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THE SPIDER ASSEMBLAGE IN A DENDROFLORISTIC HOTSPOT FROM EASTERN URUGUAY

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ABSTRACT

In previous studies, Uruguay has been considered a biogeographical crossroads. Paso Centurión and Sierra de Ríos in eastern Uruguay were recently entered into the National System of Protected Areas. The landscape is characterized by a mosaic of different ecosystems located in one of the dendrofloristic hotspots proposed for the country. The spiders constitute a megadiverse group useful for the monitoring of natural environments. The aim of this study was to know the composition and structure of the spider fauna of this protected area. The sampling of spiders was carried out in two different environments (ravine and riparian forests) and three methods were used: ground vacuum, foliage beating and manual collection. A greater richness of spider families, species and guilds was recorded compared to previous studies in other protected areas from Uruguay. The two environments showed differences in taxonomic composition and species replacement. Araneidae, Theridiidae and Salticidae represented the families with the highest species richness. The family Symphytognathidae and 55 species are new records for the country. The finding of more southern records for several species confirm that the area is located in a border zone with other biogeographic units at regional level. This fact supports the crossroads condition for the country, provides key information for the management of the area and increases the number of priority spider species for conservation in Uruguay.

Keywords: Araneae, species list, guilds, protected area, conservation.

RESUMEN

El ensamble de arañas en un hotspot dendroflorístico del este de Uruguay. Estudios recientes han considerado a Uruguay como una encrucijada biogeográfica. Paso Centurión y Sierra de Ríos en el este de Uruguay fue recientemente ingresado al Sistema Nacional de Áreas Protegidas. El paisaje está caracterizado por un mosaico de diferentes ecosistemas situado en uno de los *hotspots* dendroflorísticos propuestos para el país. Las arañas constituyen un grupo megadiverso que es útil para el control de los entornos naturales. El objetivo del estudio consistió en conocer la composición y estructura de la araneofauna de esta área protegida. El estudio se llevó a cabo en dos tipos de ambientes (bosque ribereño y bosque de quebrada) y se utilizaron tres métodos: aspirador de suelo, batido de follaje y recolección manual. Se registró una mayor riqueza de familias, especies y gremios de arañas en comparación con estudios previos en otras áreas protegidas de Uruguay. Los dos ambientes mostraron diferencias en la composición taxonómica y reemplazo de especies. Araneidae, Theridiidae y Salticidae fueron las familias con mayor riqueza específica. La familia Symphytognathidae y 55 especies son nuevos registros para el país. El hallazgo de registros más australes para varias especies confirma que esta área se encuentra en una zona límite con otras unidades biogeográficas a nivel regional. Esto refuerza el carácter de enclave biogeográfico para el país, aporta información relevante para el manejo del área y aumenta el número de especies prioritarias de arañas para la conservación en Uruguay.

Palabras clave: Araneae, lista de especies, gremios, área protegida, conservación.

INTRODUCTION

Biodiversity is essential for maintaining life and ecological services of ecosystems. In recent centuries, the process of habitat fragmentation, pollution, invasive species and the substitution of natural areas by different land uses have increased the rate of species extinction and the ecological interactions involved, causing a loss of biodiversity worldwide

(Ellis *et al.*, 2010; Valiente-Banuet *et al.*, 2015). These threats led to the need to establish natural protected areas for biota conservation (Le Saout *et al.*, 2013). One of the important tools for conservation is to describe the biodiversity and the study of ecological communities to understand their role in ecosystems (Norris, 2012). The hotspots are priority areas for conservation, at local and regional scales, because they are characterized by high species richness, the presence of endemic, rare or threatened species, high functional diversity, a unique evolutionary history and biogeography unit (Myers, 2003; Cañadas *et al.*, 2014; Marchese, 2015). The number of species has been the most common argument to apply in the conservation management of natural ecosystems, in particular plants to estimate endemism and vertebrates for comparison between areas. However, invertebrates have probably been poorly considered due to the scarcity of data (Marchese, 2015). Natural forests maintain a high floristic diversity and are key corridors for the gene flow of fauna and flora associated with these ecosystems (Dixo *et al.*, 2009; Dardengo *et al.*, 2016). Furthermore, the boundaries at which different biota converge are known as biogeographic crossroads. This confluence generates higher levels of alpha diversity and species replacement between environments or ecosystems (beta diversity), which is why they are considered priority areas of interest for conservation (Spector, 2002).

