



RESEARCH ARTICLE - ANTS

Ants of the Panga Ecological Station, a *Cerrado* Reserve in Central Brazil

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Abstract

Species lists are an invaluable tool for a more comprehensive analysis of diversity patterns. Such lists, when derived from a comprehensive sampling effort, can indicate the presence of rare, threatened, or ecologically important species. This study aimed to generate a species list of the ants of the Panga Ecological Station, a protected *Cerrado* reserve in southeastern Brazil. This list was generated through taxonomic identification or through unification of the morphospecies codes of all specimens collected at the reserve in ten different studies since 2003. Information about the types of habitat and strata of occurrence of each species or morphospecies was also compiled. The data presented here represents one of the most intensive ant inventories conducted in the Brazilian *Cerrado*. We recorded 277 ant species belonging to 58 genera and nine subfamilies. This number is 1.63 to 3.69 times higher than the number of species recorded in other *Cerrado* localities surveyed so far. More species were collected in the savanna (249 species) than in the forest habitats (108 species), and more species were collected on ground (226 species) than in arboreal vegetation (117 species). Taxonomic identification was possible for 171 of the 277 species collected. Three of the named species are recorded for the first time in Brazil. Among the 106 unidentified species, at least six of them represent new, undescribed species. Together, these results highlight the conservation potential of this *Cerrado* reserve.

Introduction

One of the first steps for the establishment of effective conservation actions and monitoring programs is the generation and maintenance of species distribution records (Agosti & Alonso, 2000). In this sense, species lists play an important role because they provide essential data for a more comprehensive analysis of diversity patterns, including biogeographical patterns (Fisher, 2010). The compilation of species lists can also determine the presence of rare, threatened, or ecologically important species (Agosti & Alonso, 2000) that otherwise could be missed in a single survey. In addition, recording the distribution of species is essential for the creation of a data network (Agosti & Alonso, 2000) that can be very important for basic research, allowing taxonomists to access new records of poorly known species.

Comprehensive invertebrate surveys are essential for biodiversity studies as invertebrates are highly abundant, diverse, and play key ecological roles in most terrestrial ecosystems

(Fittkau & Klinge, 1973; Alonso & Agosti, 2000). Ants are a particularly important group of terrestrial invertebrates, as they establish mutualistic associations with many organisms (Ness et al., 2010), are predators of other invertebrates (Philpott & Armbrecht, 2006), secondary seed dispersers, and contribute to soil aeration (Lee & Foster, 1991) and nutrient cycling (Hudson et al., 2009). However, as is also the case for many other invertebrate groups, one of the difficulties in generating a list of ant species from a given locality or region is the taxonomic identification. This identification is usually performed at the “morphospecies” level, what makes the compilation of data originated from different researchers very difficult or even not possible.

More than 12,900 ant species, distributed in 324 genera, are known worldwide (Bolton, 2014). This fauna has strong biogeographic patterns, with different regions containing endemic and strongly related taxa that show rapid species turnover within their borders (Fisher, 2010). Their abundance and diversity reach



a peak in tropical regions and decline in temperate latitudes (Fernandez & Sendoya, 2004). The Neotropical region has the greatest ant diversity and the highest level of endemism among the different biogeographic regions in the globe (Fisher, 2010), harboring 30% of all ant species currently described (Fernandez & Sendoya, 2004). Nevertheless, there are few comprehensive inventories of the Neotropical ant fauna (but see Longino & Colwell, 1997), particularly in non-forest ecosystems.

The *Cerrado*, one of the biodiversity hotspots worldwide (Myers et al., 2000), comprises a mosaic of vegetation types, which includes grasslands, forests, and especially savannas of variable structure that originally covered over two million square kilometers of Central Brazil. About 10,000 plant species occurs in the *Cerrado* region, of which approximately 40% are endemic (Ratter et al., 1997). However, this biodiversity is highly threatened by the expansion of modern agriculture. The creation of Conservation Units in this biome is urgent, since only less than 3% of the original *Cerrado* area is currently preserved (Klink & Machado, 2005).

One of the best known ant faunas of *Cerrado* is the fauna of the “Reserva Ecológica do Panga” (hereafter Panga Ecological Station), a reserve of 409 ha located in Uberlândia, Minas Gerais, Brazil. Since 2003 several studies involving the ant fauna were conducted in this reserve (Vasconcelos et al., 2008; Campos et al., 2011; Lopes & Vasconcelos, 2008; Lopes & Vasconcelos, 2011; Pacheco & Vasconcelos, 2007; Pacheco & Vasconcelos, 2012; Powell et al., 2011; Vasconcelos et al., 2009; Camarota et al., 2015). However, a complete list of the species collected in the reserve was never compiled, since each study generated its own list of species and morphospecies and the codes used to separate the morphospecies were unique for each study. The objective of this study was to integrate information derived from the various ant surveys performed at the Panga Ecological Station, in order

to provide a comprehensive list of species. For this, we examined the specimens collected in each study, identifying to species level whenever possible and, when this was not possible, assigning a standardized code for each recognized morphospecies.

Material and methods

All ants listed in this study were collected at the Panga Ecological Station (PES), a 409 ha reserved owned by the University of Uberlândia (UFU) and located 30 km south of Uberlândia, Minas Gerais State, Brazil (19° 10' S, 48° 24' W). The region is characterized by a tropical climate with two distinct seasons: a dry winter (from May to September) and a rainy summer (from October to April). Average annual temperature in this locality is 22.8° C and average annual rainfall is 1482 mm. Soils at the site are primarily red latosols. Most of the reserve is covered by savannas - of which *cerrado sensu stricto* is the predominant - and in addition there are patches of forests and seasonally water-logged swamps. For a more detailed description of the vegetation of the study area see Cardoso et al. (2009).

