

COMPOSITION OF THE SPIDER ASSEMBLAGE IN AN URBAN FOREST RESERVE IN SOUTHEASTERN BRAZIL AND EVALUATION OF A TWO SAMPLING METHOD PROTOCOLS OF SPECIES RICHNESS ESTIMATES

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ARTÍCULO:

Composition of the spider assemblage in an urban forest reserve in southeastern Brazil and evaluation of a two sampling method protocols of species richness estimates

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Abstract:

The composition and species richness of the spider assemblage, sampled with pitfall traps and beating-trays, in an urban forest reserve located in the metropolitan region of Belo Horizonte, state of Minas Gerais, Brazil, was evaluated. A total of 10,823 spiders (2,310 adults and 8,513 juveniles) were collected. The adults were represented by 223 species and morphospecies distributed in 30 families. Of these, 94 were collected with pitfall traps, and 153 with beating-trays. A higher percentage of adults (61.3%) and males (43.2% of all individuals) were found in pitfall traps, when compared to the beating-trays (13.2% adults; 5.1% males, respectively). Only 24 species were collected by both methods. The complementarity of these methods was 89.2%. The individuals based species accumulation curves did not asymptote. The use of pitfall traps and beating-trays combined proves to be a good choice for short-time low cost surveys.

Key words: spider, sampling method, pitfall traps, beating-trays, richness estimation, composition, Neotropical, "Estação Ecológica da UFMG"

Composición de la asamblea de arañas en una reserva florestal urbana en Sureste de Brasil y evaluación de un protocolo de colecta con dos metodos para la estimación de riqueza de especies.

Resumen:

Fue evaluado la composición y riqueza de las especies de la asamblea de arañas colectados por trampa de caída y batedor en una reserva localizada en la región metropolitana de Belo Horizonte, Minas Gerais, Brasil. Fueran colectados 10.823 arañas (2.310 adultos y 8.513 inmaturos). Los adultos constituyen 223 especies distribuidas en 30 familias. Fueran colectadas 94 especies con trampa de caída y 153 especies con batedor. Una mayor porcentaje de adultos (61,3%) y machos (43,2% de todos los individuos) fue encontrada en las trampas de caída cuando comparado con batedor (13,2% de adultos y 5,1% de machos, respectivamente). Solamente 24 especies fueran colectadas con ambos los métodos. La complementariedad de estos métodos fuera 89,2%. Las curvas de acumulación de especies basada en individuos no alcanzaran la asintota. La trampa de caída combinada con batedor es una buena opción para inventarios breves y con bajo costo.

Palabras clave: Arañas; métodos de colecta; trampa de caída; batedor; Estimación de Riqueza; Composición; Neotropical; "Estação Ecológica da UFMG"

Introduction

In recent years, the importance of the planet's biodiversity has been exhaustively discussed in diverse academic and public areas. However, only recently has data on invertebrate richness been incorporated to conservation efforts, that used to privilege vertebrate groups (New, 1995). Nevertheless, a major challenge to the definitive inclusion of invertebrates in conservation politics is to determine and understand their diversity, the patterns of their taxonomic richness, and the parameters affecting their distribution and abundance (New, 1999).

Among the invertebrates, spiders represent an interesting study group because they are a very diverse taxa and extremely sensitive to habitat changes, including vegetation complexity and microclimatic characteristics (Turnbull, 1973; Hatley & Macmahon, 1980; Uetz, 1991; New, 1999). Furthermore, spiders play an important role in many terrestrial ecosystems due to their predatory nature, abundance and ubiquity (Wise, 1993). For the purpose of understanding their patterns of diversity, it is indispensable to evaluate and standardize sampling methods to collect them (New, 1995; Churchill, 1997).

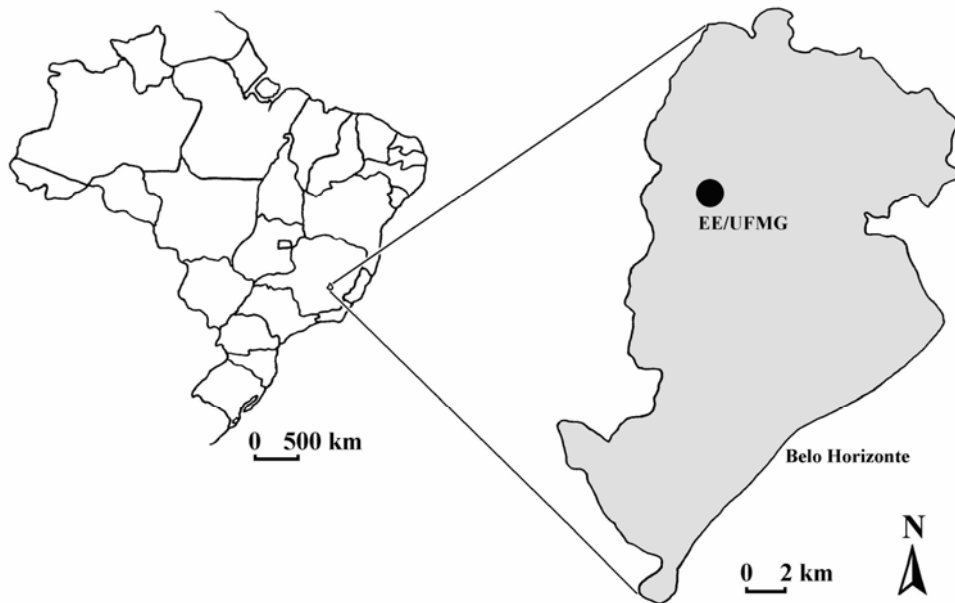


Fig. 1. Map showing the location of the sampling site in the Belo Horizonte municipality, in Minas Gerais State, Brazil.