From a biogeographic point of view, Uruguay is included in the Pampean Province (Morrone, 2014) where grasslands are the most common landscape throughout the country. Grela (2004) established the first proposal of endemism and hotspots for the Uruguayan dendroflora and the connections with neighboring floristic biota in southern South America. He recognized four floristic hotspots in the country that reflect the influence with other biogeographic areas such as the Alto Paraná forest and the Chaco provinces. From this point of view, Uruguay constitutes a border zone between the temperate grasslands of the Pampas with different ecoregions (Olson *et al.*, 2001) or provinces (Morrone, 2014) of subtropical forests. Thus, the Uruguayan biogeographic regionalization proposed by Grela (2004) provided a framework for focusing future efforts on establishing protected areas in the country. Simó *et al.* (2014) reported the Uruguayan opiliofauna areas based on modeling of distribution species. They postulated this country as a biogeographic crossroads for the confluence of species from the Pampas and Paraná forests in agreement with Grela proposal for dendroflora. In addition, Laborda *et al.* (2018) showed the important role played by the riparian forests of the islands of the Uruguay River as a biological corridor for spider species with Alto Paraná forest. These facts place Uruguay as an area of high interest in the conservation of natural environments in South America. In spite of the uniqueness of the dendroflora, only 4.5% of the territory (Toranza *et al.* 2019) is represented by different types of natural forests such as riparian, hillside and ravine forests, which maintain biogeographic connections on a regional scale. Unfortunately, less than 1% of Uruguayan landscapes are included in the country's protected areas and, in addition, agricultural expansion and the loss of natural habitats for other productive activities have increased in recent decades (Brazeiro *et al.*, 2020). It is therefore imperative to generate knowledge about biodiversity as tools for planning new areas that cover more ecosystems and the corridors that connect them.

Spiders constitute a megadiverse group with 48770 species described worldwide (WSC 2020). Studies in South American riparian forests showed that these environments have a great richness of spider species, where spider diversity or the richness of spider guilds could be affected by vegetation structure (Rodrigues & Mendonça, 2012; Rodrigues *et al.*, 2014; Griotti *et al.*, 2017). Therefore, the high richness of spider species and guilds in Uruguay is expected to be associated with high plant diversity such as the four floristic hotspots proposed by Grela (2004). Efforts to record the spider diversity in Uruguay have been carried out over the last two decades, focusing on unexplored or little-known regions (Simó *et al.*, 2015, Laborda *et al.*, 2018). One of these regions is the east of the country, where Grela (2004) proposed two floristic hotspots. The northernmost where a rapid spider assessment was conducted in the truncated hills range (Simó *et al.* 2015). In this study, the authors found a high richness of spider species and proposed that the hills are linked to northern ecoregions based on the presence of species from Alto Parana forest and Araucaria forest. In the southernmost dendrofloristic hotspot, Paso Centurión and Sierra de Ríos were recently included in the National System of Protected Areas (SNAP, 2019). This area represents a mosaic of different ecosystems with high diversity and rare species (Grela, 2004; Brussa & Grela 2007; Brazeiro, 2015). Since knowledge about the spider fauna in this area is scarce, we conducted an assessment in order to study the spider community in one of the dendrofloristic hotspots from Uruguay as a baseline for the conservation management of the area.

MATERIAL AND METHODS

Study area

The study was carried out in Paso Centurión and Sierra de Ríos, in eastern Uruguay, near the border with Brazil (Fig. 1A). The area is located at the confluence of the Gondwananic Sedimentary Basin and Sierra del Este ecoregions (Brazeiro, 2015) and is connected to the Sul-Riograndense Planalto in

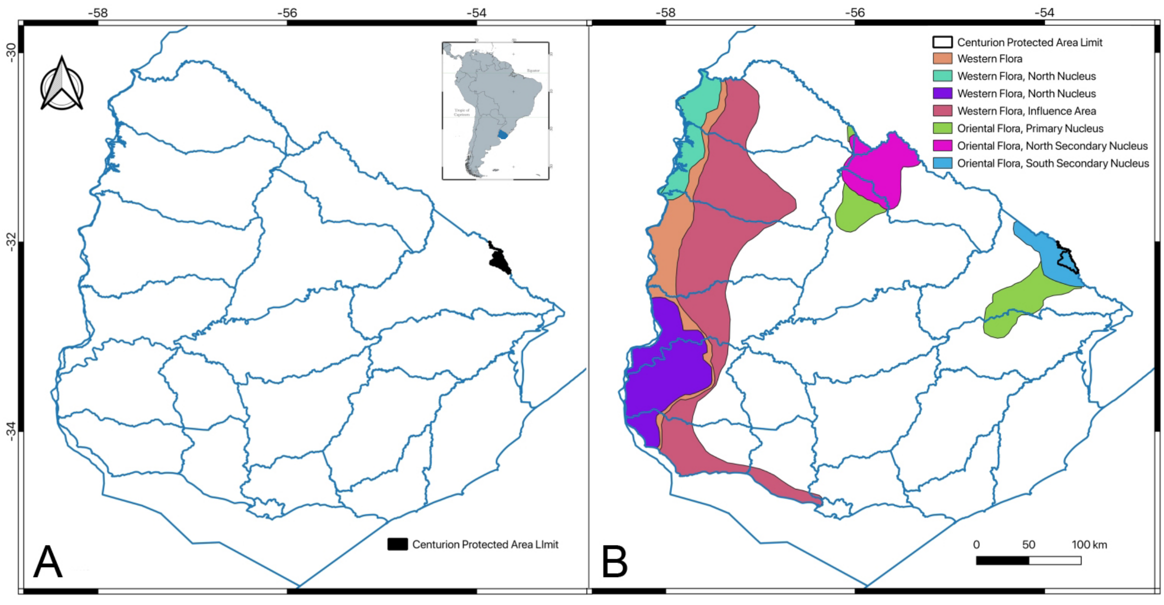

Fig. 1. A. Map showing location of Paso Centurión and Sierra de Ríos in Uruguay. B. Dendrofloristic hotspot proposed by Grela (2004) for Uruguay (Dendroflora shapefile downloaded from https://www.dinama.gub.uy/geoservicios/).