The species list provided here results from a compilation of data from 10 different ant surveys performed at PES since 2003 (Table 1). All specimens collected during these studies are deposited at the Zoological Collection of the Federal University of Uberlândia (UFU), in Uberlândia, Brazil. We examined all specimens deposited at UFU's Zoological Collection. All material identified at the morphospecies level was revised in order to unify morphospecies codes across the studies. Once this was done, we attempted to identify the specimens using taxonomic keys (Longino, 2003; Wild, 2005; Mayhé-Nunes & Brandão, 2006; Klingenberg & Brandão, 2009; Mackay & Mackay, 2010) or by sending specimens to ant taxonomists (see acknowledgments).

Table 1. List of studies involving the ant fauna of the Panga Ecological Station, including sampling effort, sampling method and habitats studied.

Source	Number of samples	Sampling method	Habitats sampled
Pacheco & Vasconcelos (2007)	60	Baited pitfall traps	Savanna (<i>Cerrado sensu stricto</i>)
Lopes & Vasconcelos (2008)	120	Baits Pitfall traps Winkler extractor	Savanna (<i>Cerrado sensu stricto</i> , <i>Cerrado ralo</i> and <i>Cerrado Denso</i>), Forest
Vasconcelos et al. (2008)	80	Corn flour baits Orange peel baits	Savanna (<i>Campo Cerrado</i> , <i>Cerrado sensu stricto</i> , <i>Cerradão</i>), Semideciduous forest
Vasconcelos et al. (2009)	160	Mini-Winkler extractors	Savanna (<i>Cerrado Denso</i>)
Campos et al. (2011)	320	Pitfall traps Sardine and honey baits	<i>Cerrado sensu stricto</i>
Lopes & Vasconcelos (2011)	90	Vegetation beating Active search	Savanna (<i>Cerrado denso</i>)
Powell et al. (2011)	60	Baited pitfall traps	Savanna (<i>Cerrado sensu stricto</i> , <i>Cerrado ralo</i> , <i>Cerradão</i>)
Pacheco & Vasconcelos (2012)	100	Pitfall traps (epigeic and hypogeic)	Savanna (<i>Cerrado sensu stricto</i>)
Koch (2014)	81	Baited pitfall traps Vegetation beating	Savanna (<i>Cerrado sensu stricto</i> , <i>Cerrado ralo</i>)
Camarota et al. (2015)	240	Baited pitfall traps	Savanna (<i>Cerrado sensu stricto</i> , <i>Cerrado ralo</i>)

Sampling completeness (across all studies) was determined using the Chao 2 species richness estimator, which was calculated using the default options of EstimateS 9.1.0 (Colwell et al, 2012). Based on information existing on the specimens labels and/or through information in the original data sets of the various studies listed in Table 1, we determined the habitats (savanna or forest) and the foraging strata (soil or woody vegetation) of occurrence (number of times the species was recorded in all studies) for each species and morphospecies.

Results

We recorded a total of 277 ant species from 58 genera and nine subfamilies (Appendix). Using taxonomic keys or with the aid of experts we were able to name a total of 177 species (63.9% of the total). In the previous studies conducted at PES only 24 species had been formally named. Therefore, the present study adds 153 species names for the ant fauna of the reserve. The total number of species recorded so far at the reserve represents 89.2% of the expected species number to be found there according to the species richness estimator Chao 2 (310.4 species). The diversity-dominance curve (Fig 1) shows a high proportion of rare species (24.9% of the total), i.e. of species that were collected only once or twice.

The subfamily Myrmicinae was the most diverse, with 153 species, followed by Formicinae with 43 species and Dolichoderinae and Ponerinae, with 23 species each. The most diverse genus was *Pheidole* with 39 species, followed by *Camponotus* with 35 and *Cephalotes*, with 17 species. The most frequent species was *Camponotus crassus* Mayr, 1862, with 442 records of occurrence, followed by *Cephalotes pusillus* (Klug, 1824), *Pheidole oxyops* Forel, 1908 and *Pheidoleradoszkowskii* Mayr, 1884 with 348, 337 and 306 records, respectively.

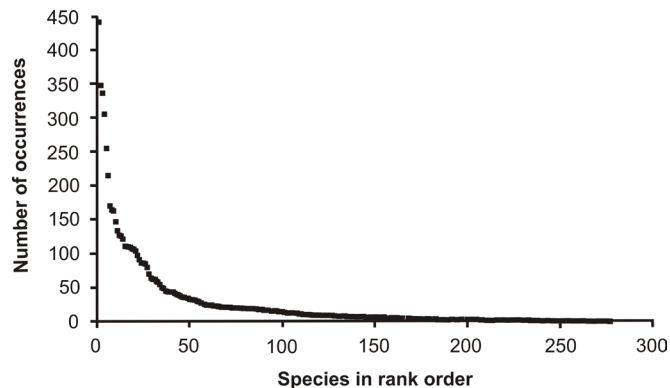


Fig 1. Diversity-abundance curve of all ant species collected at the Panga Ecological Station.

More species were recorded in the savanna (249 species) than in the forest habitats (108 species), and more species were collected on ground (226 species) than in the arboreal vegetation (117 species). A total of 160 species from 56 genera were only found on ground, whereas 51 species from 23 genera were only found in the woody vegetation. Regarding species occurrences in different vegetation types, 169 species were collected exclusively in the savanna habitats, 28 only in the forest habitats, and 141 in both.

Discussion

The data presented here represents one of the most intensive ant inventories conducted in the Brazilian *Cerrado*. We found that at least 277 ant species coexist within the 409 hectares of Panga Ecological Station. This number of species is nearly as high as the number of species recorded by Silvestre et al. (2004) in seven different *Cerrado* localities (333 species in total) and higher than the number of species recorded in savannas of Africa and Australia (Table 2).

Table 2. Number of ant species recorded in different tropical savannas areas of the world.

