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# Short-term spider community monitoring after cattle removal in grazed grassland

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**ABSTRACT.** At the Pampa Biome, grazing, like others disturbances, affects fauna and flora, creating heterogeneity in the environment. Little is known about how the diversity and richness of arthropods change during this impact. To improve the knowledge of how spider diversity is affected by grazing, experiments were realized at Pampa. The hypothesis is that abundance of spider will be different when comparing grazed and ungrazed areas. A paired block, with two areas of one hectare each, was established in three areas in the Environmental Protection Area of Ibirapuitã (APA Ibirapuitã), state of Rio Grande do Sul, Brazil. One of these hectares was closed with fences, excluding the catle grazing, in August of 2012. Samplings were realized in November of 2011, 2012 and 2013 using Pitfall traps filled with formol 4% and disposed in an "X" format in each area. For statistical analyses, T test, ANOSIM, ANOVA and Rarefaction were performed. A total of 1,315 spiders were captured, comprising 77 species or morphospecies belonging to 20 families. The family most abundant was Lycosidae followed by Hahniidae, Linyphiidae and Theridiidae. Linyphiidae was the richest family with 14 species or morphospecies identified. All spiders, adults and juveniles, only adults in species and morphospecies, and most abundant species were used as models for statistics. These models revealed no significant difference between grazed and ungrazed areas after three and 15 months of cattle exclusion.

**KEYWORDS.** Neotropical, Pampa, diversity, Araneae.

**RESUMO. Monitoramento de curto prazo da comunidade de aranhas após a remoção do gado em campos pastejados.** No Pampa, o pastejo, como outros distúrbios, afeta a fauna e a flora, proporcionando uma maior heterogeneidade no ambiente. Pouco se sabe como a diversidade e a riqueza de artrópodes muda durante este impacto. Para aprimorar o conhecimento de como a diversidade de aranhas é afetada pelo pastejo, experimentos foram realizados no Pampa. A hipótese é que a abundância de aranhas será diferente quando áreas pastejadas e sem pastejo são comparadas. Um bloco de duas parcelas, cada uma com um hectare, foi estabelecido em três fazendas na APA (Área de Proteção Ambiental) do Ibirapuitã, Rio Grande do Sul, Brasil. Um destes hectares foi fechado com cercas, excluindo o pastejo do gado, em agosto de 2012. As amostragens foram realizadas em novembro de 2011, 2012 e 2013 usando armadilhas de queda preenchidas com formol 4% e dispostas em formato de "X" em cada hectare. Foram utilizados para análise estatística Teste T, ANOSIM, ANOVA e Rarefação. Um total de 1.315 aranhas foi amostrado, compreendendo 77 espécies ou morfoespécies de 20 familias. A família mais abundante foi Lycosidae, seguida de Hahniidae, Linyphiidae e Theridiidae. Linyphiidae foi a família mais rica, com 14 espécies ou morfoespécies identificadas. A soma das abundâncias de aranhas jovens e adultas, a abundância de apenas aranhas adultas e a abundância total somente das espécies mais abundantes foram utilizadas como modelos estatísticos. Estes modelos não revelaram diferença significativa entre áreas com e sem pastejo mesmo após três ou 15 meses de exclusão do gado.

**PALAVRAS-CHAVE.** Neotropical, Pampa, diversidade, Araneae.

The Pampa is a Neotropical region biome localized in meridional South America, including south Brazil, Uruguay and part of Argentina, covering 750,000 km$^2$ (Vélez *et al.*, 2009; Andrade *et al.*, 2015) (Fig. 1). It is composed originally by areas with grasslands and meadows (Behling *et al.*, 2009) and according to Köppen-Geiger classification, the climate is considered as "Cfa" (humid temperate with hot summers; Kottek *et al.*, 2006). In conformity to Suertegaray & Silva (2009), the Pampa is located in the Southern Temperate Zone with four well-characterized seasons and has a maximum altitude of 200 m.

The human presence in this region began around 10,000 (BP) with pre-Columbian cultures (Suertegaray & Silva, 2009). In general it is not exactly know how the Pampa was before more than some 300 years ago, when disturbance increases dramatically after the European colonization due cattle introduction, uncontrolled fire management, farming and silvicultural activities (Suertegaray & Silva, 2009; Rodrigues *et al.*, 2010; Podgaiski *et al.*, 2014; Ferrando *et al.*, 2016). Considering theses disturbances, many components of the biota, as also the invertebrate fauna, should be directly affected. However, these fauna and its level of endemism are poorly known for this region (Lewinsohn, 2006), and the enhancement of studies on biodiversity and biogeography of insects, arachnids, crustaceans as for other invertebrates groups are still necessary (Bencke, 2009).

