

First standardized inventory of ants (Hymenoptera: Formicidae) in the natural grasslands of Paraná: New records for Southern Brazil

Weslly Franco^{1,2} & Rodrigo Machado Feitosa^{1,3}

¹ Universidade Federal do Paraná (UFPR), Departamento de Zoologia (DZ00), Laboratório de Sistemática e Biologia de Formigas (LSBF), Curitiba, PR, Brasil.

² ORCID: 0000-0003-2670-4527. E-mail: weslly.franco@gmail.com (corresponding author)

³ ORCID: 0000-0001-9042-0129. E-mail: rsmfeitosa@gmail.com

Abstract. Despite the large number of studies investigating ant diversity in Brazilian biomes, no ant-related studies have been carried out in *Campos Gerais*, a grassland physiognomy in Paraná state. The present study is the first inventory of the ant fauna in one of the few conservation units protecting the *Campos Gerais* landscape, the *Guartelá* State Park (PEG). Sixty samples were collected from different habitats within PEG using pitfall traps. Qualitative samples of leaf litter were collected from forest fragments and submitted to Winkler extractors. In addition, manual qualitative sampling was carried out in the various physiognomies within the PEG. A total of 163 species was collected and sorted into 43 genera and nine subfamilies. Five genera and 28 species were recorded for the first time in the state of Paraná. Out of these, 17 species were also recorded for the first time in the Southern Region of Brazil and two were recorded for the first time to the country. The significant species richness in the PEG and the high number of new records is a strong sign of this ecosystem's potential to reveal taxonomic novelties. These results suggest that PEG, and the *Campos Gerais* as a whole, should be the target of greater conservation efforts to preserve native remnants.

Keywords. Diversity; Survey; *Campos Gerais*; Distribution; Taxonomic Novelties; Conservation.

INTRODUCTION

Ants are highly abundant and diverse around the world, on both local and regional scales, and are extremely important economically and ecologically (Davidson *et al.*, 2003; Wilson & Hölldobler, 2005; Ward, 2007; Guénard, 2013). They are also considered excellent bioindicators, as the presence or absence of specific groups is strongly correlated with various environmental characteristics, such as temperature and availability of resources. Therefore, changes in the environment can promote significant changes in the composition of the ant community in a certain area (Andersen, 2003). In Brazil, around 1,500 species belonging to 111 genera have been recorded so far; nine of these genera are endemic to the country (AntWiki, 2017). Despite these numbers, the global richness of ant species is probably severely underestimated, especially when poorly-explored Neotropical areas are taken into account (Lattke, 2003).

Among Neotropical countries, Brazil stands out for occupying an extensive area and for having a large number of biomes with unique floral and faunal attributes (Brandão *et al.*, 2006). However,

few diversity studies have been conducted on Brazilian ecosystems that have a restricted geographical range. Despite the presence of large forest biomes in the country, grasslands, savannas, shrublands and open woodlands cover large extensions of land in at least four of the six Brazilian biomes. These environments hold a unique biodiversity, but are highly neglected concerning conservation policies and protection when compared to forest ecosystems (Overbeck *et al.*, 2015).

Natural areas of shrublands and grasslands, known as *Campos*, are widespread over the Southern states of Brazil. In the last years, only a few number of ant surveys were conducted in the Brazilian southern grasslands, all in the state of Rio Grande do Sul (Diehl *et al.*, 2005; Diehl *et al.*, 2014; Albuquerque & Diehl, 2009; Rosado *et al.*, 2012). Diehl *et al.* (2005) found 60 species in a sampling expedition to three habitats within *Itapuã* State Park, a coastal area with sandy soil. In the inventory carried out by Albuquerque & Diehl (2009), 32 species were recorded using several sampling methods (active sampling, baits and pitfall traps) in eight grassland regions surrounding the *Aparados da Serra* National Park. Rosado *et al.* (2012) recorded 72 species using pitfall traps in

60 sampling points in each of three different grassland areas. The most recent comprehensive inventory of ant diversity in Rio Grande do Sul compiled data from 13 collection sites, including all the different physiognomies found in the state (Diehl *et al.*, 2014) and five sampling methods: manual sampling, baits, Winkler extractors, pit-fall traps, and underground traps.