Different sampling methods can misrepresent certain species in spider assemblages (Merrett & Snazell, 1983; Churchill, 1993). Commonly used sampling methods to collect spiders include: pitfall traps (Uetz & Unzicker, 1976), sweep net (Horvath *et al.*, 2000), Berlese funnels (Szathmary, 1999), suction sampling (Greenstone, 2001), beating-trays (McCaffrey *et al.*, 1984), visual search (Coddington *et al.*, 1991; Borges & Brescovit, 1996; Sørensen, 2004) and canopy fogging (Höfer *et al.*, 1994). To obtain statistically and ecologically meaningful data and to maximize the number of species sampled in biodiversity assessments, several authors have used a wide range of combined methods. Coddington *et al.* (1991) and Silva & Coddington (1996), for example, standardized a collecting protocol in the Neotropical rainforest that includes mainly visual search and beating-trays, and Silva (1996) added to these methods the fogging technique; Rinaldi *et al.* (2002) and Rinaldi & Ruiz (2002) used beating-trays and visual search to sample spiders in sugar cane cultures and rubber tree plantations; Flórez (1998, 1999) used visual search, sweep net, beating-trays, Berlese funnels and pitfall traps; Churchill (1993) and Sørensen *et al.* (2002) used and compared pitfall traps, sweep net, and visual search. Other researchers tested different combinations of sampling protocols, but none of them tested pitfall traps and beating-trays as complementary methods in the Neotropical region.

Despite some disadvantages of the pitfall traps in producing biases in the catches (Luff, 1975; Adis, 1979), these traps are the most effective method for capturing ground-dwelling spiders. However, this method underestimates the diversity and abundance of the foliage-dwelling fauna, sampled more efficiently by beating-trays (Churchill, 1993; Green, 1999). In this paper, the composition of the spider assemblage collected using pitfall traps and beating-trays and the efficiency of these two sampling methods in capturing dominant

spider taxa was compared at the “Estação Ecológica da Universidade Federal de Minas Gerais”, illustrating how the choice of a method can influence the final interpretation of community composition and species richness.

Material and methods

Study area

The “Estação Ecológica da Universidade Federal de Minas Gerais” (EE/UFMG) is a 102 ha urban reserve located in the northwestern area of the metropolitan region of Belo Horizonte, state of Minas Gerais, southeastern Brazil (19°52' S, 43°58' W; 800–880 m) (Fig. 1). A warm and rainy season from October to March and a dry winter from April to September characterize the climate. Mean annual temperature is 21°C, and annual rainfall typically ranges from 1500 to 1750 mm.

The vegetation consists predominantly of herbs, shrubs, and small sized trees. There are areas of secondary forest with Atlantic forest influence and patches of “cerrado” (savannah-like vegetation), and areas of “capoeira” (disturbed second-growth vegetation), marshlands and abandoned monocultures of introduced species (*Pennisetum purpureum* Schumacher, *Bambusa* sp. and *Eucalyptus* spp.). Collections were conducted in two sampling sites: a secondary forest area, called “Bosque do Sossego”, and a shrub dominant area of “capoeira”. “Bosque do Sossego” predominant trees are *Copaifera langsdorffii* Desfontaines and *Chorisia speciosa* Saint Hillaire. “Capoeira” predominant vegetal species are *Baccharis* spp., *Panicum* sp. and *Melinis minutiflora* Beauv.

Sampling methods

Forty-five pitfall traps were placed in each sampling site. These traps were arranged in three parallel lines, five meters apart, with 15 traps each separated by a distance of two meters, totalling approximately 450 m².

Table I. Number of individuals and species richness by family according to the collecting method in the EE/UFMG (N, total number of spiders; N', number of adults; %N', percentage of adults; S, number of species based only on adult specimens collected). The families marked with “*” are represented only by juveniles.