Spiders are the second richest group of Arachnida, counting with more than 46,000 valid species distributed in 4,059 genera and 112 families (World Spider Catalog, 2017). The official number of spiders for Brazil is unknown but they could easily reach more than 4,000 species (Brescovit, 1999; Brescovit *et al*., 2011). For Rio Grande do Sul state, spider richness reach 808 species (Buckup *et al*., 2010). In terms of grasslands, richness and abundance of spider vary. For African grassland, Ammoxenidae, Lycosidae and Salticidae seems to be the most abundant (Jansen *et al*., 2013; Haddad *et al*., 2015; Foord *et al*., 2016) as Gnaphosidae, Salticidae and Thomisidae were the richest (Foord *et al*., 2011; Haddad *et al*., 2015; Foord & Dippenaar-Schoeman, 2016) in most recent studies. For South American grasslands Linyphiidae, Lycosidae and Salticidae seems to be the most abundant and richest families (Rodrigues *et al*., 2010; Pompozzi *et al*., 2011; Podgaiski *et al*., 2013; Cunha *et al*., 2015; Zanetti, 2016). However, spider diversity is still poorly known at Pampa (Oliveira *et al*., 2017).

Spiders have their diversity dependent of many factors (Foelix, 2011): vegetal structure (Baldissera *et al*., 2004; Nogueira & Pinto-da-Rocha, 2016), capacity of dispersal and settlement (Rodrigues *et al*., 2009; Lin *et al*., 2016) being distance insignificant (Horváth *et al*., 2009), prey availability and competitive exclusion (Dennis *et al*., 2015; Rodriguez-Artigas *et al*., 2016). Moreover, spider are still capable of consume high biomass rate (Nyfeller, 2000; Ott, 2016), are generalist predators in different trophic levels, even eating other spiders (Wise, 2006) and occupying nearly all terrestrial territories (Foelix, 2011), making up great ecological models (Craig *et al*., 2001; Foelix, 2011). Their resilience in rapidly reoccupy impacted environmental (Podgaiski *et al*., 2013), would be a great model for testing the absence of cattle graze impact.

The objective of this work is to present a list of families, species or morphoespecies of ground dwelling spider of Pampa biome. Moreover, to compare the areneofauna in areas with and without cattle graze after three and 15 months of total exclusion of this impact at Pampa. The hypothesis is that abundance of spiders will be different when comparing grazed and ungrazed areas.

## MATERIAL AND METHODS

**Study site.** The experiments were carried out at Ibirapuitã River Environmental Protection Area "Área de Proteção Ambiental – APA do Ibirapuitã" located at Western Pampas Areas of Rio Grande do Sul state, Brazil (Fig. 1). Six plots of one hectare each, located at three different farms in the municipality of Sant'Ana do Livramento and georeferenced