However, so far, no standardized study has been performed in the grassland areas in the state of Paraná, known as *Campos Gerais*. The state of Paraná, the northernmost state of Southern Region, includes five large geographic divisions: the coast in the East, escarpments of the crystalline complex, and the first, second, and third plateaus in succession westward (Maack, 1981). The *Campos Gerais* are located on the second Paraná plateau, characterized by the prevalence of rocky soils, shallow rivers, canyons, craters, and caves, among other associated formations (Melo *et al.*, 2001). The dominant phytophysiognomy consists of open grasslands (*campo limpo*) interspersed with gallery forests and stands of *Araucaria* (Maack, 1981). Although the soil is generally exposed, depressed areas are occupied by small woods, where the accumulation of organic matter on the soil supports larger plants (Klein & Hatschbach, 1971).

Rocha & Weirich Neto (2007) revealed that most of the *Campos Gerais* vegetation is secondary, a result of human activity. However, according to Castella & Britez (2004), some studies suggest there is ongoing floristic regeneration in this area. The *Campos Gerais* have a long history of human interference, which has gradually reduced the extent and diversity of this environment over the years. However, a few conservation units still remain in this region. Among these is the *Guartelá* State Park (PEG) (Takeda *et al.*, 2001), located on the left margin of the *Iapó* River canyon, in the municipality of Tibagi. Due to its exceptional natural beauty, this park has great tourism potential and receives a large number of visitors every year.

The region where PEG is located is characterized by a mosaic of different vegetation types and by the presence of a rocky soil that constrains plant establishment and growth. Despite that, a study by Carmo & Assis (2012) found that forest fragments within the park have a high number of plant species, and a survey of vascular plants deposited in the herbarium of the State University of Londrina found 667 specimens collected between 1987 and 2005, belonging to 61 subfamilies and 243 plant species (Rossetto *et al.*, 2012). In addition, a survey identified 160 species of ferns and lycophytes in PEG, belonging to 54 genera and 19 families (Michelon & Labiak, 2012). Rossetto *et al.* (2012) and Michelon & Labiak (2012) found endemic grassland, Cerrado and Atlantic forest species in PEG, making this region a priority for the conservation of these biomes in Southern Brazil.

To date, no studies have addressed arthropod diversity in the PEG region. Such studies are urgently needed because of the great ecological importance of these organisms. Soil arthropods participate in nutrient cycling by fragmenting and ingesting materials in the leaf litter, interact with many microorganisms, and help decompose and mineralize soil materials (Höfer *et al.*, 2001).

Among soil arthropods, ants are particularly important because they are principally predators, but also help in degrade organic matter and remove seeds, affecting the establishment of plant species (Kaspari *et al.*, 2004; Lewinsohn *et al.*, 2005). In addition, the ant species composition of a given area may be an indicator of the conservation status of that ecosystem, because many ant species have obligatory interactions with plants and other animals (Kaspari & Majer, 2000; Schultz & McGlynn, 2000). Ants are also relatively easy to be sampled, which provides quick answers to studies on environmental disturbance (Lewinsohn *et al.*, 2005).

In the PEG region, ant research has great potential to provide a foundation for monitoring and preservation activities, which are urgently needed to reduce the serious degree of environmental degradation of the *Campos Gerais* of Paraná. With that in mind, we carried out the first inventory of the PEG ant fauna using a number of sampling methods. Our objectives were to generate the first ant list for a *Campos Gerais* area and to increase the knowledge of the diversity and biological potential of this threatened ecosystem.

MATERIAL AND METHODS

Study site

Guartelá State Park (PEG) is located in the municipality of Tibagi, on the second plateau of Paraná state. The park is part of the *Área de Proteção Ambiental da Escarpa Devoniana* (Devonian Escarpment Environmental Protection Area), with a highly varied topography and mostly shallow soils. Most of the area is covered by grassland physiognomies, with patches of Mixed ombrophilous forest and Cerrado (Veloso *et al.*, 1991). According to Köppen's classification system, the regional climate is Cfb (humid temperate) with direct influence of Cfa (humid subtropical) (Carmo & Assis, 2012).