Families	Pitfall traps				Beating-trays				Pitfall + Beating-trays			
	N	N'	%N'	S	N	N'	%N'	S	N	N'	%N'	S
Actinopodidae	35	24	68.6	3	11	0	0	0	46	24	52.2	3
Amaurobiidae	1	1	100.0	1	2	2	100.0	1	3	3	100.0	1
Anyphaenidae	3	0	0	0	1852	87	4.7	11	1855	87	4.7	11
Araneidae	8	2	25.0	1	598	32	5.4	15	606	34	5.6	15
Corinnidae	228	177	77.6	10	22	0	0	0	250	177	70.8	9
Ctenidae	28	5	17.9	2	0	0	0	0	28	5	17.9	2
Deinopidae	2	0	0	0	43	6	14.0	1	45	6	13.3	1
Dictynidae	0	0	0	0	195	66	33.8	2	195	66	33.8	2
Dipluridae*	2	0	0	0	0	0	0	0	2	0	0	*
Gnaphosidae	11	2	18.2	2	8	0	0	0	19	2	10.5	2
Hahniidae	74	65	87.8	2	0	0	0	0	74	65	87.8	2
Idiopidae	1	1	100.0	1	0	0	0	0	1	1	100.0	1
Linyphiidae	241	182	75.6	8	3	2	66.7	2	244	179	73.4	9
Lycosidae	204	18	8.8	6	2	0	0.0	0	206	18	8.7	6
Mimetidae	0	0	0	0	136	15	11.0	1	136	15	11.0	1
Miturgidae	0	0	0	0	342	1	0.3	1	342	1	0.3	1
Mysmenidae	0	0	0	0	4	2	50.0	1	4	2	50.0	1
Nemesiidae	28	13	46.4	3	0	0	0	0	28	13	46.4	3
Oonopidae	31	28	90.3	4	64	25	39.1	4	95	53	55.8	6
Oxyopidae	40	16	40.0	4	235	24	10.2	4	275	40	14.5	5
Palpimanidae	6	5	83.3	1	0	0	0	0	6	5	83.3	1
Philodromidae	28	14	50.0	2	17	6	35.3	3	45	20	44.4	3
Pholcidae	73	38	52.1	3	127	93	73.2	3	200	131	65.5	3
Salticidae	215	148	68.8	23	1691	250	14.8	37	1906	398	20.9	52
Scytodidae	13	7	53.8	1	240	86	35.8	2	253	93	36.8	2
Segestriidae*	1	0	0	0	2	0	0	0	3	0	0	*
Selenopidae*	0	0	0	0	5	0	0	0	5	0	0	*
Senoculidae*	0	0	0	0	6	0	0	0	6	0	0	*
Sparassidae*	1	0	0	0	67	0	0	0	68	0	0	*
Tetragnathidae	12	0	0	0	217	14	6.5	5	229	19	8.3	5
Theraphosidae	1	1	100.0	1	2	0	0	0	3	1	33.3	1
Theridiidae	192	120	62.5	13	1721	404	23.5	38	1913	524	27.4	50
Theridiosomatidae*	0	0	0	0	2	0	0	0	2	0	0	*
Thomisidae	13	2	15.4	2	1370	71	5.2	22	1383	73	5.3	23
Titanoecidae	16	16	100.0	1	0	0	0	0	16	16	100.0	1
Trechaleidae*	0	0	0	0	4	0	0	0	4	0	0	*
Zodariidae	327	239	73.1	1	0	0	0	0	327	239	73.1	1
Total	1835	1119	61.3	95	8988	1186	13.2	153	10823	2310	21.3	224

Results

Total species richness and composition sampled by both methods

A total of 10,823 spiders (8,513 immatures and 2,310 adults) belonging to 37 families were collected. Seven families were represented only by juveniles (Dipluridae, Segestriidae, Selenopidae, Senoculidae, Sparassidae, Theridiosomatidae and Trechaleidae). Adults comprised 223 species distributed in 30 families (Table I). The richest families were Salticidae (52 species) and Theridiidae (50 species), followed by Thomisidae (23 species), Araneidae (15 species) and Anyphaenidae (11 species). In relation to the number of adult individuals, the most representative families were Theridiidae (22.7%), Salticidae (17.2%), Zodariidae (10.3%), Li-

nyphiidae (7.7%) and Corinnidae (7.6%). The five most abundant species were *Tenedos* sp. (10.3%), *Falconina gracilis* (Keyserling, 1891) (6.3%), *Meioneta* sp. (5.6%), *Tupigea* sp. (3.7%) and *Achaearanea hirta* (Taczanowski, 1873) (3.3%).

Sampling method, family composition and relative abundance

The results obtained by the two methods employed in this study are not statistically comparable due to statistical premisses and methodological differences. Thus, only qualitative descriptions of the composition of species and families collected by both methods can be made.

Table II. Summary of the values of number of species and families sampled with the two methods separated and combined, and the species richness estimated with these data. The decimal places in values obtained in the richness estimation were omitted. The families marked with “*” are represented only by juveniles.

	Pitfall traps	Beating-trays	Pitfall traps + Beating-trays
Number of samples	540	120	660
Number of individuals	1,835	8,988	10,823
Number of families (considering adults and immatures)	29	29	37
Number of adults	1124	1186	2310
Number of families (adults only)	25	18	30
Number of species	94	153	223
Exclusive species	70	129	-
Exclusive families (adults only)	12	6	-
Number of singletons	35	60	78
Number of doubletons	12	16	22
Richness estimators			
Chao1	140 ± 24	257 ± 42	333 ± 37
Chao2	131 ± 18	230 ± 29	312 ± 29
Jackknife1	129 ± 6	212 ± 9	299 ± 10
Bootstrap	109	179	257

With pitfall traps, 1,835 individuals (adults and juveniles) distributed in 29 families were collected. The most abundant spider families, collected in pitfall traps, were Zodariidae (18.4%), Linyphiidae (13.1%), Salticidae (11.7%), Lycosidae (11.1%) and Theridiidae (10.5%) (Table I). Adults comprised 1,124 spiders, belonging to 24 families and 94 species. This method collected a higher percentage of adults (61.3%) and more adult males (43.2%) than females (18.0%), than the other sampling method.