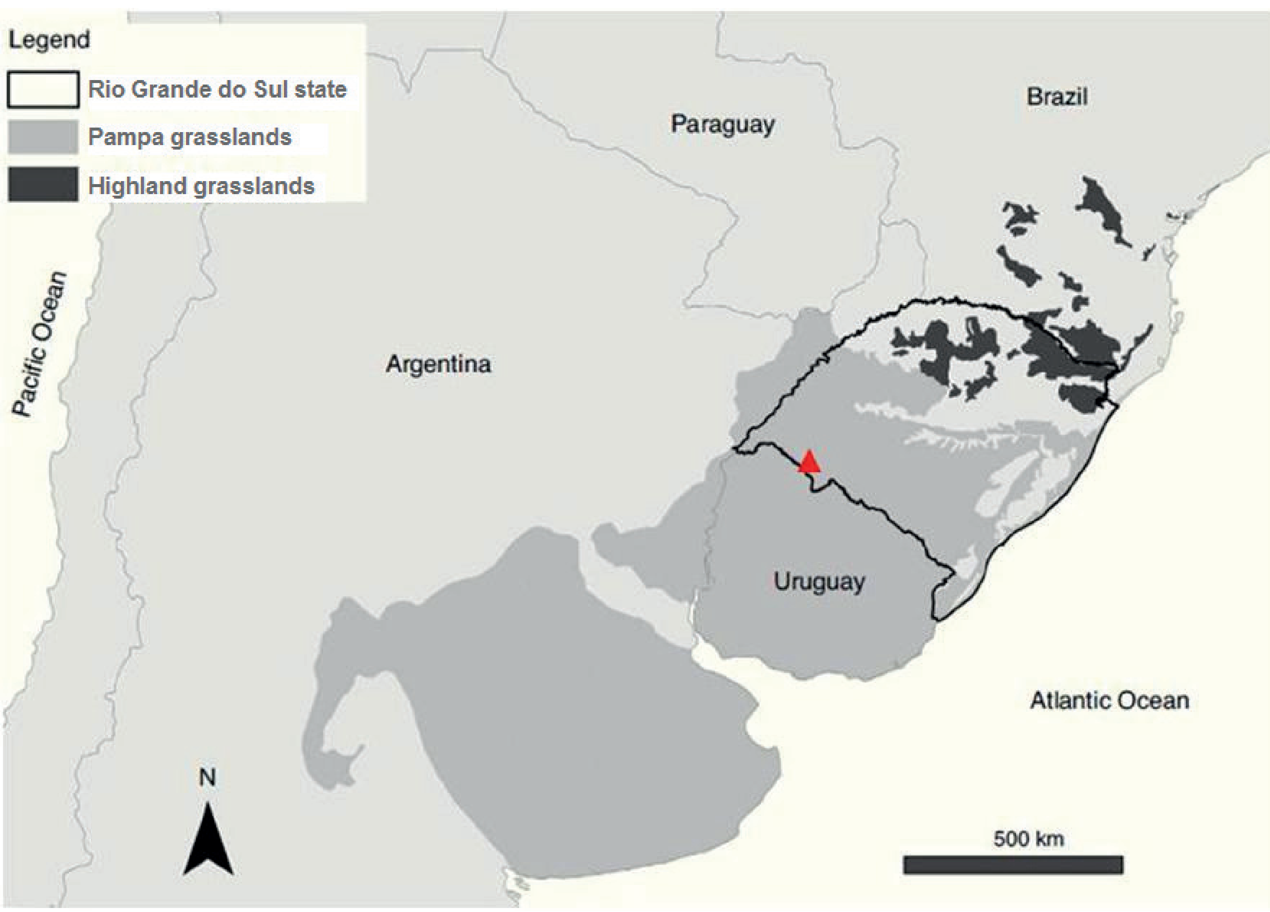


Fig. 1. Extension of the Pampa Biome at Neotropical region. Red triangle indicates APA Ibirapuitã's localization, state of Rio Grande do Sul, Brazil. Map from Andrade *et al*., 2015.

at 30°28'50.57"S, 55°33'10.21"W ("Estância do Açude"; Farm 1), 30°28'54.97"S, 55°34'14.05"W ("Fazenda Rincão dos Moraes"; Farm 2) and 30°25'54.78"S, 55°38'39.75"W ("Fazenda Bela Vista"; Farm 3) were selected for the sampling. In each farm a block of two plots placed close to 200 m far from each other were established, being one of them closed with fences in August of 2012, excluding totally the cattle grazing access; the second plot was defined only by poles placed at its corners and the cattle was allowed to free grazing access in the area. Closed plots without grazing were defined herein as ungrazed areas (T1, T2 and T3) and plots with free cattle grazing access were defined as grazed areas (C1, C2 and C3).

**Data collection.** The plots were sampled using pitfall traps made by ordinary plastic cups of 500 ml (15 cm depth, 10 cm diameter) inserted into a 10 cm diameter PVC guide. Twelve traps were installed disposed in "X" format from corner to corner of each plot (72 in total). To measure possible border effects, the traps were separated in three different groups of four traps regarding the distance to the border (edge, middle and center). Traps were placed around 20 m apart from each other and at least 10 m from the fence or border line of each plot (Fig. 2). Sampling periods occur in three different years: 8 to 15 November 2011 (no fences), 8 to 16 November 2012 (three months fences enclosure) and 26 November to 3 December 2013 (15 months fence enclosure), fulfilling 1,512 trap days. Traps were filled around 1/3 of total volume with formol at 4% concentration with some drops of liquid soap to break superficial tension.

**Data analysis.** Spiders collected at samples were sorted out manually and placed in vials containing 80% ethanol and after examined using a stereomicroscope. For determination in the lowest possible taxonomic level, dichotomous key were used for families (Dippenaar-Schoemann & Jocqué, 1997; Brescovit *et al*., 2002) and papers, available on-line at NMBE World Spider Catalog (World Spider Catalog, 2017), for genera and species. The classification used is also based in the same catalog above; families, genera and species are listed in alphabetic order. Adult and juveniles were sorted by family level and only adult spiders were identified at morphospecies and species level. All adult spiders were deposited at the aracnological collection of "Museu de Ciências Naturais da Fundação Zoobotânica do Rio Grande do Sul" (MCN), Porto Alegre, Brazil.

Most abundant species were defined by their dominance, as those making up ≥2% of the total of all individuals (adapted from Spiller & Schorner, 1998; Petcharad *et al*., 2016). For posterior analysis, these species were separated in three ways: (i) most abundant species in general, with abundance of all individuals of 2011, 2012 and 2013; (ii) most abundant species with abundance of all individuals of 2012 and 2013, for testing grazed and ungrazed areas differences; and (iii) most abundant species after 15 months of enclosure, with only abundance of all individuals of 2013, for testing border effect.