Sampling points were established in three areas within PEG: (1) a low grassland (24°34'07.54"S, 50°15'33.60"W); (2) a high grassland (24°34'18.68"S, 50°15'04.72"W), and (3) a patch of Cerrado (24°33'48.18"S, 50°15'14.33"W). The two grassland areas represent the most common phytophysiognomy of *Campos Gerais*, the dry grassland (*campo seco*), defined by the presence of tall or short grasses and small shrubs and rocky outcrops (Moro & Carmo, 2007). The Cerrado patch is one of the last remnants of the biome in the South of Brazil, along with the *Cerrado* State Park in the municipality of Jaguariaíva, Paraná. This area is a savanna formation with a semi-continuous herbaceous stratum interrupted only by trees and shrubs, whose growth is directly affected by alternating regional cycles of dry and wet season (Coutinho, 1978).

Collection and processing of samples

A 400 m long transect was established in each area, 1 km apart from the other transects. In each transect,

20 sampling points were marked 20 m apart from each other, to ensure independence among samples. At each point, four pitfall traps were installed at each corner of a 2 m × 2 m grid. Each grid represents a single sample, for a total of 60 samples. Each pitfall trap consisted of a 300 ml plastic cup filled to a third of its volume with a water, salt and detergent solution. Traps were buried so that the opening was level with the soil surface, and exposed for 48 hours. After this period, all biological material was removed from the traps and stored in 80% ethanol.

We also used Winkler extractors to carry out qualitative samplings of the leaf litter in a Mixed ombrophilous forest area adjacent to the transects. In total, 20 leaf litter samples were collected. In the Winkler technique, 1 m² areas are defined in the forest soil, the top layer of leaf litter is removed and passed through a sieve, and the resulting material is placed in cloth bags for transportation. The material is then placed in Winkler extractors for 48 hours to extract the fauna (for more details on this technique, see Fisher, 1999). In contrast to the usual technique, we did not fill the collection container of the Winkler extractor with alcohol. Instead, a strip of moist sponge was placed on the bottom, keeping the organisms captured alive. During the 48-hour extraction interval, the collection containers were periodically removed, and the contents were transferred to a white tray. Moving animals in the sieved material were collected while still alive and stored in 80% ethanol. In addition to pitfall and Winkler sampling, various areas within the park were manually sampled, mostly to capture arboreal ants and cryptic soil species, for a total collection effort of 24 h.

Samples were processed in the *Laboratório de Sistemática e Biologia de Formigas da Universidade Federal do Paraná*. Ants were separated from other arthropods and identified to the genus level using the identification keys in Baccaro *et al.* (2015). Whenever possible, ants were identified to the species level by checking the publications cited in Baccaro *et al.* (2015) and consulting specialists. When species determination was not possible, taxa were treated as morphospecies. Vouchers were deposited in the *Padre Jesus Santiago Moure* Entomological Collection at the *Universidade Federal do Paraná* (DZUP).

RESULTS

In total 163 species were collected, comprising 43 genera and nine subfamilies (Appendix 1). A total of 100 species were identified (60.8% of the total). Based on generic richness, the main subfamily was Myrmicinae (25 genera), followed by Ponerinae (five genera) and Formicinae (four genera) (Table 1). The richest genus was *Pheidole*, (46 species), followed by *Camponotus*, (18 species), and *Solenopsis*, *Hypoponera* and *Crematogaster* (eight species each).

The pitfall traps captured 119 species in seven subfamilies and 34 genera. The species with the highest number of records in the pitfall traps was *Linepithema micans* (Forel, 1908) (Dolichoderinae), with 38 records, followed by *Pheidole valens* Wilson, 2003 (Myrmicinae), 37

Table 1. Number of genera and species collected by subfamily.

Subfamily	Genera	Species
Myrmicinae	25	100
Ponerinae	5	16
Formicinae	4	26
Dolichoderinae	3	9
Ectatomminae	2	5
Pseudomyrmecinae	1	4
Proceratiinae	1	1
Amblyoponinae	1	1
Dorylinae	1	1
Total	43	163

records, and *Solenopsis invicta* Buren, 1972 (Myrmicinae), 35 records.

From the 119 species collected in pitfall traps 65 were found in the low grassland, 57 in the high grassland, and 103 in cerrado. Eight of these were exclusive to the low grassland, six to the high grassland, and 41 species were found only in Cerrado. The low and high grassland areas shared two species; the low grassland and the Cerrado area shared 13 species; the high grassland and the cerrado, seven species. A total of 42 species were shared between all three transects.