southern Brazil. It was considered one of the areas of eastern Uruguay with conservation priority based on that it was included in a dendrofloristic hotspot (Grela 2004) and because of the high species diversity in plants and vertebrates (Brazeiro, 2015) (Fig. 1B). The landscape is made up of three topographic units: 1) Highlands, which are characterized by hills with grasslands, shrublands and hillside forests, 2) Ravines, which are areas of steeply sloping terrain occupied by hillside forests, 3) Lowlands, with a predominance of plains with riparian forest along the rivers. The main productive activity in the area is extensive cattle raising and to a lesser extent crops, forestry, mineral production, wind energy and tourism (SNAP, 2019). For the study, we selected two sites: Paso Centurión (32º7'54.29"S; 53º44'5.24"W) characterized by flood plains and riparian forests associated with the Yaguarón River and Sierra de Ríos (32º11'0.79''S; 53º51'15.02''W) composed of hills with ravine forests and grasslands associated with rock formations.

Sampling procedure

Seasonal samplings were conducted in July (2016, winter), April (2017 and 2019, autumn) and November (2017, spring) in two different environments: riparian forests and ravine forests, each associated with grassland and rocky areas ecotones (Fig. 2). Three complementary collecting methods were used in each survey: ground vacuum for ground and herbaceous vegetation stratum, consisting of 20 daytime and 20 one-minute nighttime samples; manual collection, four one-hour daytime and four one-hour nighttime samples; and foliage beating consisting of 20 daytime samples, each represented by 15 hits on the tree vegetation collected in 1 m^2 of a white cloth. These methods are considered very effective in capturing spiders from foliage and soil (Coddington *et al.* 1996; Pérez-Miles *et al.* 1999; Adis 2002; Schmidt *et al.* 2006; Jorge *et al.,* 2013). Juveniles and adults were identified at the family level in order to recognize functional guilds. Adults were identified for morphospecies as far as possible at the species level through the use of keys (Jocqué & Dippenaar-Schoeman, 2007; Grismado *et al.*, 2014) and taxonomic reviews. Spider guilds were classified according to Cardoso *et al.* (2011). We collected under DINAMA scientific collecting permit No. 2020/ 14000/003764. The voucher specimens were deposited in the arachnological collection of Facultad de Ciencias, Universidad de la República, Uruguay. A map of the study area was elaborated using QGIS (2020).

Statistics

To test the statistical differences in taxonomic composition between the two surveyed sites, we conducted an ANOSIM test. In order to evaluate the contribution of the species to the similarity/dissimilarity

Fig. 2. Paso Centurión and Sierra de Ríos. Environments studied. A. Riparian forest, B. Ravine forest.

between the environments, we performed a SIMPER test. The statistics were calculated using PAST 4.03 software (Hammer *et al.*, 2001).

RESULTS

We collected 2591 spiders, represented by 38 families, 127 genera and 252 species/morphospecies (Table 1). One family (Symphytognathidae), 30 genera and 55 species are new records for Uruguay (Figs. 3 and 4). Furthermore, 60% were juveniles, 25% adult females and 15% adult males. Almost all of the species recorded (72%) belong to seven families, Araneidae (18%), Theridiidae (17%), Salticidae (14%), Linyphiidae (8%), Lycosidae (6%), Thomisidae (5%) and Anyphaenidae (4%). The number of species recorded was higher in the riparian forest (S = 206) than in the ravine forest (S = 83). More than half of the species recorded belong to the guilds of Other Hunters (24%), Orb Web (23%), and Space Web (19%).

Species composition for the environments studied (ravines and riparian forest) were significantly different (ANOSIM test: Bray-Curtis index R=0.1054, p=0.0001; Morisita index R=0.1074, p=0.0001) (Fig. 5) and with a high degree of species replacement (Jaccard similarity index: 0.146825). According to the SIMPER test of comparison between environments, *Faiditus plaumanni* (Theridiidae) was the species that most contributed to the observed dissimilarity (5.3%). This species was found in both types of environments studied, but with greater abundance in the riparian forest. All other species have less than 5% of contribution.