A total of 8,988 individuals (adults and juveniles) of 29 families were collected with beating-trays. The most abundant families were Anyphaenidae (20.6%), Theridiidae (19.2%), Salticidae (18.8%), Thomisidae (15.2%), Araneidae (6.6%) and Miturgidae (3.8%). The adults (1,186 spiders) were distributed in 18 families and 153 species. A low percentage of adults (13.2%) was obtained by this method, and adult females were more abundant than adult males (8.1% and 5.1%, respectively). Some families (Anyphaenidae, Thomisidae, Miturgidae, and Araneidae) were represented by a great number of individuals, but with a low proportion of adults (Table I).

Considering only the adult spiders, 12 families and 70 species (31.4% of total species) were collected exclusively by pitfall traps. Six families and 129 species (57.9%) were represented exclusively in beating-tray samples (Table II). Only 24 species (10.7%) were collected by both methods (Table II). These methods, thus, showed a very low overlapping, with a high complementarity (89.2%).

The composition of the most diverse and abundant families differed considerably between the methods (Table I). In terms of number of species, for both methods, Salticidae was also the most diverse family, with 52 species, followed by Theridiidae, with 50 species and Thomisidae with 23 species (Table I, Appendage I).

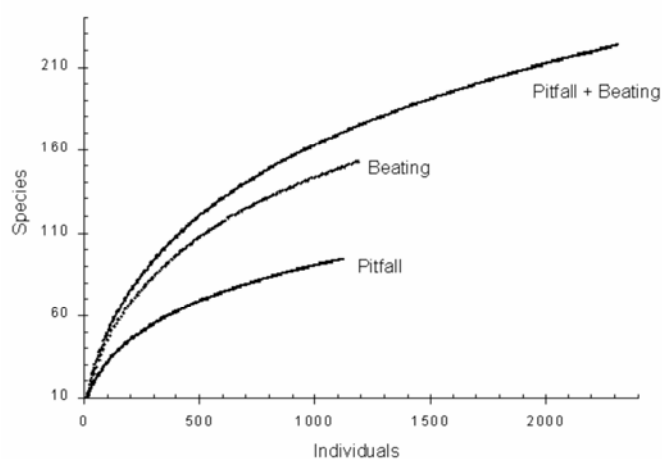


Fig. 2. Individual-based species accumulation curves with 100 randomizations for the beating-trays, pitfall traps and beating-trays + pitfall traps data set.

Sampling method and spider estimated richness

Figure 2 presents the species accumulation curves generated with pitfall traps, beating-trays and both methods combined. None of the curves reached an asymptote, but the one generated by the pitfall traps was less inclined. The results of estimated species richness for the combined methods and for each one are presented in table II. Estimators ranged from 179 (Bootstrap) to 257 ± 42 SD (Chao1) for beating-trays, 109 (Bootstrap) to 138 ± 22 SD (Chao1) for pitfall traps, and 257 (Bootstrap) to 333 ± 37 SD (Chao1) for combined methods. The percentage of singletons was lowest with the combined data (35.0%), when compared with each method alone (39.2% for beating-trays and 37.2% for pitfall traps).

Discussion

Considering that the EE/UFGM is a disturbed urban reserve, the spider richness that resulted from this survey is considerable. However, direct comparisons of these results with other surveys carried out in the Neotropical region are very difficult to be made, since the sampling effort is not the same, allowing only qualitative comparisons. Indeed, these comparisons must be taken with care, since sampling effort, season, size, number of sampled sub-areas and part of community accessed in different studies were quite different from those employed in the EE/UFGM.

Analysing each method separately, the results of richness of ground spiders of EE/UFGM were greater than that obtained by pitfall traps in the three urban areas in the city of São Paulo (Candiani *et al.*, in press), where 46 species (1569 adults) were found in 600 samples during four sampling periods, and in two sampling sites (continental area and Parque dos Eucaliptos Island) in the Guarapiranga Reservoir, in the city of São Paulo (Indicati *et al.*, in press), where 86 species and 2171 adults were collected in 400 traps in four sampling expeditions. Analysing the results of the estimators, the expected richness for the EE/UFGM was also greater than that obtained in these two studies, except by the Chao2 in the continental area sampled by Indicatti *et al.* (in press), where an estimated richness of 135 species was obtained. In the Parque Estadual da Ilha do Cardoso, city of Cananéia, state of São Paulo, Fowler & Venticinque (1995), using pitfall traps (number of samples not indicated), found 31 species and 477 spiders (number of adults not indicated). However authors did not provide further analysis with estimators and species accumulation curves. Concerning richness of spiders sampled by beating-trays, there are no studies for comparison in the Neotropics that specify the spiders species collected with this method. The same is true for studies from some other areas in Brazil (Borges & Brescovit, 1996; Martins & Lise, 1997; Lise, 1998; Brescovit *et al.*, 2004), in which the authors did not separated the spiders collected by each method, thus, only the observed richness can be compared. In such case, the results of the spider richness of the EE/UFGM were similar to some areas surveyed in the Brazilian Amazonia and in other areas in the Atlantic Forest. For example, Lise (1998) found in the Ilha de Maracá, in the State of Roraima, 270 species (number of adults not indicated) using beating-trays, sweep-net and pitfall traps (number of samples not indicated), in 21 days of collecting. In Caxiuanã, city of Melgaço, State of Pará, Martins & Lise (1997) found 135 species (354 adults), using beating-trays, sweep net, pitfall traps and visual search (number of samples not indicated) during a ten day period. In the Mamirauá reserve, in the state of Amazonas, Borges & Brescovit (1996) found 102 species in 20 days using visual search (number of samples not indicated). In the Estação Ecológica Juréia-Itatins, in the state of São Paulo, in the Atlantic Forest dominium, Brescovit *et al.* (2004) found, after four expeditions, 274 species (about 3800 adults) using visual search (diurnal and