Winkler extractors and active sampling combined yielded 69 recorded species, representing eight subfamilies and 31 genera. Out of the 69 species, 44 were collected only from Winkler extractors and active sampling, while 25 species had already been recorded through pitfall traps.

Five genera found in the present study were recorded for the first time in the state of Paraná (*Forelius*, *Kalathomyrmex*, *Mycetarotes*, *Ochetomyrmex* and *Centromyrmex*). *Centromyrmex* and *Kalathomyrmex* are also first records for the South Region of Brazil. In total, 28 species represent new records for Paraná state (Appendix 1), out of these, 17 were also recorded for the first time in the South Region of Brazil. In addition, *Dorymyrmex paranensis* Santschi, 1922, *Pheidole pampiana* Santschi, 1929 and *Pheidole breviseta* Santschi, 1919 were recorded in Brazil for the first time.

DISCUSSION

The number of ant species found in *Guartelá* State Park (163) is significant, especially when compared to studies that used similar sampling efforts. For example, Diehl *et al.* (2014) listed a total richness of 127 ant species in the inventory of Rio Grande do Sul state, fewer than the total recorded in PEG.

It is important to underscore that the relatively high number of species recorded in PEG was only achievable through a combination of different sampling techniques. This diversity of methods is essential to approach the actual number of species in a given area, since many variables affect the niches occupied by species and their distribution throughout the environment, such as resource availability and competition (Pulliam, 2000; Albrecht

& Gotelli, 2001). Ants, in particular, can occupy a wide range of habitats, from arboreal to below-ground strata (Romero & Jaffé, 1989; Bestelmeyer *et al.*, 2000; Camacho & Vasconcelos, 2016).

The pitfall trap was the quantitative method responsible for the largest number of epigeic species recorded in the present study. Winkler extractors were almost exclusively responsible for sampling specialized species within the leaf litter, while most arboreal and specialized predator species were collected through active sampling. Although active sampling and Winkler extractors were used qualitatively in this study, they were extremely important as supplementary methods to obtain a more complete inventory of the local ant fauna, given the number of species collected exclusively through these methods (44).

Among the subfamilies collected the dominance of Myrmicinae, Formicinae, and Ponerinae was already expected, because these are the largest Formicidae subfamilies and have high local species richness in the Neotropical region (Ward, 2014). In fact, these three subfamilies together represent 83% of the total known diversity of ants.

The prevalence of *Pheidole* species in the samples was also predictable, since this genus is considered hyperdiverse and ubiquitous (Wilson, 2003). Despite this, the 46 *Pheidole* species recorded in PEG still represented a surprisingly large number, given the geographic extension of the park and the fact that habitat heterogeneity in grassland areas is not as great as in forests, for instance. The genus *Camponotus*, also hyperdiverse and ubiquitous with generalist habits and high colonization success, was well-represented in PEG samples, with 18 recorded species.

Although Myrmicinae, Formicinae, and Ponerinae were generally prevalent, the species with the highest number of records was *Linepithema micans* (Dolichoderinae), a generalist ant that may occupy different phytophysiognomies. This is the most common ant species in vineyards of Southern Brazil (Sacchetti *et al.*, 2009), and it is considered the main disseminator of the land-pearl, *Eurhizococcus brasiliensis* (Hempel, 1922), a hemipteran in the Margarodidae family that is considered a pest of grapevines (Hickel *et al.*, 2001).

In the present work, we noticed a scarcity of army ants (Dorylinae), known for their massive foraging habits, nomadic behavior, and lack of permanent nests (Brady, 2003). The only specimen of this group of ants in our samples belonged to *Neivamyrmex diana* (Forel, 1912). *Neivamyrmex* ant colonies have thousands of individuals, which have a partial or predominantly subterranean habit and form long foraging columns. These ants are specialized predators of other ant colonies, and forage as a group (Brady, 2003). The dearth of army ants in our samples reflects the fact that this group is primarily found in structurally more heterogeneous physiognomies, such as forests, and are usually less diverse and harder to observe in open fields and savannas (Baccaro *et al.*, 2015). However, this result can also be due to short sampling period (see O'Donnell *et al.*, 2007).