Locality sampled	Ant species richness	Number of samples	Sampling methodology	Type of habitat	Source
Brazil (SP e GO)	56	120	Baits	Cerrado	Silva et al. (2004)
Brazil, Niquelândia (GO)	158	50	Baits and additional methods*	Cerrado	Silvestre et al. (2004)
Brazil, Colinas do Sul (GO)	167	50	Baits and additional methods*	Cerrado	Silvestre et al. (2004)
Brazil, Campinaçu (GO)	154	50	Baits and additional methods*	Cerrado	Silvestre et al. (2004)
Brazil, Uruaçu (GO)	170	50	Baits and additional methods*	Cerrado	Silvestre et al. (2004)
Brazil, Luiz Antônio (SP)	128	50	Baits and additional methods*	Cerrado	Silvestre et al. (2004)
Brazil, Cajuru (SP)	85	150	Baits and additional methods*	Cerrado	Silvestre et al. (2004)
Brazil, Aguas Emendadas (DF)	75	150	Baits and additional methods*	Cerrado	Silvestre et al. (2004)
Brazil (MG)	61	51	Baited pitfall traps	Cerrado	Campos et al. (2008)
Australia	27	100	Sweep nets	Arboreal savanna	Andersen et al. (2007)
Africa	34	105	Mini-Winkler extractor and pitfall traps	Arboreal savanna	Parr&Chown (2001)
Africa	160	120	Pitfall traps	Arboreal savanna	Parr et al. (2004)
Africa	72	200	Pitfall traps	Arboreal savanna	Sithole et al. (2010)

*Including manual collection, pitfall traps, subterranean pitfall traps, color trays, light traps, Malaise traps and Winkler extractors.

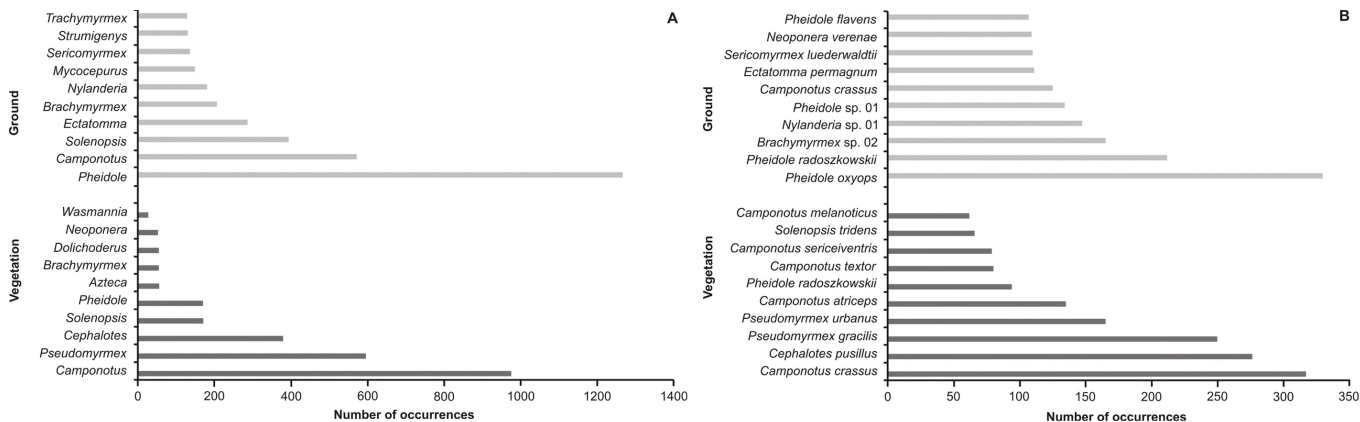


Fig 2. The most abundant ant genera (A) and most abundant species (B) collected on ground or in the woody vegetation.

However, it is important to mention that the elevated number of species recorded at PES may only reflect the higher diversity of sampling methods and/or the higher intensity of sampling at this reserve compared to the other savannas areas sampled so far.

Only 66 species were recorded both on ground and in the woody vegetation, indicating that, as also observed in tropical forests (Bruhl et al., 1998; Vasconcelos & Vilhena, 2006; Wilkie et al., 2010) and in other *Cerrado* areas (Campos et al., 2008), there is a vertical stratification of the ant fauna. *Camponotus*, *Pseudomyrmex* and *Pheidole* were the most frequent genera in the vegetation, whereas *Pheidole*, *Camponotus* and *Solenopsis* were the most frequent ones on ground. Differences in species composition were also clear. The most abundant species in the vegetation were *Camponotus crassus* and *Cephalotes pusillus*, whereas on ground *Pheidole oxyops* and *Pheidole radoszkowskii* were the most abundant ones (Fig 2). Therefore, the high diversity of ants in the *Cerrado* reserve we studied can be explained, at least in part, by the specialization of some species to forage and/or nest either on ground or in the vegetation (Campos et al., 2008). Habitat specialization is probably also involved since many of the species inhabiting the savannas were not recorded in the forest habitats and vice-versa (Fig 3).

Taxonomic identification was possible for 171 of the 277 species collected at PES. Although many of the named species are widely distributed in Neotropics (Fernandez & Sendoya, 2004) some are poorly known. For instance, *Pheidole superba* Wilson, 2003, was previously known only from its type locality in Colombia and from Panamá (Wilson, 2003). Similarly, *Crematogaster crucis* Forel, 1912 and *Myrmicocrypta urichi* Weber, 1937 were recorded for the first time in Brazil (Ant Wiki, 2014). *Cyatta abscondita* Sosa-Calvo, Schultz, Brandão, Klingenberg, Feitosa, Rabeling, Bacci, Lopes & Vasconcelos, 2014, the only representative of the newly described genus *Cyatta*, is also present at PES. The same is true for *Cephalotes specularis* Brandão, Feitosa, Powell & Del-Claro, 2014, a newly described species that presents a remarkable social parasitism behavior (Powell et al., 2014). In addition, *Pseudomyrmex curacaensis* (Forel, 1912) and *Pseudomyrmex euryblemma* (Forel, 1899) are recorded for the first time in the *Cerrado* region (Rodrigo M. Feitosa, Departamento de Zoologia da Universidade Federal do Paraná, personal communication, December 12, 2014).