nocturnal), beating-trays, litter sampling and pitfall traps (number of samples not indicated). Despite the urban location and the disturbed and fragmented nature of EE/UFGM reserve, these results give a good expectative of a very high richness in Cerrado and non-coastal Atlantic Forests.

None of the species accumulation curves reached an asymptote, as expected for most tropical communities of arthropods (Gotelli & Colwell, 2001). This suggests that there are more species to be discovered in both assemblages and an increase of sampling effort is needed to saturate the curves. The percentage of rare species (singletons) found (35%) is also similar to that found in the literature for tropical regions, which range from 30 to 70% (Silva, 1996; Silva & Coddington, 1996; Sørensen, 2004). The bootstrap estimate was the lowest in all analyses, as expected (Colwell & Coddington, 1994; Coddington *et al.*, 1996; Sørensen *et al.*, 2002). The percentage of observed richness in relation to the mean of the expected richness obtained by these estimators ranged from 67.1% to 86.2% for pitfall traps, 59.5% to 85.5% for beating-tray and 70.0% to 86.8% for combined data. These results of richness estimators corroborate that both soil and vegetation spider assemblages of the EE/UFGM were underestimated.

The low species overlapping observed in this study emphasizes the differences between the two methods. The coincident species can be interpreted as a stochastic event, as a behaviour of some individuals or sex class, or as habits of these species that include the zone between the lower parts of vegetation and the surface of soil. Sørensen *et al.* (2002) found very similar results when testing diverse combination of methods in the Afrotropical region. They found that pitfall and beating-tray are a very complementar combination (92%), similar to the result found in this study (89.2%). These two methods have very different characteristics regarding to sample size, influence of the spider activity, sampling way, vegetal stratum sampled etc. Owing to this, quantitative comparisons between both methods are not recommended. However, a qualitative analysis might provide a better way to evaluate the composition of the spider assemblages sampled.

Studies on the natural history of most Neotropical species are lacking, and considerations about family habits are generalizations, sometimes inferred from a few species or from species of other zoogeographical regions. Although not definitive, our data suggest habitat preferences for some species. In the EE/UFGM, Linyphiidae species were very abundant in the soil, as found by Indicatti *et al.* (in press), Candiani *et al.* (in press), Fowler & Venticinque (1995) and Azevedo *et al.* (2002). Spiders of the families Lycosidae and Corinnidae were also abundant in soil. Candiani *et al.* (in press) and Indicatti *et al.* (in press) found that Zoridae spiders were abundant in soil, but species of this family was not found in the EE/UFGM in this survey. On the other hand, in the EE/UFGM, spiders of the families Anyphaenidae and Thomisidae were more abundant in the

vegetation, the main habitat of most of their species. Pitfall traps also collected individuals of Oxyopidae (four of the five species were represented), a family common in vegetation, showing that these spiders probably also use the soil for foraging. The Pholcids were very abundant in both habitats, but with different species dominating in each of these. Theridiids and Salticids were abundant and species rich in both soil and vegetation, as shown by most of the works in the tropical region (Silva, 1992; Silva, 1996; Flórez-D, 1998; Lise, 1998; Höfer & Brescovit, 2001; Azevedo *et al.*, 2002; Rinaldi *et al.*, 2002).

Pitfall traps were more efficient in capturing adult spiders. This result had already been observed in previous studies (Uetz & Unzicker, 1976; Churchill, 1993; Azevedo *et al.*, 2002) and is related to the higher activity of mature spiders compared to immatures. Considering only adult spiders, males are also more active than females, and this fact also explains the high rate of males observed in pitfall samples (Costa, 1998). Therefore the proportion of spiders collected with pitfall traps does not reflect the real abundance in the assemblage but a higher activity rate (Luff, 1975; Uetz & Unzicker, 1976; Topping & Luff, 1995).