There was a low degree of species overlap between the three sampled areas, and a high number of exclusive species in the Cerrado transect. This may reflect significant differences in habitat structure between areas, particularly between the two grassland areas and the patch of Cerrado, because the latter has a denser and more heterogeneous shrub layer that support the establishment of a larger number of species (Campos *et al.*, 2008).

One of the main results of the present study was the detection and addition of many new taxa to the ant fauna of Paraná state, the Southern of Brazil, and even for Brazil as a whole. The new records for the state belonged to genera *Forelius* (Dolichoderinae), *Centromyrmex* (Ponerinae), *Kalathomyrmex*, *Mycetarotes*, and *Ochetomyrmex* (Myrmicinae).

Neotropical species in the genus *Forelius* nest in the ground, in open areas without of vegetation. Nests often have a layer of loose soil by the entrance, and there is usually more than one nest per colony. Because these ants have high thermal tolerance, they are typically active during the hottest times of the day. Workers move quickly and forage primarily on soil arthropods and, in some cases, on honeydew accumulated on the vegetation (Cuezzo, 2000). *Centromyrmex* is a cosmopolitan Ponerinae genus with a mostly tropical distribution, easily recognized by the presence of spiniform setae on the mesotibiae. Species in this genus are obligatory predators of termites and have subterranean habits, nesting in cavities inside their prey's nests. Colonies are usually relatively small (Kempf, 1967). The cryptic habit and the low local abundance make it rare for ant inventories to detect species of this genus. *Kalathomyrmex* is a monotypic fungus-farming ant genus found exclusively in South America. Nests are usually built in sandy soils and can endure long flood periods. As a result, they are very common in riverbanks across many regions of Brazil (Klingenberg & Brandão, 2009). *Mycetarotes*, another genus of fungus-farming ants, is exclusively Neotropical. Species have small colonies of 100-350 individuals that live in underground nests with a narrow opening bordered by a small mound of dirt (Mayhé-Nunes, 1995). *Ochetomyrmex* includes only two species, and little is known about them. They are probably epigeic generalist predators, found in elevations between 100 m and 1,300 m in the central-northern region of South America (Fernández, 2003).

The results from this study represent an advance in Neotropical Myrmecology, especially regarding the knowledge of ant diversity in natural grasslands of Southern Brazil. Considering the anthropogenic pressure over the *Campos Gerais*, an endemic physiognomy of Paraná, species inventories are clearly important, because only through the knowledge about the local fauna it is possible to develop conservation strategies (Margules & Pressey, 2000). Through this study, which represents the first formal survey of the ant fauna in a conservation area within the *Campos Gerais* of Paraná state, we hope to stimulate an increase in the number of studies addressing local diversity, which may reveal priority taxonomic interest groups and therefore provide a foundation for future conservation policies.

ACKNOWLEDGEMENTS

We thank Instituto Ambiental do Paraná (IAP, Environmental Institute of Paraná) for issuing a collection permit (Nº 23.16 – 07/20/2016) and Mr. Cristovam S. Queiroz, PEG's manager, for supporting our study. We also thank Aline M. de Oliveira for helping with sampling and Luiza F. Luzio for helping with processing of samples. We thank the following specialists in different genera, who confirmed the species listed in this study: Alexandre Casadei Ferreira (*Pheidole*), Lina Maria Pedraza (*Crematogaster*), Mayrón Escárraga (*Linepithema*), and Thiago S. Ranzani da Silva (*Strumigenys*). This work was supported by the Brazilian Council of Research and Scientific Development (CNPq grant 459353/2014-4). Finally, WF and RF thank the CNPq for the grants 130642/2016-9 and 302462/2016-3, respectively.

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APPENDIX 1

Species recorded in *Guartelá* State Park. LG – low grassland; HG – high grassland; CE – Cerrado; FO – forest (leaf litter).
* First record for Paraná, + First record for the Southern Brazil; # First record for Brazil.