For statistical analysis, Student's tests were performed to compare differences in abundance between grazed and ungrazed areas using as models all spiders, only adults in species/morphospecies and the most abundant species. Three categories of tests were applied with these models: (i) sum of 2012 and 2013 abundance; (ii) only 2012 abundance to test three months of enclosure in ungrazed areas; and (iii) only 2013 abundance to test 15 months of enclosure in ungrazed areas. Analysis of similarities (ANOSIM) was performed based in Morisita, Bray-Curtis and Jaccard measures. Abundance of families in 2013, all spiders, only adults in species/morphospecies and most abundant species were used as models to test difference between pitfall groups in ungrazed areas. Analysis of variance (ANOVA) was performed to test differences between pitfall groups in 2013 using medians of abundance of all spiders, only adults in species/morphospecies and most abundant species. Rarefaction curves were performed to plot spider richness in ungrazed areas through the years using ANOVA for testing significance. All statistical analyses were made using Past (Paleontological Statistics 3.13, Hammer et al., 2001). The significance level utilized was $p<0.05$.

## RESULTS

A total of 1,315 spiders (775 adults, 576 males, 199 females; 540 juveniles) were sampled, 685 in grazed areas and 630 in ungrazed areas. Twenty six families were registered, considering juveniles and adults individuals; 77 species or morphospecies of 20 families were identified, of these, 33 nominal species, 33 morphospecies at genera level and 11morphospecies at only family level (Tab. I). Most abundant families were Lycosidae (433 individuals), Hahniidae (359), Linyphiidae (143), Theridiidae (94). Hahniidae followed by Lycosidae, Linyphiidae and Theridiidae were the most abundant families in ungrazed areas. Lycosidae followed by Hahniidae, Linyphiidae and Theridiidae were the most abundant in grazed areas. Adults in grazed areas sum 360 individuals (271 males; 89 females) and in ungrazed areas sum 415 individuals (305 males; 110 females) (Tab. I).

Linyphiidae was the richest family (14 species or morphospecies), followed by Lycosidae (13), Gnaphosidae (9), Salticidae (8) and Theridiidae (8) (Tab. I). Amphinectidae, Anyphaenidae, Araneidae, Caponiidae, Ctenidae, Miturgidae, Nemesiidae, Oonopidae, Oxyopidae, Phrurolithidae and Tetragnathidae were represented by only one species or morphospecies (Tab. I). Only juveniles of Microstigmatidae, Philodromidae, Pholcidae, Sparassidae and Tengelidae were sampled. Anyphaenidae, Philodromidae, Pholcidae, Tetragnathidae and Trechaleidae were exclusively found in ungrazed areas. Caponiidae, Microstigmatidae, Oxyopidae, Sparassidae and Tengelidae were exclusively recorded in grazed areas.

The most abundant species in general represent 34% of the total of spiders. They were *Neohania* sp. 1 (186 individuals), *Neohania* sp. 2 (155), *Guaraniella mahnerti* Baert, 1984 (45), *Agyneta* sp. 2 (35), *Schizocosa malitiosa*

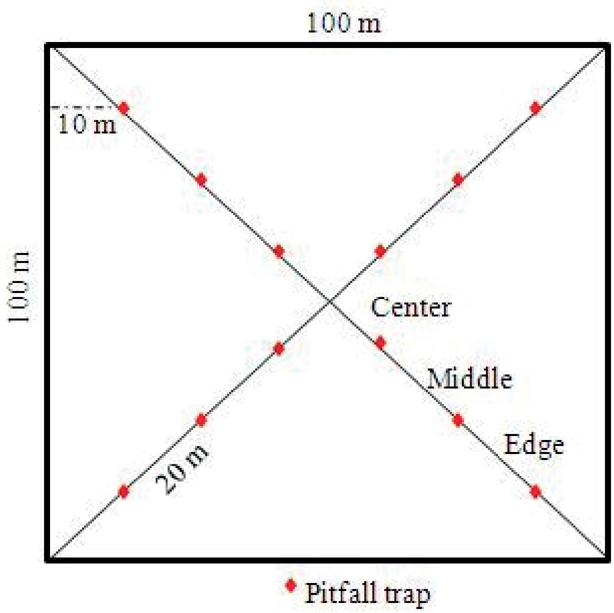


Fig. 2. Format used for exposal of pitfall traps in APA Ibirapuitã, state of Rio Grande do Sul, Brazil during the campaign of 2011, 2012 and 2013. Red diamonds indicates the places of the traps. Traps were placed around 20 m from each other and least 10 m from the fence or border of each plot.

(Tullgren, 1905) (30). Twenty-six species are exclusively from ungrazed areas and 14 from grazed areas. Twenty-seven species were singletons and 13 were doubletons.