DISCUSSION

The high number of new spider records for the country increased the knowledge of the Uruguayan spider fauna. In addition, the high species richness and endemism of this area confirmed Paso Centurión and Sierra de Ríos as a hotspot for the spiders in eastern Uruguay. The results indicate that this area has the highest spider species richness compared to other natural environments studied in the country (Simó *et al.*, 1994; Costa *et al.*, 2006; Simó *et al.*, 2015; Laborda *et al.*, 2018). The dendroflora is influenced by de southern limit of the Brazilian Atlantic Forest (Brussa & Grela, 2007) that constitutes the Paso Centurión and Sierra de Ríos as the biotic limit of this ecoregion with the Pampas, which provides additional interest for conservation. This is supported by several species of spiders found here (S = 46; 18%) where their presence represents the southernmost record. In addition, these species agree with six of the seven criteria proposed by Ghione *et al.* (2017) for considering arachnid species as a conservation priority in Uruguay. They are as follows: C1, species endemic to Uruguay; C2, species with few records in arachnological collections in the country; C3, species only present in threatened environments; C4, species only recorded in rare habitats in the country; C5, species in which Uruguay represents the southernmost record in its distribution area; C6, species with ecological uniqueness. This last criterion was assumed on the basis that these species are associated with subtropical forests that encroach on Uruguayan territory (Brussa & Grela, 2007). As a result of this study, 12 species of those indicated by

Table 1. Taxonomic list of spiders collected in Paso Centurión and Sierra de Ríos (protected area), indicating guilds and associated environments for each species. New records are indicated with an asterisk (*****). Southernmost records are indicated with a superscript S ([S]). New species to be considered with conservation priority for Uruguay are indicated with a superscript NPC ([NPC]). Species considered with conservation priority for Uruguay *sensu* Ghione *et al.* (2015) are indicated with a superscript PC ([PC]). Abbreviations: **AH** = Ambush Hunters; **GH** = Ground Hunters; **OH** = Other Hunters; **OW** = Orb Web; **R** = Ravine; **RF** = Riparian Forest; **S** = Specialists; **ShH** = Sheet Hunters; **ShW** = Sheet Web; **SpW** = Space Web; **SW** = Sensing Web.

	Guild	Environment
Actinopodidae		
Actinopus sp.	SW	R
Amaurobiidae		
Amaurobiidae sp.1	ShW	RF
Amaurobiidae sp.2	ShW	R
Retiro nigronotatus Mello-Leitão, 1947*[SNPC]	ShW	RF/R
Anyphaenidae		
Anyphaenidae sp.1	OH	RF
Aysha sp.1	OH	R
Aysha sp.2	OH	R
Aysha sp.3	OH	RF
Aysha sp.4	OH	RF
Aysha borgmeyeri (Mello-Leitão, 1926)*[SNPC]	OH	RF
Aysha vacaria Brescovit, 1992*[SNPC]	OH	
RF/R		
Sanogasta backhauseni (Simon, 1895)	OH	R
Tasata variolosa Mello-Leitão, 1943	OH	RF
Xiruana sp.	OH	RF
Araneidae		
Acacesia tenella (L. Koch, 1871)*[SNPC]	OW	RF
Alpaida carminea (Taczanowski, 1878)	OW	R
Alpaida ericae Levi, 1988*	OW	RF
Alpaida rubellula (Keyserling, 1892)	OW	RF
Alpaida veniliae (Keyserling, 1865)	OW	R
Alpaida sp.	OW	RF
Araneus lathyrinus (Holmberg, 1875)	OW	R
Araneus omnicolor (Keyserling, 1893)	OW	
RF/R		
Araneus unifromis (Keyserling, 1879)	OW	RF/R
Araneus workmani (Keyserling, 1884)	OW	RF
Argiope argentata (Fabricius, 1775)	OW	RF
Cyclosa fililineata Hingston, 1932*[SNPC]	OW	RF
Cyclosa machadinho Levi, 1999	OW	RF/R
Cyclosa morretes Levi, 1999*[SNPC]	OW	RF/R
Eriophora sp. *	OW	RF
Eustala cidae Poeta, 2014*[SNPC]	OW	RF
Eustala saga (Keyserling, 1893)	OW	RF/R
Eustala minuscula (Keyserling, 1892)	OW	RF
Eustala sp.1	OW	RF
Eustala sp.2	OW	RF
Eustala sp.3	OW	RF/R
Eustala taquara (Keyserling, 1892)	OW	R
Gasteracantha cancriformis (Linnaeus, 1758)	OW	RF/R
Kaira altiventer O. Pickard-Cambridge, 1889*[SNPC]	OW	RF
Larinia bivittata Keyserling, 1885	OW	RF
Mangora fundo Levi, 2007	OW	RF/R
Mangora strenua (Keyserling, 1893)*[SNPC]	OW	RF/R
*Mastophora catarina Levi, 2003**[SNPC]	OW	RF
Mastophora sp.	OW	R
Micrathena furva (Keyserling, 1892)	OW	RF/R
Micrathena furcata (Hahn, 1822)	OW	RF
Micrathena nigrichelis Strand, 1908	OW	R