	Habitat				Method				Habitat				Method		
	LG	HG	CE	FO	Pitfall	Winkler	Active		LG	HG	CE	FO	Pitfall	Winkler	Active
Amblyoponinae															
<i>Fulakora elongata</i> (Santschi, 1912)				X		X			X	X	X	X	X	X	X
Dolichoderinae															
<i>Dorymyrmex paranensis</i> Santschi, 1922 #	X		X	X	X		X								
<i>Dorymyrmex</i> sp. 1	X	X	X	X	X		X								
<i>Dorymyrmex</i> sp. 2	X				X										
<i>Linepithema anathema</i> Wild, 2007		X			X										
<i>Linepithema gallardoi</i> (Brèthes, 1914)			X		X										
<i>Linepithema humile</i> (Mayr, 1868)	X				X										
<i>Linepithema micans</i> (Forel, 1908)	X	X	X	X	X	X	X								
<i>Linepithema</i> sp.	X	X	X		X								X		
<i>Forelius pusillus</i> Santschi, 1922 * +	X	X	X		X										
Dorylinae															
<i>Neivamyrmex diana</i> (Forel, 1912) * +			X		X										
Ectatomminae															
<i>Ectatomma edentatum</i> (Roger, 1863)	X	X	X		X										
<i>Ectatomma permagnum</i> (Forel, 1908)	X	X	X		X										
<i>Gnamptogenys reichenspergeri</i> Santschi, 1929	X			X	X	X									
<i>Gnamptogenys striatula</i> Mayr, 1884	X	X	X	X	X	X									
<i>Gnamptogenys sulcata</i> (Smith, 1858) *			X		X										
Formicinae															
<i>Brachymyrmex</i> sp. 1	X	X	X		X										
<i>Brachymyrmex</i> sp. 2		X	X		X										
<i>Brachymyrmex</i> sp. 3	X		X		X										
<i>Brachymyrmex</i> sp. 4				X		X	X								
<i>Brachymyrmex</i> sp. 5				X		X									
<i>Brachymyrmex</i> sp. 6				X		X	X								
<i>Camponotus atriceps</i> (Smith, F., 1858)				X			X								
<i>Camponotus bonariensis</i> Mayr, 1868			X		X										
<i>Camponotus brasiliensis</i> Mayr, 1862	X	X	X		X										
<i>Camponotus cingulatus</i> Mayr, 1862				X		X									
<i>Camponotus crassus</i> Mayr, 1862	X	X	X	X	X		X								
<i>Camponotus melanoticus</i> Emery, 1894	X	X	X		X										
<i>Camponotus</i> nr. <i>melanoticus</i> sp. 1	X	X	X		X										
<i>Camponotus</i> nr. <i>melanoticus</i> sp. 3	X	X	X		X										
<i>Camponotus novogranadensis</i> Mayr, 1870	X	X	X		X										
<i>Camponotus</i> nr. <i>novogranadensis</i> sp. 1			X		X										
<i>Camponotus sericeiventris</i> (Guérin-Méneville, 1838)				X			X								
<i>Camponotus rufipes</i> (Fabricius, 1775)	X	X	X	X	X		X								
<i>Camponotus</i> sp. 1			X		X										
<i>Camponotus</i> sp. 2			X		X										
<i>Camponotus</i> sp. 3			X		X										
<i>Camponotus</i> sp. 4			X		X										
<i>Camponotus</i> sp. 5	X		X		X										
<i>Camponotus</i> sp. 6			X		X										
<i>Myrmelachista gallicola</i> (Mayr, 1887) *	X	X	X		X										
<i>Nylanderia</i> sp.	X		X		X										
Myrmicinae															
<i>Acromyrmex aspersus</i> (Smith, 1858)			X		X										
<i>Acromyrmex coronatus</i> (Fabricius, 1804)	X	X	X	X	X	X	X								
<i>Acromyrmex crassispinus</i> (Forel, 1909)				X			X								
<i>Acromyrmex landolti</i> (Forel, 1885) *	X	X	X		X										
<i>Acromyrmex</i> sp.			X		X										
<i>Apterostigma</i> sp.	X	X	X	X	X	X	X								
<i>Atta laevigata</i> (Smith, 1858)					X									X	
<i>Basicoeros disciger</i> (Mayr, 1887)					X								X		
<i>Carebara</i> sp.					X								X		
<i>Cephalotes pusillus</i> (Klug, 1824)					X	X	X							X	
<i>Cephalotes pavonii</i> (Latreille, 1809) *					X									X	
<i>Crematogaster ampla</i> Forel, 1912 * +		X			X										
<i>Crematogaster crinosa</i> Mayr, 1862 *		X	X		X										
<i>Crematogaster distans</i> Mayr, 1870					X									X	
<i>Crematogaster evallans</i> Forel, 1907	X	X	X		X										
<i>Crematogaster nigropilosa</i> Mayr, 1870					X								X		
<i>Crematogaster obscurata</i> Emery, 1895			X	X	X	X	X							X	
<i>Crematogaster rochai</i> Forel, 1903		X	X	X	X	X	X							X	
<i>Crematogaster torosa</i> Mayr, 1870		X	X		X										
<i>Cyphomyrmex minutus</i> Mayr, 1862 *		X			X										
<i>Cyphomyrmex rimosus</i> (Spinola, 1851)	X	X	X		X										
<i>Hylomyrma reitteri</i> (Mayr, 1887)					X								X		
<i>Kalathomyrmex emeryi</i> (Forel, 1907) * +					X										
<i>Lachnomyrmex plaumanni</i> Borgmeier, 1957					X									X	
<i>Megalomyrmex incisus</i> Smith, M.R., 1947					X									X	
<i>Mycetarotes parallelus</i> (Emery, 1906) * +	X	X	X		X										
<i>Mycetarotes</i> sp.					X									X	
<i>Mycetophylax lectus</i> (Forel, 1911) * +					X								X		
<i>Mycetophylax olitor</i> (Forel, 1893)			X	X	X	X	X							X	
<i>Mycocepurus goeldii</i> (Forel, 1893)			X	X	X	X	X							X	
<i>Myrmicocrypta</i> sp.		X	X	X	X	X	X								
<i>Ochetomyrmex semipolitus</i> Mayr, 1878 *			X		X										
<i>Octostruma stenognatha</i> Brown & Kempf, 1960					X									X	
<i>Oxyepoecus rastratus</i> (Mayr, 1887)			X		X										
<i>Pheidole aberrans</i> Mayr, 1868	X	X	X		X										
<i>Pheidole ambigua</i> Wilson, 2003 * +					X									X	
<i>Pheidole breviseta</i> Santschi, 1919 #	X	X	X		X										
<i>Pheidole guilelmuelleri</i> Forel, 1886 *			X		X										
<i>Pheidole jelskii</i> Mayr, 1884	X				X										
<i>Pheidole nitidula</i> Emery, 1888 *	X	X	X		X										
<i>Pheidole nubila</i> Emery, 1906					X									X	
<i>Pheidole</i> nr. <i>obtusopilosa</i> Mayr, 1887					X								X		
<i>Pheidole oxyops</i> Forel, 1908	X		X		X										
<i>Pheidole pampana</i> Santschi, 1929 #			X		X										
<i>Pheidole paranana</i> Santschi, 1925 *	X	X	X		X										
<i>Pheidole pubiventris</i> Mayr, 1887			X		X										
<i>Pheidole radoszkowskii</i> Mayr 1884	X	X	X		X										
<i>Pheidole rudigenis</i> Emery, 1906					X								X		
<i>Pheidole rufipilis</i> Forel, 1908			X		X										
<i>Pheidole</i> nr. <i>transversostrata</i> Mayr, 1887			X		X										
<i>Pheidole triconstricta</i> Forel, 1886			X		X									X	
<i>Pheidole sarcina</i> Forel, 1912 * +			X		X									X	
<i>Pheidole subarmata</i> Mayr, 1884			X		X										
<i>Pheidole susannae</i> Forel, 1886 *			X		X										
<i>Pheidole vafra</i> Santschi, 1923 *					X									X	
<i>Pheidole valens</i> Wilson, 2003 * +	X	X	X		X										
<i>Pheidole</i> sp. 1	X	X	X		X										
<i>Pheidole</i> sp. 2	X	X	X		X										