Among the 106 unidentified species, at least six of them represent new, undescribed species, including five species of *Trachymyrmex* (Antônio Mayhé-Nunes, Departamento de

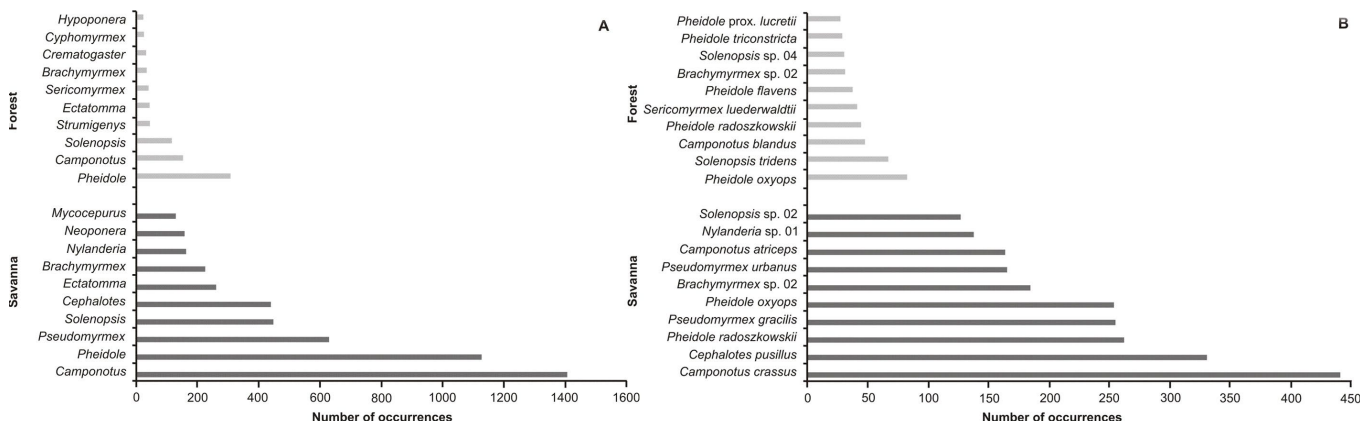


Fig 3. The most abundant ant genera (A) and most the abundant species (B) collected in the savanna or forest habitats.

Biologia Animal, Universidade Federal Rural do Rio de Janeiro, personal communication, July 2010) and one species of *Xenomyrmex* (Livia P. Prado, Museu de Zoologia da Universidade de São Paulo, personal communication, February 14, 2014). Together, these results highlight the conservational potential of this *Cerrado* reserve. The Panga Ecological Station harbors a surprisingly high number of ant species indicating that, although poorly studied, the *Cerrado* has a highly diverse ant fauna. Moreover, the large number of species that remain unnamed shows that the ant fauna of this region is taxonomically poorly known, emphasizing the need for a greater effort in the collection and description of new species.

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Appendix. List of species recorded at the Panga Ecological Station. Numbers represent the total number of occurrences in different habitats or strata.

	Savanna	Forest	Ground	Woody vegetation	Total
Amblyoponinae					
Prionopelta					
<i>Prionopelta</i> cf. <i>punctulata</i> Mayr, 1866	5	4	9	0	9
Dolichoderinae					
Azteca					
<i>Azteca</i> sp. 01	32	0	0	32	32
<i>Azteca</i> sp. 02	19	0	2	17	19
<i>Azteca</i> sp. 03	10	0	5	5	10
<i>Azteca</i> sp. 04	1	0	0	1	1
Dolichoderus					
<i>Dolichoderus</i> <i>bispinosus</i> (Olivier, 1792)	6	0	0	6	6
<i>Dolichoderus</i> <i>diversus</i> Emery, 1894	1	0	1	0	1
<i>Dolichoderus</i> <i>imitator</i> (Emery, 1894)	2	0	2	0	2
<i>Dolichoderus</i> <i>lamellosus</i> (Mayr, 1870)	16	0	0	16	16
<i>Dolichoderus</i> <i>lutosus</i> (F. Smith, 1858)	32	0	0	32	32
Dorymyrmex					
<i>Dorymyrmex</i> prox. <i>jheringi</i> Forel, 1912	8	0	8	0	8
<i>Dorymyrmex</i> <i>pyramicus</i> Forel, 1912	47	7	44	10	54
<i>Dorymyrmex</i> sp. 01	1	0	1	0	1
<i>Dorymyrmex</i> sp. 02	0	1	0	1	1
Forelius					
<i>Forelius</i> <i>brasiliensis</i> (Forel, 1908)	6	0	3	0	6
<i>Forelius</i> <i>maranhaoensis</i> Cuezco, 2000	2	0	2	0	2
Gracilidris					
<i>Gracilidris</i> <i>pombero</i> Wild & Cuezco, 2006	1	0	1	0	1
Linepithema					
<i>Linepithema</i> <i>aztecoides</i> Wild, 2007	98	0	73	25	98
<i>Linepithema</i> <i>cerradense</i> Wild, 2007	1	0	1	0	1
<i>Linepithema</i> <i>micans</i> Forel, 1908	12	0	11	1	12
<i>Linepithema</i> sp. 01	13	6	19	0	19
Tapinoma					
<i>Tapinoma</i> sp. 01	7	0	7	0	7
<i>Tapinoma</i> sp. 02	5	0	5	0	5
<i>Tapinoma</i> sp. 03	13	0	0	13	13
Dorylinae					
Cerapachys					
<i>Cerapachys</i> <i>splendens</i> Borgmeier, 1957	2	2	4	0	4
Eciton					
<i>Eciton</i> <i>vagans</i> Borgmeier, 1955	2	1	3	0	3
Labidus					
<i>Labidus</i> <i>coecus</i> (Latreille, 1802)	11	0	10	1	11
Neivamyrmex					
<i>Neivamyrmex</i> sp. 01	6	0	6	0	6
Nomamyrmex					
<i>Nomamyrmex</i> <i>esenbeckii</i> (Westwood, 1842)	2	0	2	0	2

Appendix. List of species recorded at the Panga Ecological Station. Numbers represent the total number of occurrences in different habitats or strata (Continuation).