As suggested by some authors (Coddington *et al.*, 1991, 1996; Churchill, 1993; Topping & Luff, 1995; Green, 1999), proper assessment of spider fauna requires the use of a combination of sampling methods. Pitfall traps and beating-trays are two important methods that, together, can catch a higher number of species from two of the most important microhabitats. Besides, these methods are simple, cheap and easily replicable. Anot-

her relevant aspect affecting the sampling is seasonal differences. Although poorly studied in Neotropical araneofauna, it has a very important role in the spider fauna composition sampled in a survey, and have been observed in a number of spider species taken by different sampling methods (Merret, 1983; Silva & Coddington, 1996). This emphasizes the need to choose not only the methods that can sample different microhabitats, but also to plan the survey to include different seasons.

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Appendage I.

Number of individuals by species according to the collecting method in the EE/UFGM
(B, beating-trays; P, Pitfall traps).

Species by family	P	B	Total	Species by family	P	B	Total
Actinopodidae				<i>Erigone</i> sp1	2	0	2
<i>Actinopus</i> sp1	15	0	15	<i>Erigone</i> sp2	7	0	7
<i>Actinopus</i> sp2	9	0	9	<i>Exocora</i> sp1	5	0	5
Amaurobiidae				<i>Meioneta</i> sp1	129	0	129
<i>Amaurobiidae</i> sp1	1	2	3	<i>Meioneta</i> sp2	27	1	28
Anyphaenidae				<i>Meioneta</i> sp3	0	1	1
<i>Aysha marinonii</i> Brescovit, 1992	0	4	4	<i>Sphecozone rubescens</i> O. P.-Cambridge, 1870	2	0	2
<i>Jessica osoriana</i> (Mello-Leitão, 1922)	0	1	1	<i>Erigoninae</i> sp1	1	0	1
<i>Osoriella tahela</i> Brescovit, 1998	0	26	26	Lycosidae			
<i>Pippuhana</i> sp1	0	20	20	<i>Hogna</i> sp1	4	0	4
<i>Teudis angusticeps</i> (Keyserling, 1891)	0	3	3	<i>Lycosa erythrognatha</i> Lucas, 1836	1	0	1
<i>Teudis</i> sp1	0	7	7	<i>Molitorosa molitor</i> (Bertkau, 1880)	1	0	1
<i>Teudis</i> sp2	0	4	4	Lycosidae sp1	2	0	2
<i>Teudis</i> sp3	0	10	10	Lycosidae sp2	4	0	4
<i>Umuara</i> sp1	0	10	10	Lycosinae sp3	6	0	6
Anyphaenidae sp1	0	1	1	Mimetidae			
Anyphaenidae sp2	0	1	1	<i>Gelanor</i> sp1	0	15	15
Araneidae				Miturgidae			
<i>Alpaida bicornuta</i> (Taczanowski, 1878)	0	1	1	<i>Cheiracanthium inclusum</i> (Hentz, 1847)	0	1	1
<i>Alpaida trispinosa</i> (Keyserling, 1892)	0	1	1	Mysmenidae			
<i>Alpaida</i> sp1	0	4	4	Mysmenidae sp1	0	2	2
<i>Araneus guttatus</i> (Keyserling, 1865)	0	1	1	Nemesiidae			
<i>Araneus horizonte</i> Levi, 1991	0	1	1	<i>Acanthognathus</i> sp1	5	0	5
<i>Cyclosa tapetifaciens</i> Hingston, 1932	0	1	1	<i>Prorachias bristowei</i> Mello-Leitão, 1924	3	0	3
<i>Dubiepeira dubitata</i> (Soares & Camargo, 1948)	0	1	1	<i>Rachias</i> sp1	5	0	5
<i>Gasteracantha cancriformis</i> (Linnaeus, 1758)	0	2	2	Oonopidae			
<i>Kapogea alayoi</i> (Archer, 1958)	0	1	1	<i>Opopaea</i> sp1	18	0	18
<i>Mecynogea lemniscata</i> (Walckenaer, 1842)	0	6	6	<i>Opopaea</i> sp2	0	1	1
<i>Micrathena plana</i> (C. L. Koch, 1836)	2	5	7	<i>Orchestina</i> sp1	6	1	7
<i>Micrathena spitzii</i> Mello-Leitão, 1932	0	1	1	<i>Orchestina</i> sp2	1	22	23
<i>Parawixia velutina</i> (Taczanowski, 1878)	0	1	1	Oonopidae sp1	3	0	3
<i>Testudinaria</i> sp1	0	3	3	Oonopidae sp2	0	1	1
<i>Wagneriana neglecta</i> (Mello-Leitão, 1939)	0	1	1	Oxyopidae			
Corinnidae				<i>Peucetia flava</i> Keyserling, 1877	3	5	8
<i>Attacobius luederwaldti</i> (Mello-Leitão, 1923)	2	0	2	<i>Oxyopes bolivianus</i> Tullgren, 1905	1	0	1
<i>Castianeira</i> sp1	12	0	12	<i>Oxyopes pugilator</i> Mello-Leitão, 1929	0	14	14
<i>Castianeira</i> sp2	1	0	1	<i>Oxyopes salticus</i> Hentz, 1845	11	2	13
<i>Castianeira</i> sp3	1	0	1	<i>Oxyopes stephanurus</i> Mello-Leitão, 1929	1	3	4
<i>Corinna capito</i> (Lucas, 1856)	1	0	1	Palpimanidae			
<i>Falconina gracilis</i> (Keyserling, 1891)	146	0	146	<i>Fernandezina pelta</i> Platnick, 1975	5	0	5
<i>landuba varia</i> (Keyserling, 1891)	6	0	6	Philodromidae			
<i>Mazax</i> sp1	3	0	3	<i>Berlandiella</i> sp1	12	3	15
<i>Orthobula</i> sp1	4	0	4	<i>Berlandiella</i> sp2	2	1	3
Corinnidae sp1	1	0	1	<i>Berlandiella</i> sp3	0	2	2
Ctenidae				Pholcidae			
<i>Isoctenus</i> sp1	4	0	4	<i>Mesabolivar difficilis</i> (Mello-Leitão, 1918)	29	7	36
<i>Oligoctenus ornatus</i> (Keyserling, 1876)	1	0	1	<i>Mesabolivar</i> sp1	4	6	10
Deinopidae				<i>Tupigea</i> sp1	5	80	85
<i>Deinopis</i> sp1	0	6	6	Salticidae			
Dictynidae				<i>Amphidraus</i> sp1	3	0	3
<i>Dictyna</i> sp1	0	21	21	<i>Aphirape uncifera</i> (Tullgren, 1905)	1	0	1
Dictynidae sp1	0	45	45	<i>Atelurius</i> sp1	0	4	4
Gnaphosidae				<i>Bryantella</i> sp1	0	1	1
<i>Apopyllus iheringi</i> (Mello-Leitão, 1943)	1	0	1	<i>Chira</i> sp1	1	27	28
<i>Apopyllus</i> sp1	1	0	1	<i>Chira</i> sp2	0	1	1
Hahniidae				<i>Chira</i> sp3	0	1	1
Hahniidae sp1	40	0	40	<i>Cotinusa vittata</i> Simon, 1900	0	28	28
Hahniidae sp2	25	0	25	<i>Cotinusa</i> sp1	0	1	1
Idiopidae				<i>Cylistella</i> sp1	0	14	14
<i>Idiops</i> sp1	1	0	1	<i>Descanso</i> sp1	0	2	2
Linyphiidae				<i>Descanso</i> sp2	0	1	1
<i>Antronetes</i> sp1	9	0	9	<i>Frigga</i> sp1	0	3	3