	Habitat				Method		
	LG	HG	CE	FO	Pitfall	Winkler	Active
<i>Pheidole</i> sp. 3	X	X	X		X		
<i>Pheidole</i> sp. 4			X		X		
<i>Pheidole</i> sp. 5			X		X		
<i>Pheidole</i> sp. 6	X		X		X		
<i>Pheidole</i> sp. 7			X		X		
<i>Pheidole</i> sp. 8			X		X		
<i>Pheidole</i> sp. 9			X		X		
<i>Pheidole</i> sp. 10			X		X		
<i>Pheidole</i> sp. 11			X		X		
<i>Pheidole</i> sp. 12	X				X		
<i>Pheidole</i> sp. 13	X		X		X		
<i>Pheidole</i> sp. 14	X		X		X		
<i>Pheidole</i> sp. 15	X	X	X		X		
<i>Pheidole</i> sp. 16			X		X		
<i>Pheidole</i> sp. 17	X	X	X		X		
<i>Pheidole</i> sp. 18	X	X	X		X		
<i>Pheidole</i> sp. 19			X		X		
<i>Pheidole</i> sp. 20	X		X		X		
<i>Pheidole</i> sp. 21			X		X		
<i>Pheidole</i> sp. 30				X		X	
<i>Pheidole</i> sp. 31				X		X	
<i>Pheidole</i> sp. 32				X		X	
<i>Pogonomyrmex naegelli</i> Forel, 1878	X	X	X	X	X		X
<i>Solenopsis invicta</i> Buren, 1972	X	X	X	X	X	X	X
<i>Solenopsis</i> sp. 1	X	X	X	X	X	X	X
<i>Solenopsis</i> sp. 2			X	X	X	X	
<i>Solenopsis</i> sp. 3	X				X		
<i>Solenopsis</i> sp. 4			X	X	X	X	
<i>Solenopsis</i> sp. 5			X		X		
<i>Solenopsis</i> sp. 7	X				X		
<i>Solenopsis</i> sp. 8				X			X
<i>Strumigenys epinotalis</i> Weber, 1934* ⁺	X	X			X		
<i>Strumigenys infidelis</i> Santischi, 1919	X	X		X	X		