	Savanna	Forest	Ground	Woody vegetation	Total
Ectatomminae					
<i>Ectatomma</i>					
<i>Ectatomma brunneum</i> F. Smith, 1858	10	0	8	2	10
<i>Ectatomma edentatum</i> Roger, 1863	12	1	13	0	13
<i>Ectatomma lugens</i> Emery, 1894	41	17	58	0	58
<i>Ectatomma opaciventre</i> Roger, 1861	27	6	33	0	33
<i>Ectatomma permagnum</i> Forel, 1908	104	7	111	0	111
<i>Ectatomma planidens</i> Borgmeier, 1939	16	0	16	0	16
<i>Ectatomma suzanae</i> Almeida, 1986	35	8	43	0	43
<i>Ectatomma tuberculatum</i> Olivier, 1792	14	5	4	15	19
<i>Gnamptogenys</i>					
<i>Gnamptogenys acuminata</i> (Emery, 1896)	4	0	4	0	4
<i>Gnamptogenys horni</i> (Santschi, 1929)	2	0	2	0	2
<i>Gnamptogenys striatula</i> Mayr, 1884	5	2	10	0	10
<i>Typhlomyrmex</i>					
<i>Typhlomyrmex</i> sp. 01	1	0	1	0	1
Formicinae					
<i>Brachymyrmex</i>					
<i>Brachymyrmex</i> sp. 01	40	3	39	4	43
<i>Brachymyrmex</i> sp. 02	184	31	165	50	215
<i>Brachymyrmex</i> sp. 03	2	0	2	0	2
<i>Camponotus</i>					
<i>Camponotus arboreus</i> (F. Smith, 1858)	25	0	7	18	25
<i>Camponotus atriceps</i> (F. Smith, 1858)	163	7	35	135	170
<i>Camponotus blandus</i> (F. Smith, 1858)	74	47	68	53	121
<i>Camponotus cameranoi</i> Emery, 1894	11	0	0	11	11
<i>Camponotus cingulatus</i> Mayr, 1862	5	19	20	4	24
<i>Camponotus crassus</i> Mayr, 1862	442	0	125	317	442
<i>Camponotus dimorphus</i> Emery, 1894	0	3	0	3	3
<i>Camponotus fastigatus</i> Roger, 1863	4	0	0	4	4
<i>Camponotus genatus</i> Santschi, 1922	7	0	0	7	7
<i>Camponotus latangulus</i> Roger, 1863	1	15	9	7	16
<i>Camponotus lespeii</i> Forel, 1866	90	20	89	21	110
<i>Camponotus leydigi</i> Forel, 1866	5	2	3	4	7
<i>Camponotus melanoticus</i> Santschi, 1839	84	1	20	62	85
<i>Camponotus novogranadensis</i> Mayr, 1870	6	0	5	1	6
<i>Camponotus renggeri</i> Emery, 1894	64	0	41	19	64
<i>Camponotus rufipes</i> Fabricius, 1775	42	2	19	25	44
<i>Camponotus senex</i> F. Smith, 1858	21	0	0	21	21
<i>Camponotus sericeiventris</i> Guerin-Meneville, 1838	111	16	46	79	127
<i>Camponotus tenuiscapus</i> Roger, 1893	21	0	10	11	21
<i>Camponotus textor</i> Forel, 1899	80	0	0	80	80
<i>Camponotus trapeziceps</i> Santschi, 1922	0	1	0	1	1
<i>Camponotus vittatus</i> Forel, 1904	1	0	1	0	1
<i>Camponotus</i> sp. 01	62	0	6	56	62

Appendix. List of species recorded at the Panga Ecological Station. Numbers represent the total number of occurrences in different habitats or strata (Continuation).

	Savanna	Forest	Ground	Woody vegetation	Total
Camponotus (Continuation)					
<i>Camponotus</i> sp. 02	24	0	0	24	24
<i>Camponotus</i> sp. 03	0	1	0	1	1
<i>Camponotus</i> sp. 04	6	0	2	4	6
<i>Camponotus</i> sp. 05	4	0	3	0	4
<i>Camponotus</i> sp. 06	4	0	4	0	4
<i>Camponotus</i> sp. 07	10	0	5	5	10
<i>Camponotus</i> sp. 08	20	0	20	0	20
<i>Camponotus</i> sp. 09	3	5	6	2	8
<i>Camponotus</i> sp. 10	0	12	11	1	12
<i>Camponotus</i> sp. 11	5	0	5	0	5
<i>Camponotus</i> sp. 12	5	0	5	0	5
<i>Camponotus</i> sp. 13	6	0	6	0	6
Myrmelachista					
<i>Myrmelachista</i> sp. 01	15	3	18	0	18
Nylanderia					
<i>Nylanderia</i> sp. 01	137	10	147	0	147
<i>Nylanderia</i> sp. 02	2	0	2	0	2
<i>Nylanderia</i> sp. 03	9	9	18	0	18
<i>Nylanderia</i> sp. 04	14	0	14	0	14
Heteroponerinae					
Acanthoponera					
<i>Acanthoponera mucronata</i> Roger, 1860	1	0	0	1	1
Myrmicinae					
Acanthognathus					
<i>Acanthognathus rudis</i> Brown & Kempf, 1969	1	1	2	0	2
Acromyrmex					
<i>Acromyrmex ambiguus</i> Emery, 1888	1	0	1	0	1
<i>Acromyrmex balzani</i> Emery, 1890	9	0	9	0	9
<i>Acromyrmex subterraneus</i> (Forel, 1893)	0	2	2	0	2
Apterostigma					
<i>Apterostigma</i> sp.01	6	1	6	1	7
<i>Apterostigma</i> sp.02	35	0	35	0	35
<i>Apterostigma</i> gr. <i>auriculatum</i> sp.03	0	6	6	0	6
Atta					
<i>Atta laevigata</i> Smith, F., 1858	18	2	13	7	20
<i>Atta sexdens</i> Linnaeus, 1758	1	5	6	0	6
Cardiocondyla					
<i>Cardiocondyla emeryi</i> Forel, 1881	4	0	4	0	4
Carebara					
<i>Carebara brevipilosa</i> (Fernandéz, 2004)	8	5	13	0	13
<i>Carebara urichi</i> (W.M. Wheeler, 1922)	1	0	1	0	1
<i>Carebara</i> gr. <i>lignata</i> sp. 01	2	0	2	0	2
Cephalotes					
<i>Cephalotes adolphi</i> Emery, 1906	1	0	0	1	1
<i>Cephalotes angustus</i> Mayr, 1862	7	0	0	7	7

Appendix. List of species recorded at the Panga Ecological Station. Numbers represent the total number of occurrences in different habitats or strata (Continuation).

