suffer direct impacts from seasonal floods further increases their stability and constancy over time, maintaining richer assemblages adapted to the local conditions (Corrêa et al., 2006; Ribas & Shoeder, 2007). In these mixed-vegetation areas, it was observed that among the analysed vegetation variables, only dominance had an effect on canopy ant richness, demonstrating the heterogeneity of the area and the distribution of available resources (e. g. Lange et al., 2008).

In general, the composition of canopy ant assemblages varied according to the evaluated vegetation formations (habitat heterogeneity) as well as the different seasonal periods of the Mato Grosso Pantanal. However, in

our study, no effects of the greater richness of arboreal species in cordilheira areas on the species richness of canopy ants was observed. In the same way, no variation in ant richness between the dry and full water / flood seasons was observed for both areas. Our results demonstrate the importance of habitat variety and the complexity of their functioning in these flood plains, as well as the need for the maintenance and conservation of these habitats, for the conservation of ant assemblages associated with this ecosystem.

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Table 1. Presence (1) and absence (-) of Formicidae specimens sampled in the canopy of monodominant (cambarazal) and mixed-species (cordilheira) vegetation formations during dry and high water periods in the northern Pantanal region of Mato Grosso, Brazil.

Taxa	Species	Cambarazal		Cordilheira	
		Dry season	High water	Dry season	High water
Amblyoponinae					
Amblyoponini	<i>Prionopelta</i> sp.	1	-	1	-
Dolichodorinae					
Dolichoderini	<i>Azteca trigona</i> Emery, 1893	1	-	1	1
	<i>Azteca</i> sp.	-	-	1	-
	<i>Dolichoderus bispinosus</i> (Olivier, 1792)	1	1	-	-
	<i>Dolichoderus ferrugineus</i> Forel, 1903	1	1	-	-
	<i>Dolichoderus lamellosus</i> (Mayr, 1870)	1	1	1	1
	<i>Dolichoderus lutosus</i> (Smith, 1858)	1	1	1	1
	<i>Dolichoderus voraginosus</i> MacKay, 1993	1	1	1	1
	<i>Dolichoderus</i> sp.	-	-	1	-
	<i>Dorymyrmex brunneus</i> Forel, 1908	1	-	1	1
	<i>Linepithema humile</i> (Mayr, 1868)	1	1	1	-
	<i>Linepithema micans</i> (Forel, 1908)	-	-	1	1
Dorylinae					
Ecitonini	<i>Neivamyrmex diana</i> (Forel, 1912)	-	1	-	1
	<i>Neivamyrmex</i> sp.	-	-	1	-
Ectatomminae					
Ectatommini	<i>Ectatomma brunneum</i> Smith, 1858	-	1	-	1
	<i>Ectatomma planidens</i> Borgmeier, 1939	-	-	1	-
	<i>Ectatomma tuberculatum</i> (Olivier, 1792)	-	-	1	1
	<i>Gnamptogenys moelleri</i> (Forel, 1912)	-	1	-	1
Formicinae					
Brachymyrmecini	<i>Brachymyrmex heeri</i> Forel, 1874	1	1	1	1
	<i>Brachymyrmex patagonicus</i> Mayr, 1868	1	1	1	1
	<i>Brachymyrmex</i> sp.	-	-	1	-
	<i>Myrmelachista</i> sp.	1	1	1	1
	<i>Nylanderia</i> sp. 1	1	1	1	-
	<i>Nylanderia</i> sp. 2	-	1	-	1
	<i>Nylanderia</i> sp. 3	-	1	-	-
	<i>Nylanderia</i> sp. 4	1	-	-	-
Camponotini	<i>Camponotus arboreus</i> Smith, 1858	1	1	1	1
	<i>Camponotus bidens</i> Mayr, 1870	1	-	-	-
	<i>Camponotus crassus</i> Mayr, 1862	1	1	1	1
	<i>Camponotus fastigatus</i> Roger, 1863	1	1	1	1
	<i>Camponotus leydigi</i> Forel, 1886	1	1	1	1
	<i>Camponotus renggeri</i> Emery, 1894	1	-	1	-
	<i>Camponotus rufipes</i> (Fabricius, 1775)	1	-	1	-
	<i>Camponotus sexguttatus</i> (Fabricius, 1793)	-	1	1	1
	<i>Camponotus (Myrmobrachys)</i> sp. 1	-	1	-	1
	<i>Camponotus (Myrmophaenus)</i> sp. 2	1	-	1	-
	<i>Camponotus (Tanaemyrmex)</i> sp. 3	1	1	1	1
	<i>Camponotus (Tanaemyrmex)</i> sp. 4	1	1	1	1
Myrmicinae					
Attini	<i>Acromyrmex rugosus</i> (Smith, 1858)	-	-	-	1
	<i>Atta laevigata</i> Smith, 1858	-	-	-	1
	<i>Atta sexdens rubropilosa</i> Forel, 1908	-	1	1	1
	<i>Atta</i> sp.	-	-	-	1
	<i>Cephalotes atratus</i> Linnaeus, 1758	1	1	1	1
	<i>Cephalotes clypeatus</i> (Fabricius, 1804)	1	1	-	-
	<i>Cephalotes guayaki</i> De Andrade, 1999	1	-	-	-
	<i>Cephalotes maculatus</i> (Smith, 1876)	1	1	1	1