In 2012 and 2013, 918 spiders were sampled. Of these, the most abundant species represent 33% of total spiders: *Neohania* sp. 1 (104 individuals), *Neohania* sp. 2 (96), *G. mahnerti* (31), *S. malitiosa* (25), *Agyneta* sp. 2 (24) and *Birabenia* sp. 1 (21). In only 2012, 459 spiders were sampled. Of these, the most abundant species represent 31% of total spiders and were *Neohania* sp. 2 (63), *Neohania* sp. 1 (33), *S. malitiosa* (22), *G. mahnerti* (19), *Agyneta* sp. 2 (8). A total of 459 spiders were sampled only in 2013; the most abundant species represent 39% of total spiders: *Neohania* sp. 1 (71), *Neohania* sp. 2 (33), *Agyneta* sp. 2 (16), *Birabenia* sp. 1 (15), *Erigone* sp. 1 (12), *G. mahnerti* (12), *Semiopyla cataphracta* Simon, 1901 (11) and *Lycosa thorelli* (Keyserling, 1877) (10).

Students' test revealed no significant difference between grazed and ungrazed areas regarding all spiders in 2012 and 2013 (p= 0.8047), only 2012 with three months of enclosure (p= 0.7888) and 2013 with 15 months of enclosure (p= 0.8413). The test wasn't significant different regarding just adults in species/morphospecies in 2012 and 2013 (p= 0.4782), in just 2012 (p= 0.2807) and in 2013 (p= 0.8465). Also, most abundant species weren't significant different in the same parameters 2012 and 2013 (p= 0.5744), only 2012 (p= 0.2086) and just 2013 (p= 0.7550).

Regarding the distance of the traps to the border of ungrazed areas, the Analysis of Similarity (ANOSIM) revealed no significant difference for families (Morisita: R= 0.0036, p= 0.4095; Bray-Curtis: R= 0.0060, p= 0.3943; Jaccard: R= 0.0064, p= 0.3923), all spiders (Morisita: R= -0.0519, p= 0.9174; Bray-Curtis: R= -0.0322, p= 0.7674; Jaccard: R= -0.0427, p= 0.8608), only adults in species/morphospecies (Morisita: R= -0.0298 p= 0.7978; Bray-Curtis: R= -0.0073 p= 0.5322; Jaccard: R= -0.0210, p= 0.7046) and most abundant species (Morisita: R= -0.0379, p= 0.8833; Bray-Curtis: R= -0.0400, p= 0.8508; Jaccard: R= -0.0361, p= 0.8694) between pitfall groups in 2013.

The Analysis of Variance (ANOVA) based in the means of spiders abundance demonstrated no significant difference between pitfall groups in 2013 when all spiders (p= 0.6737), only adults in species/morphospecies (p= 0.7392) and most abundant species (p=0.7365) were used as models.

Regarding the rarefaction curves a higher richness was presented in T1 than in T3 and T2 (Fig. 3) through years. However, ANOVA reveled no significant difference between ungrazed areas (p= 0.08305).

## DISCUSSION

Comparing our species list with that of Uruguay (Capocasale, 1990) (144 species and morphospecies), *Argiope argentata* (Fabricius, 1775), *Caponina notabilis* (Mello-Leitão, 1939), *L. thorelli*, *Metaltella simoni* Keyserling, 1878, *S. malitiosa* and *Teminius insularis* (Lucas, 1857) are shared between both lists. For Brazil, São Paulo state has registered 875 species, with just eight species in our list: *A. argentata*, *Camillina pulchra* (Keyserling, 1891), *Lycosa erythrognatha* Lucas, 1836, *L. thorelli*, *Oxyopes salticus* Hentz, 1845, *Parabatinga brevipes* (Keyserling, 1891), *S. cataphracta* and *T. insularis* (Brescovit *et al.*, 2011). Of the 808 species recorded for Rio Grande do Sul state (Buckup *et al.*, 2010), 19 species are shared with our list: *A. argentata*, *C. notabilis*, *C. pulchra*, *Castianeira chrysura* Mello-Leitão, 1943, *Castianeira gaucha* Mello-Leitão, 1943, *Eilica obscura* (Keyserling, 1891), *Eilica trilineata* (Mello-Leitão, 1941), *Euryopis camis* Levi, 1963, *Euryopis spinifera* Mello-Leitão, 1944, *Glenognatha lacteovittata* (Mello-Leitão, 1944), *G. mahnerti*, *L. erythrognatha*, *L. thorelli*, *M. simoni*, *P. brevipes*, *Psilocymbium lineatum* (Millidge, 1991), *S. malitiosa*, *O. salticus* and *T. insularis*. *A. argentata*, *L. thorelli* and *T. insularis* were present in all lists, and can be considered species with very broad range distribution. Moreover, the low quantity of common species in all lists indicates that composition of spider fauna can be very variable even comparing close regions.