Species by family	P	B	Total	Species by family	P	B	Total
<i>Gastromicans</i> sp1	0	5	5	<i>Chryso pulcherrima</i> (Mello-Leitão, 1917)	0	11	11
<i>Gypogyna forceps</i> Simon, 1900	0	1	1	<i>Coleosoma floridanum</i> Banks, 1900	0	1	1
<i>Helvetia</i> sp1	0	1	1	<i>Coleosoma</i> sp1	46	13	59
<i>Hyetussa</i> sp1	0	1	1	<i>Coleosoma</i> sp2	0	1	1
<i>Lyssomanes bitaeniatus</i> Peckham & Wheeler, 1889	0	40	40	<i>Craspedisia comuta</i> (Keyserling, 1891)	0	2	2
<i>Lyssomanes</i> sp1	0	1	1	<i>Dipoena alta</i> Keyserling, 1886	0	1	1
<i>Maeota dichrura</i> Simon, 1901	1	15	16	<i>Dipoena atlantica</i> Chickering, 1943	0	5	5
<i>Myrmarachne</i> sp1	1	1	2	<i>Dipoena bryantae</i> Chickering, 1943	0	6	6
<i>Neonella</i> sp1	5	0	5	<i>Dipoena granulata</i> (Keyserling, 1886)	27	0	27
<i>Noegus</i> sp1	1	25	26	<i>Dipoena pusilla</i> (Keyserling, 1886)	0	1	1
<i>Nyccerella aprica</i> (Peckham & Peckham, 1896)	0	1	1	<i>Dipoena</i> sp1	0	76	76
<i>Phiale gratiosa</i> C.L. Koch, 1846	0	4	4	<i>Dipoena</i> sp2	2	0	2
<i>Phiale</i> sp1	1	0	1	<i>Dipoena</i> sp3	0	10	10
<i>Phiale tristis</i> Mello-Leitão, 1945	1	2	3	<i>Dipoena</i> sp4	1	0	1
<i>Saitidops</i> sp1	0	5	5	<i>Dipoena</i> sp5	0	6	6
<i>Semiopyla</i> sp1	2	0	2	<i>Dipoena</i> sp6	0	1	1
<i>Semiopyla</i> sp2	3	0	3	<i>Emertonella taczanowskii</i> (Keyserling, 1886)	0	23	23
<i>Simprulla</i> sp1	0	1	1	<i>Episinus cognatus</i> O. P.-Cambridge, 1893	0	2	2
<i>Sitticus</i> sp1	5	0	5	<i>Episinus nebulosus</i> (Simon, 1895)	0	28	28
<i>Sitticus</i> sp2	8	0	8	<i>Euryopsis</i> sp1	25	0	25
<i>Tariona</i> sp1	0	2	2	<i>Euryopsis</i> sp2	4	0	4
<i>Thiodina germaini</i> Simon, 1900	0	4	4	<i>Guaraniella bricata</i> Baert, 1984	2	0	2
<i>Thiodina vaccula</i> Simon, 1900	0	3	3	<i>Latrodectus geometricus</i> C. L. Koch, 1841	0	1	1
<i>Tullgrenella</i> sp1	2	0	2	<i>Steatoda ancorata</i> (Holmberg, 1876)	8	0	8
<i>Tullgrenella yungae</i> Galiano, 1970	1	0	1	<i>Stemmops carius</i> Marques & Backup, 1996	1	0	1
<i>Uspachus</i> sp1	1	2	3	<i>Theridion fungosum</i> Keyserling, 1886	0	24	24
<i>Vinnius subfasciatus</i> (C. L. Koch, 1846)	2	1	3	<i>Theridion oswaldocruzi</i> Levi, 1963	0	6	6
<i>Yepoella crassistylis</i> Galiano, 1970	0	4	4	<i>Theridion pernambucum</i> Levi, 1963	1	0	1
Dendriphantinae sp1	0	9	9	<i>Theridion positivum</i> Chamberlin, 1924	0	10	10
Dendriphantinae sp2	0	1	1	<i>Theridion</i> sp1	0	1	1