	Guild	Environment
Micrathena spitzi Mello-Leitão, 1932*[SNCP]	OW	RF/R
Mecynogea bigibba Simon, 1903	OW	RF
Metepeira compsa (Chamberlin, 1916)*[SNPC]	OW	RF
Ocrepeira gnomo (Mello-Leitão, 1943)*[SNPC]	OW	RF
Ocrepeira sp.	OW	RF
Ocrepeira venustula (Keyserling, 1879)	OW	RF/R
Paraverrucosa heteracantha (Mello-Leitão, 1943)*	OW	RF
Parawixia audax (Blackwall, 1863)	OW	RF/R
Parawixia undulata (Keyserling, 1892)	OW	RF
Trichonephila clavipes (Linnaeus, 1767)	OW	RF
*Verrucosa meridionalis (*Keyserling, 1892)*[SNPC]	OW	RF/R
Verrucosa undecimvariolata (O. Pickard-Cambridge, 1889)	OW	RF
Wagneriana atuna Levi, 1991*[SNPC]	OW	RF
Caponiidae		
Nops meridionalis Keyserling, 1891*[SNPC]	S	R
Cheiracanthiidae		
Cheiracanthium inclusum (Hentz, 1847)	OH	RF
Eutichurus ibiuna Bonaldo, 1994	OH	RF
Clubionidae		
Elaver brevipes (Keyserling, 1891)*[SNPC]	OH	R
Corinnidae		
Castianeira sp.1	GH	R
Castianeira sp.2	GH	RF
Castianeira sp.3	GH	R
Castianeira sp.4	GH	RF
Falconina gracilis (Keyserling, 1891)	GH	R
Ctenidae		
Asthenoctenus borellii Simon, 1897	OH	RF
Guasuctenus longipes (Keyserling, 1891)[PC]	OH	RF/R
Parabatinga brevipes (Keyserling, 1891)	OH	RF
Desidae		
Meteltella iheringhi (Keyserling, 1891)	ShW	RF
Metaltella simoni (Keyserling, 1878)	ShW	RF
Filistatidae		
Pikelinia arenicola Lise, Ferreira & Silva, 2010*[SNPC]	ShW	RF
Gnaphosidae		
Almafuerte sp.	GH	RF
Apodrassodes guatemalensis (F. O. Pickard-Cambridge, 1899)	GH	RF
Apopyllus atlanticus Azevedo, Ott, Griswold & Santos, 2016*[SNPC]	GH	RF
Camillina galianoae Platnick & Murphy, 1987	GH	RF
Gnaphosidae sp.	GH	RF
Latonigena auricomis Simon, 1893	GH	RF
Hahniidae		
Hahniidae sp.	ShW	RF
Linyphiidae		
Dubiaranea difficilis (Mello-Leitão, 1944)	ShH	R
Linyphiidae sp.1	ShH	R
Linyphiidae sp.2	ShH	R

Table 1. Cont.