Our data suggest that grazed and ungrazed areas are still very similar in terms of abundance and species composition of ground spiders, even 15 months after the removal of the cattle. However, the findings presented here could be affected by at last two sample design negative effects as stressed below. First, considering the size of the ungrazed areas (just one hectare) added to the fact that our fenced areas are all surrounded by grazed areas, could cause a presumable edge effect over the entire ungrazed areas (Murcia, 1995; Rodrigues *et al.*, 2014). Second, the reduced quantity of traps, it size or total trapping days, in other words the reduced

Tab. I. Ground spider species of Pampa biome, Rio Grande do Sul, southern Brazil. Species listed here are from November (Nov) of 2011, 2012, 2013. Taxa are separate in families, genera and species. Numbers indicate the quantity of adult individuals.

| | Grazed | | | Ungrazed | | | Total |
|---|---|---|---|---|---|---|---|
| Taxa | Nov-11 | Nov-12 | Nov-13 | Nov-11 | Nov-12 | Nov-13 | |
| Amphinectidae | | | | | | | |
| *Metaltella simoni* Keyserling, 1878 | 3 | 4 | 1 | 1 | 2 | 5 | 16 |
| Anyphaenidae | | | | | | | |
| *Arachosia sp.* | 0 | 0 | 0 | 0 | 1 | 1 | 2 |
| Araneidae | | | | | | | |
| *Argiope argentata* (Fabricius, 1775) | 0 | 0 | 0 | 0 | 0 | 2 | 2 |
| Caponiidae | | | | | | | |
| *Caponina notabilis* (Mello-Leitão, 1939) | 1 | 0 | 0 | 0 | 0 | 0 | 1 |
| Corinnidae | | | | | | | |
| *Castianeira chrysura* Mello-Leitão, 1943 | 0 | 1 | 0 | 0 | 1 | 0 | 2 |
| *Castianeira gaucha* Mello-Leitão, 1943 | 0 | 1 | 0 | 0 | 0 | 0 | 1 |
| *Castianeira* sp. 1 | 1 | 0 | 0 | 0 | 0 | 0 | 1 |
| *Castianeira* sp. 2 | 2 | 1 | 0 | 2 | 6 | 0 | 11 |
| *Mazax* sp. | 0 | 0 | 0 | 0 | 2 | 0 | 2 |
| Ctenidae | | | | | | | |
| *Parabatinga brevipes* (Keyserling, 1891) | 0 | 0 | 0 | 0 | 0 | 1 | 1 |
| Gnaphosidae | | | | | | | |
| *Apopyllus* sp. | 0 | 0 | 0 | 0 | 2 | 0 | 2 |
| *Camillina galianoae* Platnick & Murphy, 1987 | 1 | 0 | 0 | 0 | 1 | 3 | 5 |
| *Camillina pulchra* (Keyserling, 1891) | 0 | 3 | 0 | 0 | 1 | 0 | 4 |
| *Camillina* sp. | 1 | 1 | 0 | 1 | 0 | 0 | 3 |
| *Eilica obscura* (Keyserling, 1891) | 0 | 0 | 1 | 0 | 0 | 0 | 1 |
| *Eilica* aff. *trilineata* | 0 | 0 | 0 | 1 | 1 | 0 | 2 |
| *Eilica trilineata* (Mello-Leitão, 1941) | 0 | 1 | 0 | 0 | 0 | 0 | 1 |
| Gen? sp. | 1 | 1 | 0 | 0 | 1 | 0 | 3 |
| *Neodrassex ibirapuita* Ott, 2013 | 0 | 0 | 0 | 0 | 0 | 1 | 1 |
| Hahniidae | | | | | | | |
| *Intihuatana* sp. | 0 | 1 | 0 | 0 | 0 | 0 | 1 |
| *Neohania* sp. 1 | 37 | 8 | 51 | 45 | 25 | 20 | 186 |
| *Neohania* sp. 2 | 32 | 14 | 17 | 27 | 49 | 16 | 155 |
| Linyphiidae | | | | | | | |
| *Agyneta* sp. 1 | 0 | 0 | 0 | 0 | 1 | 2 | 3 |
| *Agyneta* sp. 2 | 5 | 0 | 5 | 6 | 8 | 11 | 35 |
| *Erigone* sp.1 | 9 | 2 | 9 | 1 | 1 | 3 | 25 |
| *Laminacauda* sp. 1 | 0 | 0 | 1 | 0 | 0 | 0 | 1 |
| *Moyosi* sp. 1 | 3 | 1 | 1 | 1 | 0 | 3 | 9 |
| *Neomaso* sp. 2 | 2 | 1 | 2 | 1 | 1 | 4 | 11 |
| *Neomaso* sp. 3 | 0 | 0 | 1 | 1 | 0 | 1 | 3 |
| *Pseudotyphistes* sp. 2 | 0 | 0 | 1 | 0 | 0 | 0 | 1 |
| *Psilocymbium lineatum* (Millidge, 1991) | 1 | 0 | 0 | 0 | 0 | 0 | 1 |
| *Sphecozone* sp. 2 | 1 | 0 | 0 | 1 | 0 | 0 | 2 |
| *Tutaibo* aff. *phoeniceus* | 1 | 1 | 0 | 1 | 1 | 0 | 4 |
| *Tutaibo* sp. 1 | 3 | 0 | 0 | 3 | 4 | 3 | 13 |
| *Tutaibo* sp. 2 | 2 | 0 | 0 | 0 | 0 | 0 | 2 |
| *Tutaibo* sp. 3 | 0 | 0 | 1 | 0 | 0 | 0 | 1 |
| Lycosidae | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| *Agalenocosa* sp. | 0 | 0 | 0 | 0 | 0 | 1 | 1 |
| *Allocosa* sp. | 0 | 0 | 0 | 0 | 0 | 1 | 1 |
| *Birabenia* sp. 1 | 0 | 2 | 1 | 0 | 4 | 14 | 21 |
| *Birabenia vittata* (Mello-Leitão, 1945) | 0 | 0 | 0 | 0 | 1 | 1 | 2 |
| Gen? sp. 1 | 0 | 1 | 0 | 0 | 0 | 0 | 1 |
| Gen? sp. 2 | 1 | 1 | 3 | 1 | 1 | 4 | 11 |
| *Hogna bivittata* (Mello-Leitão, 1939) | 3 | 3 | 0 | 2 | 0 | 1 | 9 |
| *Lobizon humilis* (Mello-Leitão, 1944) | 0 | 0 | 0 | 0 | 1 | 4 | 5 |
| *Lycosa erythrognatha* Lucas, 1836 | 2 | 0 | 3 | 0 | 2 | 0 | 7 |
| *Lycosa thorelli* (Keyserling, 1877) | 0 | 2 | 9 | 0 | 3 | 1 | 15 |