Dendriphantinae sp3	0	1	1	<i>Theridion</i> sp2	0	1	1
Freinae sp1	0	1	1	<i>Theridula nigerrima</i> (Petrunkevitch, 1911)	0	1	1
Sitticinae sp1	1	0	1	<i>Thwaitesia affinis</i> O. P.-Cambridge, 1882	0	33	33
Salticidae sp1	1	33	34	<i>Tidarren haemorrhoidale</i> (Bertkau, 1880)	0	3	3
Salticidae sp2	45	0	45	<i>Wirada</i> sp1	1	0	1
Salticidae sp3	7	0	7	Theridiidae sp1	0	1	1
Salticidae sp4	9	0	9	Thomisidae			
Salticidae sp5	46	0	46	<i>Aphantochilus rogersi</i> O. P.-Cambridge, 1870	0	4	4
Salticidae sp6	0	3	3	<i>Bucranium taurifrons</i> O. P.-Cambridge, 1881	0	1	1
Scytodidae				<i>Deltocilita</i> sp1	0	1	1
<i>Scytodes itapevi</i> Brescovit & Rheims, 2000	7	66	73	<i>Epicadinus</i> sp1	0	3	3
<i>Scytodes</i> sp1	0	20	20	<i>Misumenops pallens</i> (Keyserling, 1880)	0	1	1
Tetragnathidae				<i>Misumenops pallidus</i> (Keyserling, 1880)	0	1	1
<i>Chryso meta guttata</i> (Keyserling, 1881)	0	2	2	<i>Misumenops</i> sp1	0	3	3
<i>Nephila clavipes</i> (Linnaeus, 1767)	0	11	11	<i>Misumenops</i> sp2	0	3	3
<i>Leucauge</i> sp1	0	1	1	<i>Misumenops</i> sp3	0	5	5
<i>Leucauge</i> sp2	0	1	1	<i>Misumenops</i> sp4	0	3	3
<i>Tetragnatha</i> sp1	0	1	1	<i>Onoculus echinicaudus</i> Mello-Leitão, 1929	0	6	6
Theraphosidae				<i>Onoculus garruchus</i> Lise, 1979	0	10	10
<i>Vitalius</i> sp1	1	0	1	<i>Runcinioides</i> sp1	0	3	3
Theridiidae				<i>Titidius galbanatus</i> (Keyserling, 1880)	1	0	1
<i>Achaeearanea hirta</i> (Taczanowski, 1873)	0	77	77	<i>Tmarus</i> sp1	1	1	2
<i>Achaeearanea jequirituba</i> Levi, 1963	0	1	1	<i>Tmarus</i> sp2	0	4	4
<i>Achaeearanea nigrovittata</i> (Keyserling, 1884)	0	1	1	<i>Tmarus</i> sp3	0	5	5
<i>Achaeearanea</i> sp1	0	2	2	<i>Tmarus</i> sp4	0	2	2
<i>Achaeearanea</i> sp2	1	0	1	<i>Tmarus</i> sp5	0	7	7
<i>Achaeearanea</i> sp3	0	1	1	<i>Tmarus</i> sp6	0	2	2
<i>Achaeearanea</i> sp4	1	0	1	<i>Tmarus</i> sp7	0	3	3
<i>Achaeearanea trapezoidalis</i> (Taczanowski, 1873)	0	11	11	<i>Tmarus</i> sp8	0	1	1
<i>Anelosimus ethicus</i> (Keyserling, 1884)	0	1	1	Thomisidae sp1	0	2	2
<i>Anelosimus rupununi</i> Levi, 1956	0	28	28	Titanoecidae			
<i>Anelosimus studiosus</i> (Hentz, 1850)	0	7	7	<i>Goeldia</i> sp1	16	0	16
<i>Argyrodes acuminatus</i> Keyserling, 1891	0	3	3	Zodariidae			
<i>Argyrodes alticeps</i> Keyserling, 1891	0	3	3	<i>Tenedos</i> sp1	239	0	239
<i>Argyrodes elevatus</i> Taczanowski, 1873	0	1	1	Total	1124	1186	2310