Table 1. Presence (1) and absence (-) of Formicidae specimens sampled in the canopy of monodominant (cambarazal) and mixed-species (cordilheira) vegetation formations during dry and high water periods in the northern Pantanal region of Mato Grosso, Brazil. (Continuation)

	<i>Cephalotes minutus</i> (Fabricius, 1804)	1	1	1	1
	<i>Cephalotes pallidus</i> De Andrade, 1999	1	1	1	1
	<i>Cephalotes pavonii</i> (Latreille, 1809)	1	-	-	-
	<i>Cephalotes persimilis</i> De Andrade, 1999	1	1	1	1
	<i>Cephalotes pusillus</i> (Klug, 1824)	1	-	1	1
	<i>Cephalotes umbraculatus</i> (Fabricius, 1804)	1	-	1	-
	<i>Cephalotes</i> gr. <i>laminatus</i> sp. 2	-	1	-	1
	<i>Cephalotes</i> sp. 1	-	-	1	-
	<i>Mycocepurus goeldii</i> (Forel, 1893)	-	-	-	1
	<i>Pheidole astur</i> Wilson, 2003	-	1	1	1
	<i>Pheidole</i> (gr. <i>Fallax</i>) sp. 1	1	1	1	1
	<i>Pheidole</i> (gr. <i>Flavens</i>) sp. 5	-	-	1	1
	<i>Pheidole</i> (gr. <i>Flavens</i>) sp. 6	-	1	1	1
	<i>Pheidole</i> sp. 2	1	-	-	-
	<i>Pheidole</i> sp. 3	1	-	-	-
	<i>Procryptocerus hylaeus</i> Kempf, 1951	1	1	-	-
	<i>Trachymyrmex</i> sp.	-	-	1	-
	<i>Wasmannia rochai</i> Forel, 1912	1	1	1	1
Crematogastrini	<i>Crematogaster brasiliensis</i> Mayr, 1878	1	1	1	-
	<i>Crematogaster crinosa</i> Mayr, 1862	-	-	-	1
	<i>Crematogaster curvispinosus</i> Mayr, 1862	1	1	1	1
	<i>Crematogaster victima</i> Smith, 1858	1	1	1	1
	<i>Crematogaster</i> sp.	-	-	1	-
	<i>Nesomyrmex tristani</i> (Emery, 1896)	1	1	1	1
	<i>Nesomyrmex wilda</i> (Smith, 1943)	1	-	-	-
	<i>Nesomyrmex</i> sp.3	-	1	-	-
	<i>Xenomyrmex</i> sp. 1	1	1	1	1
	<i>Xenomyrmex</i> sp. 2	1	1	1	1
Solenopsidini	<i>Strumigenys trinidadensis</i> Wheeler, 1922	1	-	-	-
	<i>Solenopsis</i> sp. 1	1	1	1	1
	<i>Solenopsis</i> sp. 2	1	1	1	1
	<i>Solenopsis</i> sp. 3	1	1	-	-
	<i>Solenopsis</i> sp. 4	1	1	1	1
Ponerinae					
Ponerini	<i>Hypoponera opaciceps</i> (Mayr, 1887)	-	-	-	1
	<i>Hypoponera</i> sp. 1	-	-	1	-
	<i>Hypoponera</i> sp. 2	-	-	1	-
	<i>Neoponera curvinodis</i> (Forel, 1899)	-	1	1	1
	<i>Neoponera foetida</i> (Linnaeus, 1758)	-	1	-	-
	<i>Neoponera unidentata</i> (Mayr, 1862)	-	-	-	1
	<i>Neoponera villosa</i> (Fabricius, 1804)	1	1	1	1
	<i>Odontomachus bauri</i> Emery, 1891	-	1	-	-
Paraponerinae					
Paraponerini	<i>Paraponera clavata</i> (Fabricius, 1775)	-	-	-	1
Pseudomyrmecinae					
Pseudomyrmecini	<i>Pseudomyrmex atripes</i> (Smith, 1860)	1	1	-	1
	<i>Pseudomyrmex curacaensis</i> (Forel, 1912)	1	1	-	1
	<i>Pseudomyrmex dendroicus</i> (Forel, 1904)	-	-	1	-
	<i>Pseudomyrmex gracilis</i> (Fabricius, 1804)	1	1	1	1
	<i>Pseudomyrmex pupa</i> (Forel, 1911)	1	1	1	1
	<i>Pseudomyrmex rochai</i> (Forel, 1912)	1	1	1	1
	<i>Pseudomyrmex schuppi</i> (Forel, 1901)	1	1	1	1
	<i>Pseudomyrmex tenuis</i> (Fabricius, 1804)	-	-	1	-
	<i>Pseudomyrmex tenuissimus</i> (Emery, 1906)	1	1	1	1
	<i>Pseudomyrmex termitarius</i> (Smith, 1855)	1	1	1	1
	<i>Pseudomyrmex triplarinus</i> (Weddell, 1850)	-	1	-	-

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<i>Pseudomyrmex</i> gr. <i>pallidus</i> sp. 1	1	1	1	1
<i>Pseudomyrmex</i> gr. <i>pallidus</i> sp. 2	-	-	1	1
<i>Pseudomyrmex</i> gr. <i>pallidus</i> sp. 3	-	1	-	-
<i>Pseudomyrmex</i> gr. <i>pallidus</i> sp. 4	1	1	1	1
<i>Pseudomyrmex</i> gr. <i>pallidus</i> sp. 5	1	1	-	-
<i>Pseudomyrmex</i> gr. <i>pallidus</i> sp. 6	1	1	-	1