	Savanna	Forest	Ground	Woody vegetation	Total
<i>Cephalotes</i> (Continuation)					
<i>Cephalotes atratus</i> (Linnaeus, 1758)	21	0	0	21	21
<i>Cephalotes clypeatus</i> Fabricius, 1804	3	0	0	3	3
<i>Cephalotes cordatus</i> Smith, F., 1853	4	0	0	4	4
<i>Cephalotes depressus</i> Klug, 1824	1	0	0	1	1
<i>Cephalotes eduarduli</i> Forel, 1921	5	0	2	3	5
<i>Cephalotes grandinosus</i> (F. Smith, 1860)	21	0	2	19	21
<i>Cephalotes liepini</i> De Andrade, 1999	2	0	0	2	2
<i>Cephalotes maculatus</i> (F. Smith, 1876)	7	0	0	7	7
<i>Cephalotes minutus</i> (Fabricius, 1804)	9	0	2	7	9
<i>Cephalotes pallidoides</i> De Andrade, 1999	7	0	0	7	7
<i>Cephalotes pellans</i> De Andrade, 1999	10	0	0	10	10
<i>Cephalotes persimilis</i> De Andrade, 1999	9	0	1	8	9
<i>Cephalotes pusillus</i> (Klug, 1824)	331	17	71	277	348
<i>Cephalotes simillimus</i> Kempf, 1951	1	1	1	2	3
<i>Cephalotes specularis</i> Brandão, Feitosa, Powell & Del-Claro, 2014	1	0	0	1	1
<i>Crematogaster</i>					
<i>Crematogaster</i> cf. <i>crucis</i> Forel, 1912	0	1	0	1	1
<i>Crematogaster curvispinosa</i> (Mayr, 1862)	0	5	3	2	5
<i>Crematogaster distans</i> (Mayr, 1870)	2	2	4	0	4
<i>Crematogaster erecta</i> (Mayr, 1866)	0	3	3	0	3
<i>Crematogaster limata</i> (Smith, F., 1858)	2	1	2	1	3
<i>Crematogaster nitidiceps</i> Emery, 1895	5	17	9	9	22
<i>Crematogaster victima</i> Forel, 1901	1	0	1	0	1
<i>Crematogaster</i> sp. 01	4	0	0	4	4
<i>Crematogaster</i> sp. 02	3	0	0	3	3
<i>Crematogaster</i> sp. 03	8	0	4	4	8
<i>Crematogaster</i> sp. 04	0	3	2	1	3
<i>Crematogaster</i> sp. 05	1	0	1	0	1
<i>Crematogaster</i> sp. 06	1	0	1	0	1
<i>Cyatta</i>					
<i>Cyatta abscondita</i> Sosa-Calvo et al., 2014	1	0	1	0	1
<i>Cyphomyrmex</i>					
<i>Cyphomyrmex olitor</i> Forel, 1903	34	11	45	0	45
<i>Cyphomyrmex rimosus</i> (Spinola, 1851)	15	14	30	0	30
<i>Cyphomyrmex</i> gr. <i>rimosus</i> sp. 01	2	0	2	0	2
<i>Cyphomyrmex</i> gr. <i>rimosus</i> sp. 02	4	0	4	0	4
<i>Cyphomyrmex</i> gr. <i>strigatus</i> sp. 01	3	0	3	0	3
<i>Hylomyrma</i>					
<i>Hylomyrma balzani</i> Emery, 1894	5	4	9	0	9
<i>Hylomyrma reitteri</i> (Mayr, 1887)	9	0	9	0	9

Appendix. List of species recorded at the Panga Ecological Station. Numbers represent the total number of occurrences in different habitats or strata (Continuation).