	Guild	Environment
Linyphiidae sp.3	ShH	RF
Linyphiidae sp.4	ShH	R
Linyphiidae sp.5	ShH	RF
Linyphiidae sp.6	ShH	RF
Linyphiidae sp.7	ShH	RF
Linyphiidae sp.8	ShH	RF
Linyphiidae sp.9	ShH	RF
Linyphiidae sp.10	ShH	RF
Linyphiidae sp.11	ShH	RF
Linyphiidae sp.12	ShH	R
Linyphiidae sp.13	ShH	RF
Linyphiidae sp.14	ShH	RF/R
Linyphiidae sp.15	ShH	RF
Linyphiidae sp.16	ShH	RF
Scolecura cambara Rodrigues, 2005*[SNPC]	GH	RF/R
Scolecura sp.	GH	RF
Sphecozone ignigena (Keyserling, 1886)	GH	R
Sphecozone sp.	GH	R
Lycosidae		
Agalenocosa sp.	GH	R
Agalenocosa velox (Keyserling, 1891)	GH	RF
Aglaoctenus lagotis (Holmberg, 1876)[PC]	GH	RF
Aglaoctenus oblongus (C. L. Koch, 1847)[PC]	GH	RF
Diapontia uruguayensis Keyserling, 1877	GH	RF
Hogna gumia (Petrunkevitch, 1911)*[SNPC]	GH	RF/R
Lobizon humilis (Mello-Leitão, 1944)	GH	RF/R
Lycosa erythrognatha Lucas, 1836	GH	RF
Lycosa poliostoma (C. L. Koch, 1847)	GH	RF/R
Lycosinae sp.1	GH	RF/R
Lycosinae sp.2	GH	R
Lycosinae sp.3	GH	RF
Navira naguan Piacentini & Grismado, 2009	GH	R
Paratrochosina amica (Mello-Leitão, 1941)*	GH	RF
Pavocosa gallopavo (Mello-Leitão, 1941)	GH	RF
Mimetidae		
Gelanor zonatus (C. L. Koch, 1845)[PC]	S	RF
Mimetus melanoleucus Mello-Leitão, 1929	S	R
Miturgidae		
Teminius insularis (Lucas, 1857)	OH	RF
Mysmenidae		
Microdipoena sp.	SpW	R
Mysmenidae sp.	SpW	RF
Oonopidae		
Neotrops lorenae Grismado & Ramírez, 2013	GH	RF
Oonopidae sp.	GH	RF
Orchestina sp.	GH	RF
Oxyopidae		
Hamataliwa cf. marmorata Simon, 1898	OH	RF
Oxyopes salticus Hentz, 1845	OH	RF
Palpimanidae		
Otiothops birabeni Mello-Leitão, 1945[PC]	S	R
Pholcidae		
Mesabolivar charrua Machado, Laborda, Simó & Brescovit, 2013[PC]	SpW	RF/R
Pycnothelidae		
Acanthogonathus tacuariensis (Pérez-Miles & Capocasale, 1982)[PC]	SW	R
Salticidae		
Aphirape flexa Galiano, 1981	OH	RF/R
Asaphobelis physonychus Simon, 1902*[SNPC]	OH	RF
Breda bicruciata (Mello-Leitão, 1943)	OH	RF
Breda tristis Mello-Leitão, 1944	OH	R
Chira aff. thysbe Simon, 1902*	OH	RF
Colonus melanogaster (Mello-Leitão, 1917)*[SNPC]	OH	RF
Cotinusa melanura Mello-Leitão, 1939*[SNPC]	OH	RF
Cotinusa trifasciata (Mello-Leitão, 1943)	OH	RF
Dendryphantini sp.1	OH	RF
Dendryphantini sp.2	OH	RF
Dendryphantini sp.3	OH	RF
Dendryphantini sp.4	OH	RF
Euophryini sp.1	OH	RF
Euophryini sp.2	OH	RF
Euophrys melanoleuca Mello-Leitão, 1944	OH	RF
Gastromicans cf. vigens (Peckham & Peckham, 1901)*	OH	RF
Lyssomanes pauper Mello-Leitão, 1945	OH	
RF/R		
Megafreya sutrix (Holmberg, 1875)	OH	RF
Metaphidippus sp.*	OH	RF
Neonella lubrica Galiano, 1988*[SNPC]	OH	RF
Neonella montana Galiano, 1988*	OH	RF
Neonella sp.	OH	RF
Philira micans (Simon, 1902)*[SNPC]	OH	RF
Pseudofluda pulcherrima Mello-Leitão, 1928*[SNPC]	OH	RF
Saphrys saitiformis (Simon, 1901)	OH	RF
Sarinda marcosi Piza, 1937	OH	RF
Sumampattus hudsoni Galiano, 1996	OH	RF
Tartamura adfectuosa (Galiano, 1977)*	OH	RF
Theriella galianoae Braul & Lise, 1996*[SNPC]	OH	RF
Titanattus andinus (Simon, 1900)	OH	R
Tullgrenella morenensis (Tullgren, 1905)*[SNPC]	OH	RF
Tullgrenella musica (Mello-Leitão, 1945)*	OH	RF
Tullgrenella serrana Galiano, 1970	OH	R
Tullgrenella sp.	OH	R
Zygoballus sp.*	OH	RF
Scytodidae		
Scytodes globula Nicolet, 1849	OH	RF/R
Segestriidae		
Ariadna boesenbergi Keyserling, 1877	SW	RF
Selenopidae		
Selenops rapax Mello-Leitão, 1929*[SNPC]	AH	RF
Selenops spixi Perty, 1833	AH	RF
Senoculidae		
Senoculus purpureus (Simon, 1880)*[SNPC]	OH	RF
Sparassidae		
Polybetes pallidus Mello-Leitão, 1941	OH	RF
Polybetes punctulatus Mello-Leitão, 1944	OH	RF
Polybetes pythagoricus (Holmberg, 1875)	OH	RF
Polybetes rapidus (Keyserling, 1880)	OH	R
Symphytognathidae*		
Anapistula sp.*	OW	R
Tetragnathidae		
Chrysometa boraceia Levi, 1986	OW	RF/R
Leucauge volupis (Keyserling, 1893)	OW	RF/R
Leucauge sp.	OW	R
Tetragnatha sp.1	OW	RF
Tetragnatha sp.2	OW	RF

Table 1. Cont.