Tab. I. Cont.

| Taxa | Grazed Nov-11 | Grazed Nov-12 | Grazed Nov-13 | Ungrazed Nov-11 | Ungrazed Nov-12 | Ungrazed Nov-13 | Total |
|---|---|---|---|---|---|---|---|
| *Navira naguan* Piancentini & Grismado, 2009 | 0 | 1 | 1 | 0 | 0 | 1 | 3 |
| *Schizocosa malitiosa* (Tullgren, 1905) | 2 | 15 | 3 | 3 | 7 | 0 | 30 |
| *Trochosa* sp. | 0 | 0 | 0 | 0 | 1 | 1 | 2 |
| Miturgidae | | | | | | | |
| *Teminius insularis* (Lucas, 1857) | 1 | 1 | 4 | 1 | 0 | 2 | 9 |
| Nemesiidae | | | | | | | |
| *Pycnothele* sp. 1 | 0 | 4 | 0 | 0 | 2 | 0 | 6 |
| *Pycnothele* sp. 2 | 0 | 0 | 0 | 1 | 0 | 0 | 1 |
| Oonopidae | | | | | | | |
| *Neotrops* aff. *tucumanus* | 2 | 2 | 0 | 0 | 1 | 1 | 6 |
| Oxyopidae | | | | | | | |
| *Oxyopes salticus* Hentz, 1845 | 1 | 0 | 0 | 0 | 0 | 0 | 1 |
| Phrurolithidae | | | | | | | |
| *Orthobula* sp. | 0 | 2 | 1 | 2 | 1 | 6 | 12 |
| Salticidae | | | | | | | |
| aff. *Phiale* sp. | 0 | 0 | 0 | 0 | 0 | 1 | 1 |
| Gen? sp. 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 |
| Gen? sp. 2 | 0 | 0 | 0 | 0 | 1 | 0 | 1 |
| Gen? sp. 3 | 0 | 0 | 0 | 1 | 0 | 0 | 1 |
| Gen? sp. 4 | 0 | 0 | 0 | 1 | 0 | 0 | 1 |
| *Neonella minuta* Galiano, 1965 | 1 | 1 | 1 | 0 | 0 | 1 | 4 |
| *Neonella montana* Galiano, 1988 | 0 | 0 | 1 | 0 | 1 | 0 | 2 |
| *Semiopyla cataphracta* Simon, 1901 | 2 | 0 | 0 | 1 | 1 | 11 | 15 |
| Tetragnathidae | | | | | | | |
| *Glenognatha lacteovittata* (Mello-Leitão, 1944) | 0 | 0 | 0 | 0 | 0 | 7 | 7 |
| Theridiidae | | | | | | | |
| *Episinus* sp.1 | 0 | 1 | 0 | 0 | 0 | 0 | 1 |
| *Euryopis camis* Levi, 1963 | 0 | 1 | 1 | 1 | 1 | 0 | 4 |
| *Euryopis* sp. 1 | 0 | 0 | 0 | 0 | 1 | 0 | 1 |
| *Euryopis* sp. 2 | 3 | 1 | 4 | 0 | 1 | 0 | 9 |
| *Euryopis spinifera* (Mello-Leitão, 1944) | 1 | 3 | 4 | 0 | 1 | 0 | 9 |
| *Guaraniella mahnerti* Baert, 1984 | 9 | 7 | 6 | 5 | 12 | 6 | 45 |
| *Styposis selis* Levi, 1964 | 0 | 0 | 0 | 0 | 1 | 4 | 5 |
| *Thymoites piratini* Rodrigues & Brescovit, 2015 | 0 | 0 | 0 | 1 | 1 | 0 | 2 |
| Thomisidae | | | | | | | |
| Gen? sp. 1 | 0 | 0 | 0 | 1 | 0 | 0 | 1 |
| Gen? sp. 2 | 0 | 1 | 0 | 0 | 1 | 0 | 2 |
| Gen? sp. 3 | 0 | 0 | 3 | 0 | 0 | 1 | 4 |
| Trachelidae | | | | | | | |
| Gen? sp. 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 |
| *Meriola* sp. | 0 | 0 | 0 | 0 | 0 | 1 | 1 |
| Total | 134 | 90 | 136 | 113 | 154 | 148 | 775 |