	Savanna	Forest	Ground	Woody vegetation	Total
Megalomyrmex					
<i>Megalomyrmex drifti</i> Kempf, 1961	0	2	2	0	2
<i>Megalomyrmex goeldii</i> Forel, 1912	0	3	3	0	3
<i>Megalomyrmex silvestrii</i> (W.M. Wheeler, 1909)	2	0	2	0	2
Monomorium					
<i>Monomorium floricola</i> Jerdon, 1851 (introduced)	4	0	2	2	4
Mycetagroicus					
<i>Mycetagroicus cerradensis</i> Brandão & Mayhé-Nunes, 2001	7	0	7	0	7
Mycetarotes					
<i>Mycetarotes parallelus</i> Emery, 1906	5	0	5	0	5
Mycocepurus					
<i>Mycocepurus goeldii</i> (Forel, 1893)	85	19	104	0	104
<i>Mycocepurus obsoletus</i> Emery, 1913	2	0	2	0	2
<i>Mycocepurus smithii</i> (Forel, 1893)	42	1	43	0	43
Myrmicocrypta					
<i>Myrmicocrypta</i> cf. <i>urichi</i> Weber, 1937	0	3	3	0	3
<i>Myrmicocrypta</i> cf. <i>squamosa</i> Smith, F., 1860	10	10	20	0	20
<i>Myrmicocrypta</i> sp. 01	3	0	3	0	3
Nesomyrmex					
<i>Nesomyrmex</i> cf. <i>brasiliensis</i> Kempf, 1958	3	0	0	3	3
<i>Nesomyrmex spininodis</i> Mayr, 1887	13	2	5	10	15
Ochetomyrmex					
<i>Ochetomyrmex semipolitus</i> Mayr, 1878	1	0	1	0	1
Octostruma					
<i>Octostruma balzani</i> (Emery, 1894)	0	18	18	0	18
<i>Octostruma iheringi</i> (Emery, 1888)	1	0	1	0	1
Oxyepoecus					
<i>Oxyepoecus longicephalus</i> de Albuquerque, Lavor & Brandão, 2004	1	0	1	0	1
Pheidole					
<i>Pheidole fallax</i>	4	0	4	0	4
<i>Pheidole fimbriata</i> (Roger, 1863)	0	8	8	0	8
<i>Pheidole flavens</i> Roger, 1863	70	37	107	0	107
<i>Pheidole gertrudae</i> Forel, 1886	2	0	2	0	2
<i>Pheidole</i> nr. <i>lucretii</i> Santschi, 1923	0	27	27	0	27
<i>Pheidole oxyops</i> Forel, 1908	253	83	330	7	337
<i>Pheidole pubiventris</i> Borgmeier, 1928	15	6	15	6	21
<i>Pheidole radoszkowskii</i> (Mayr, 1884)	262	44	212	94	306
<i>Pheidole</i> nr. <i>rugiceps</i> Wilson, 2003	11	6	17	0	17
<i>Pheidole</i> nr. <i>schmalzi</i> Emery, 1894	70	0	32	38	70
<i>Pheidole</i> nr. <i>susannae</i> Forel, 1886	26	0	24	2	26
<i>Pheidole superba</i> Wilson, 2003	2	0	2	0	2
<i>Pheidole triconstricta</i> Forel, 1886	58	28	86	0	86
<i>Pheidole</i> sp. 01	122	12	134	0	134

Appendix. List of species recorded at the Panga Ecological Station. Numbers represent the total number of occurrences in different habitats or strata. (Continuation).

	Savanna	Forest	Ground	Woody vegetation	Total
<i>Pheidole</i> (Continuation)					
<i>Pheidole</i> sp. 02	35	0	35	0	35
<i>Pheidole</i> sp. 03	2	5	7	0	7
<i>Pheidole</i> sp. 04	2	0	2	0	2
<i>Pheidole</i> sp. 05	9	0	9	0	9
<i>Pheidole</i> sp. 06	3	16	19	0	19
<i>Pheidole</i> sp. 07	8	0	8	0	8
<i>Pheidole</i> sp. 08	1	0	1	0	1
<i>Pheidole</i> sp. 09	29	5	33	1	34
<i>Pheidole</i> sp. 10	1	0	0	1	1
<i>Pheidole</i> sp. 11	9	0	9	0	9
<i>Pheidole</i> sp. 12	20	0	10	10	20
<i>Pheidole</i> sp. 13	1	0	1	0	1
<i>Pheidole</i> sp. 14	1	0	1	0	1
<i>Pheidole</i> sp. 15	1	0	1	0	1
<i>Pheidole</i> sp. 16	6	0	6	0	6
<i>Pheidole</i> sp. 17	0	3	1	2	3
<i>Pheidole</i> sp. 18	12	0	12	0	12
<i>Pheidole</i> sp. 19	11	11	22	0	22
<i>Pheidole</i> sp. 20	5	0	5	0	5
<i>Pheidole</i> sp. 21	9	0	7	2	9
<i>Pheidole</i> sp. 22	0	5	5	0	5
<i>Pheidole</i> sp. 23	12	11	22	1	23
<i>Pheidole</i> sp. 24	50	0	46	4	50
<i>Pheidole</i> sp. 25	1	1	0	2	2
<i>Pheidole</i> sp. 26	3	0	3	0	3
<i>Pogonomyrmex</i>					
<i>Pogonomyrmex naegelli</i> Emery, 1878	19	0	19	0	19
<i>Rogeria</i>					
<i>Rogeria</i> sp. 01	1	0	1	0	1
<i>Rogeria</i> sp. 02	1	1	2	0	2
<i>Sericomyrmex</i>					
<i>Sericomyrmex luederwaldti</i> Santschi, 1925	69	41	110	0	110
<i>Sericomyrmex scrobifer</i> Forel, 1911	24	0	24	0	24
<i>Solenopsis</i>					
<i>Solenopsis substituta</i> Santschi, 1925	91	16	90	17	107
<i>Solenopsis tridens</i> Forel, 1911	97	66	97	66	163
<i>Solenopsis</i> sp. 01	49	0	30	19	49
<i>Solenopsis</i> sp. 02	126	0	104	22	126
<i>Solenopsis</i> sp. 03	20	0	20	0	20
<i>Solenopsis</i> sp. 04	56	30	40	46	86
<i>Solenopsis</i> sp. 05	0	1	0	1	1

Appendix. List of species recorded at the Panga Ecological Station. Numbers represent the total number of occurrences in different habitats or strata (Continuation).