	Guild	Environment
Theraphosidae		
Catumiri parvum (Keyserling, 1878)	SW	RF
Theridiidae		
Achaearanea sp.*	SpW	RF
Anelosimus ethicus (Keyserling, 1884)*[SNPC]	SpW	RF
Anelosimus sp.	SpW	RF
Anelosimus vierae Agnarsson, 2012[PC]	SpW	RF
Argyrodes elevatus Taczanowski, 1873	SpW	R
Argyrodes sp.	SpW	RF
Ariamnes longissimus Keyserling, 1891*[SNPC]	SpW	RF
Coleosoma acutiventer (Keyserling, 1884)*	SpW	RF
Cryptachaea altiventer (Keyserling, 1884)	SpW	RF/R
Cryptachaea belulla (Keyserling, 1891)	SpW	R
Cryptachaea ericae Rodrigues & Poeta, 2015*[SNPC]	SpW	RF
Cryptachaea sp.1	SpW	RF
Cryptachaea sp.2	SpW	RF
Cryptachaea sp.3	SpW	RF
Cryptachaea sp.4	SpW	RF
Cryptachaea sp.5	SpW	RF
Dipoena granulata (Keyserling, 1886)	SpW	RF/R
Dipoena santacatarinae Levi, 1963*[SNPC]	SpW	RF
Dipoena sp.1	SpW	RF
Dipoena sp.2	SpW	RF
Dipoena sp.3	SpW	R
Dipoena variabilis (Keyserling, 1886)*[SNPC]	SpW	RF
Faiditus americanus (Taczanowski, 1874)*	SpW	RF/R
Faiditus altus (Keyserling, 1891)*[SNPC]	SpW	RF
Faiditus plaumanni (Exline & Levi, 1962)*[SNPC]	SpW	RF/R
Faiditus sicki (Exline & Levi, 1962)*[SNPC]	SpW	RF
Faiditus sp.1	SpW	RF
Faiditus sp.2	SpW	RF
Guaraniella manherti Baert, 1984	SpW	RF
Rhomphaea brasiliensis Mello-Leitão, 1920*[SNPC]	SpW	RF
Rhomphaea paradoxa (Taczanowski, 1873)*[SNPC]	SpW	RF
Styposis selis Levi, 1964 *[SNPC]	SpW	RF
Steatoda sp.	SpW	RF
Tekellina sp.*	SpW	RF
Theridiidae sp.1	SpW	RF
Theridiidae sp.2	SpW	RF
Theridiidae sp.3	SpW	RF
Theridiidae sp.4	SpW	RF
Theridiidae sp.5	SpW	RF
Theridion calcynatum Holmberg, 1876	SpW	RF
Theridion sp.1	SpW	RF
Theridion sp.2	SpW	RF
Thymoites puer (Mello-Leitão, 1941)	SpW	RF
Wamba crispulus (Simon, 1895)*	SpW	RF
Theridiosomatidae		
Theridiosomatidae sp.1	OW	RF
Theridiosomatidae sp.2	OW	RF
Thomisidae		
Epicadinus villosus Mello-Leitão, 1929[SNPC]	AH	RF
Epicadus rubripes Mello-Leitão, 1924*[NPC]	AH	RF
Misumenops pallidus (Keyserling, 1880)	AH	RF
Strophius albofasciatus Mello-Leitão, 1929	AH	RF
Titidius sp.1	AH	RF
Titidius sp.2	AH	RF
Titidius sp.3	AH	RF
Titidius sp.4	AH	R
Titidius sp.5	AH	RF
Tmarus cf. albifrons Piza, 1944	AH	RF/R
Tmarus sp.1	AH	RF
Tmarus sp.2	AH	R
Trachelidae		
Meriola sp.1	GH	RF
Meriola sp.2	GH	RF
Trachelidae sp.1	GH	RF
Trachelidae sp.2	GH	R
Trachelidae sp.3	GH	R
Trachelopachys keyserlingi (Roewer, 1951)*[SNPC]	GH	R
Trechaleidae		
Paratrechalea ornata (Mello-Leitão, 1943)[PC]	S	RF/R
Trechaleoides biocellata (Mello-Leitão, 1926)[PC]	S	R
Uloboridae		
Conifaber yasi Grismado, 2004*[SNPC]	OW	RF
Miagrammopes guttatus Mello-Leitão, 1937*[SNPC]	OW	RF/R
Miagrammopes sp.	OW	RF
Uloborus elongatus Opell, 1982	OW	RF/R
Uloborus sp.	OW	RF

Ghione et al. (2015) were found in the protected area and 46 new species were categorized here, thus increasing the number with conservation priority for Uruguay from 35 to 81 spider species.

The family Symphytognathidae was first registered in Uruguay. This family comprises very small spiders, mainly extended in the tropics, which build orb webs in the litter (Jocqué & Dippenaar-Schoeman, 2007). The genus *Anapistula* Gertsch, 1941 is represented in the Neotropical Region with nine species described. Some of them have been recorded for the Atlantic Forest in southern Brazil and the Yungas in Argentina (Rheims & Brescovit, 2003; Rubio & González, 2010). The species collected in Paso Centurión and Sierra de Ríos are not known; so they must be described.