"sample effort", could lead to a very low power outcome of statistical tests and therefore no significant difference was found (Brennan *et al*., 1999; Work *et al*., 2002). However, it is also very likely that in this case, ground spider fauna is not really being affected by grazing, at least in the first 15 months after enclosure and cattle removal.

Due the methodology adopted in this work, the absence of spiders most commonly found in aerial vegetation, like orb-web builders (*A. argentata* sampled are totally occasional), could be another factor that led us to no significant difference between grazed and ungrazed areas. As spiders' diversity seems to be much correlated to vegetal structure (Cadenasso & Pickett, 2001; Souza, 2007; Rodrigues *et al*., 2010; Gómez *et al*., 2016; Nogueira & Pinto-da-Rocha, 2016), in short time the ground spider fauna seems to be less affected by grazing disturbance. Experiments with fire, where the vegetation is completely burned (Podgaiski *et al*., 2013), demonstrate that web-builders take more time to occupy recent disturbed areas, due its need of tri-dimensional structures for establish a webs (Halaj *et al*., 1998; Pfister *et al*., 2015; Nogueira & Pinto-da-Rocha, 2016). Therefore, aerial vegetation correlated spiders and web-builders, would be more sensitive and respond more strongly to absence of cattle grazing.

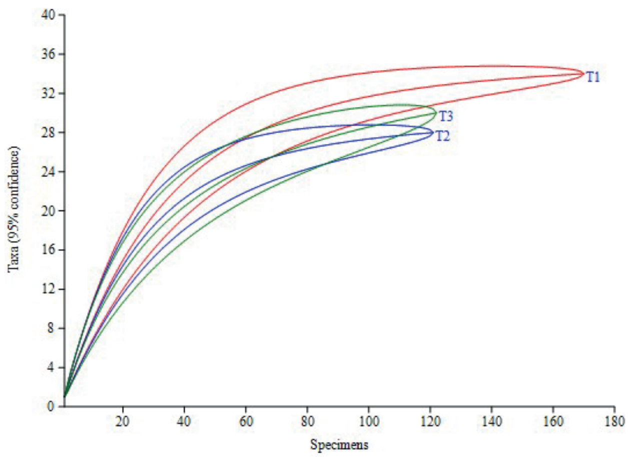


Fig. 3. Richness based rarefaction curves for spiders sampled in ungrazed areas of APA Ibirapuitã, Rio Grande do Sul state, Brazil, trough springs of 2011, 2012 and 2013. Adjacent lines indicates 95% confidence intervals.

Spiders are usually considered as a useful group to monitory management studies, due to quickly occupancy of altered habitats (Uetz *et al*., 1999) and its important role as predators (Rodrigues *et al*., 2010; Foelix, 2011; Laws & Joern, 2015); however, ground spiders provide only piece of information (Gibson *et al.*, 1992). It is very possible that spiders and other invertebrates, such as beetles (Grandchamp *et al*., 2005; Woodcok *et al*., 2005), ants (Red & Andersen, 2000; Calcaterra *et al*., 2010) and grasshoppers (Hao *et al*., 2015; Ferrando *et al*., 2016) living in the vegetation could respond quicker and intensively to grassland management. Moreover, correlating abundance of these arthropods, would allow a better overview of how the fauna change without grazing perturbation.

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