	Savanna	Forest	Ground	Woody vegetation	Total
<i>Solenopsis</i> (Continuation)					
<i>Solenopsis</i> sp. 06	3	0	3	0	3
<i>Solenopsis</i> sp. 07	1	0	1	0	1
<i>Solenopsis</i> sp. 08	0	1	1	0	1
<i>Solenopsis</i> sp. 09	2	0	2	0	2
<i>Solenopsis</i> sp. 10	0	1	1	0	1
<i>Solenopsis</i> sp. 11	2	1	3	0	3
<i>Solenopsis</i> sp. 12	1	0	1	0	1
<i>Strumigenys</i>					
<i>Strumigenys denticulata</i> Mayr, 1887	15	24	39	0	39
<i>Strumigenys eggersi</i> (Emery, 1890)	34	6	40	0	40
<i>Strumigenys</i> sp. 01	1	0	1	0	1
<i>Strumigenys grytava</i> Bolton, 2000	17	0	17	0	17
<i>Strumigenys zeteki</i> (Brown, 1959)	0	2	2	0	2
<i>Strumigenys</i> nr. <i>elongata</i> Roger, 1863	3	0	3	0	3
<i>Strumigenys louisianae</i> Roger, 1863	6	0	6	0	6
<i>Strumigenys perparva</i> Brown, 1958	12	8	20	0	20
<i>Strumigenys</i> nr. <i>trinidadensis</i> (W.M. Wheeler, 1922)	0	5	5	0	5
<i>Trachymyrmex</i>					
<i>Trachymyrmex bugnioni</i> (Forel, 1912)	13	4	17	0	17
<i>Trachymyrmex cirratus</i> Mayhé-Nunes & Brandão, 2005	3	0	3	0	3
<i>Trachymyrmex cornetzi</i> (Forel, 1912)	3	0	3	0	3
<i>Trachymyrmex dichrous</i> Kempf, 1967	16	0	16	0	16
<i>Trachymyrmex farinosus</i> Emery, 1894	9	0	9	0	9
<i>Trachymyrmex holmgreni</i> W.M. Wheeler, 1925	4	0	4	0	4
<i>Trachymyrmex</i> gr. <i>urichi</i> sp. 01	1	0	1	0	1
<i>Trachymyrmex</i> gr. <i>urichi</i> sp. n. 02	19	0	19	0	19
<i>Trachymyrmex</i> sp. n. 03	8	0	8	0	8
<i>Trachymyrmex</i> sp. n. 04	3	0	3	0	3
<i>Trachymyrmex</i> sp. n. 05	16	2	18	0	12
<i>Trachymyrmex</i> sp. n. 06	24	0	24	0	24
<i>Tranopelta</i>					
<i>Tranopelta gilva</i> Mayr, 1866	1	0	1	0	1
<i>Wasmannia</i>					
<i>Wasmannia affinis</i> Santschi, 1929	12	0	6	6	12
<i>Wasmannia auropunctata</i> (Roger, 1863)	71	20	79	12	91
<i>Wasmannia rochai</i> (Forel, 1912)	9	0	0	9	9
<i>Xenomyrmex</i>					
<i>Xenomyrmex</i> sp. n.	1	0	0	1	1
Ponerinae					
<i>Anochetus</i>					
<i>Anochetus bispinosus</i> (F. Smith, 1858)	24	14	38	0	38
<i>Hypoponera</i>					
<i>Hypoponera foreli</i> Mayr, 1887	2	3	5	0	5
<i>Hypoponera</i> sp. 01	7	0	7	0	7

Appendix. List of species recorded at the Panga Ecological Station. Numbers represent the total number of occurrences in different habitats or strata (Continuation).

	Savanna	Forest	Ground	Woody vegetation	Total
<i>Hypoponera</i> (Continuation)					
<i>Hypoponera</i> sp. 02	2	0	2	0	2
<i>Hypoponera</i> sp. 03	0	4	4	0	4
<i>Hypoponera</i> sp. 04	0	1	1	0	1
<i>Hypoponera</i> sp. 05	10	11	21	0	21
<i>Hypoponera</i> sp. 06	0	3	3	0	3
<i>Hypoponera</i> sp. 07	3	2	5	0	5
<i>Hypoponera</i> sp. 08	1	0	1	0	1
<i>Neoponera</i>					
<i>Neoponera agilis</i> (Forel, 1901)	2	0	0	2	2
<i>Neoponera apicalis</i> Latreille, 1802	2	0	2	0	2
<i>Neoponera crenata</i> (Roger, 1861)	0	2	0	2	2
<i>Neoponera inversa</i> F. Smith, 1858	19	0	1	18	19
<i>Neoponera laevigata</i> (F. Smith, 1858)	1	0	1	0	1
<i>Neoponera verena</i> (Forel, 1922)	95	14	109	0	109
<i>Neoponera villosa</i> Fabricius, 1804	41	0	10	31	41
<i>Odontomachus</i>					
<i>Odontomachus bauri</i> Emery, 1892	5	0	5	0	5
<i>Odontomachus chelififer</i> (Latreille, 1802)	20	13	33	0	33
<i>Odontomachus laticeps</i> Roger, 1861	3	0	3	0	3
<i>Odontomachus meinerti</i> Forel, 1905	10	4	14	0	14
<i>Pachycondyla</i>					
<i>Pachycondyla harpax</i> Fabricius, 1804	52	10	62	0	62
<i>Pachycondyla striata</i> F. Smith, 1858	1	7	8	0	8
<i>Pseudomyrmecinae</i>					
<i>Pseudomyrmex</i>					
<i>Pseudomyrmex curacaensis</i> (Forel, 1912)	29	0	0	29	29
<i>Pseudomyrmex elongatus</i> Mayr, 1870	59	0	0	59	59
<i>Pseudomyrmex euryblemma</i> (Forel, 1899)	2	0	0	2	2
<i>Pseudomyrmex gracilis</i> (Fabricius, 1804)	255	0	5	250	255
<i>Pseudomyrmex kuenckeli</i> Emery, 1890	9	0	0	9	5
<i>Pseudomyrmex maculatus</i> F. Smith, 1855	6	0	0	6	6
<i>Pseudomyrmex pallidus</i> F. Smith, 1855	13	6	12	7	19
<i>Pseudomyrmex sericeus</i> Stitz, 1913	4	0	0	4	4
<i>Pseudomyrmex simplex</i> (F. Smith, 1877)	36	0	0	36	36
<i>Pseudomyrmex tenuis</i> Fabricius, 1804	3	0	3	0	3
<i>Pseudomyrmex tenuissimus</i> Emery, 1906	14	0	0	14	14
<i>Pseudomyrmex termitarius</i> F. Smith, 1855	21	2	23	0	23
<i>Pseudomyrmex unicolor</i> F. Smith, 1855	9	0	0	9	9
<i>Pseudomyrmex urbanus</i> F. Smith, 1877	165	0	0	165	165
<i>Pseudomyrmex</i> sp. 01	3	0	0	3	3
<i>Pseudomyrmex</i> sp. 02	1	0	0	1	1