	Habitat				Method		
	LG	HG	CE	FO	Pitfall	Winkler	Active
<i>Strumigenys louisianae</i> Roger, 1863					X		X
<i>Strumigenys crassicornis</i> Mayr, 1887					X		X
<i>Strumigenys abditivata</i> (Bolton, 2000)					X		X
<i>Trachymyrmex holmgreni</i> Wheeler, W.M., 1925	X	X	X		X		
<i>Trachymyrmex</i> sp. 1	X	X	X		X		
<i>Trachymyrmex</i> sp. 2				X		X	
<i>Wasmannia auropunctata</i> (Roger, 1863)	X	X	X		X		
<i>Wasmannia affinis</i> Santischi, 1929	X		X		X		
<i>Wasmannia lutzi</i> Forel, 1908	X		X	X	X	X	X
Ponerinae							
<i>Centromyrmex brachycola</i> (Roger, 1861)* ⁺		X	X		X		
<i>Hypoponera foreli</i> (Mayr, 1887)				X		X	
<i>Hypoponera</i> sp. 1		X			X		
<i>Hypoponera</i> sp. 2		X		X	X	X	
<i>Hypoponera</i> sp. 4				X		X	
<i>Hypoponera</i> sp. 5				X		X	
<i>Hypoponera</i> sp. 6				X		X	
<i>Hypoponera</i> sp. 7				X		X	
<i>Hypoponera</i> sp. 8				X		X	X
<i>Neoponera marginata</i> (Roger, 1861)			X	X	X		X
<i>Neoponera verena</i> Forel, 1922	X	X	X	X	X		X
<i>Odontomachus chelifer</i> (Latreille, 1802)			X		X		
<i>Odontomachus haematodus</i> (Linnaeus, 1758)	X		X		X		
<i>Odontomachus meinerti</i> (Forel 1905)			X		X		
<i>Pachycondyla harpax</i> (Fabricius, 1804)			X		X		
<i>Pachycondyla striata</i> Smith, 1858	X	X	X		X		
Proceratiinae							
<i>Discothyrea sexarticulata</i> Borgmeier, 1954				X		X	
Pseudomyrmecinae							
<i>Pseudomyrmex simplex</i> (Smith, F., 1877)* ⁺	X		X		X		
<i>Pseudomyrmex termitarius</i> (Smith, 1885)			X		X		
<i>Pseudomyrmex</i> sp. 3	X				X		
<i>Pseudomyrmex</i> sp. 4				X			X