Araneidae, Theridiidae and Salticidae showed high species richness at the family level. Araneidae include orb-web weavers, Theridiidae build three-dimensional webs, and Salticidae include jumping spiders that are foliage or ground stalking hunters (Cardoso *et al.*, 2011). Representatives of these families are reported to be very abundant and diverse in the Atlantic Forest (Rodrigues *et al.*, 2014; Rubio,

Fig. 3. New spider records of Paso Centurión and Sierra de Ríos I. A. *Kaira altiventer* (Araneidae). B. *Mastophora catarina* (Araneidae). C. *Micrathena spitzi* (Araneidae). D. *Paraverrucosa heteracantha* (Araneidae). E. *Verrucosa meridionalis* (Araneidae). F. *Nops meridionalis* (Caponiidae). G. *Hogna gumia* (Lycosidae). H. *Selenops rapax* (Selenopidae).

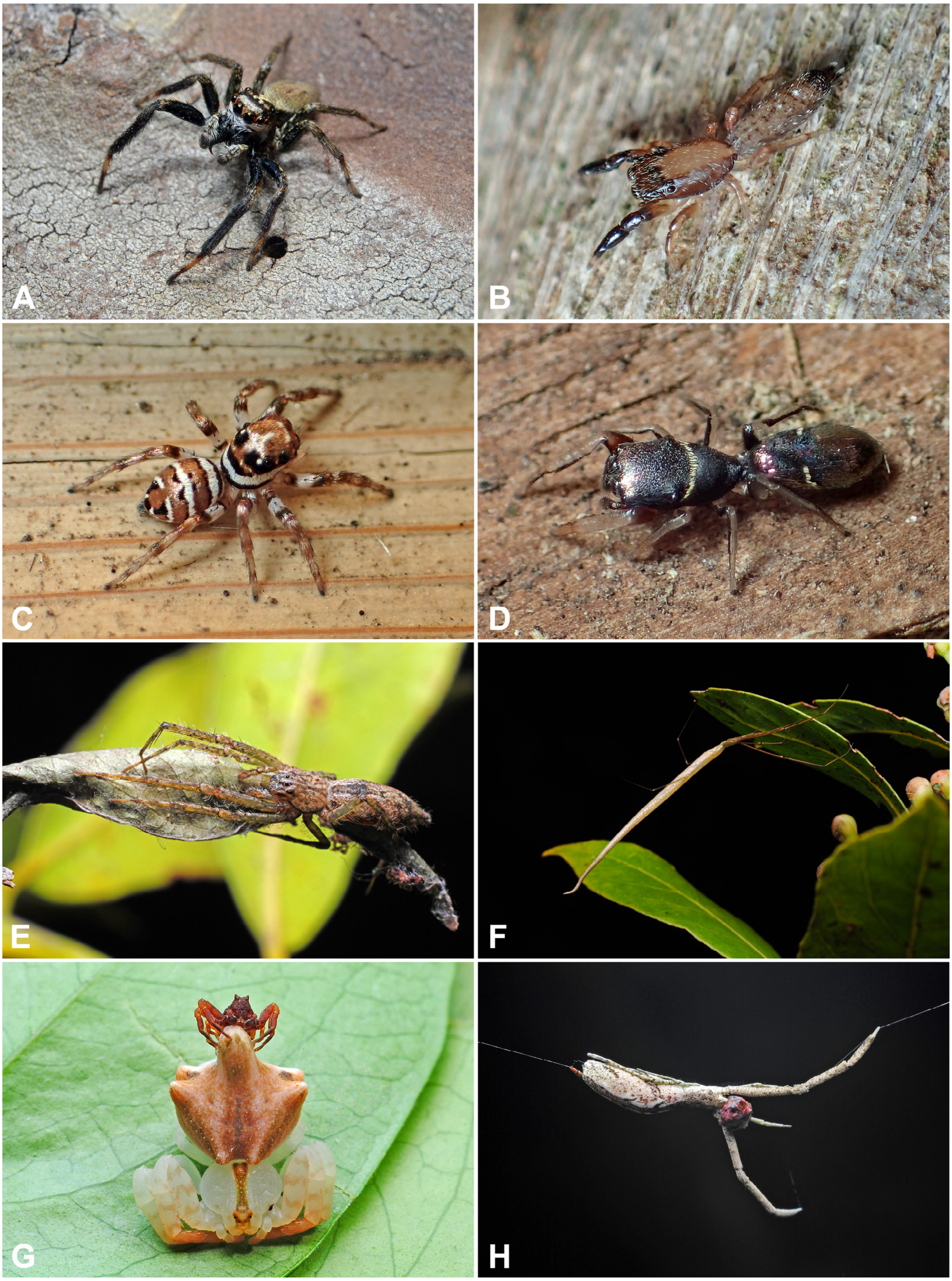

Fig. 4. New spider records of Paso Centurión and Sierra de Ríos II. A. *Asaphobelis physonychus* (Salticidae). B. *Cotinusa melanura* (Salticidae). C. *Philira micans* (Salticidae). D. *Pseudofluda pulcherrima* (Salticidae). E. *Senoculus purpureus* (Senoculidae). F. *Ariamnes longissimus* (Theridiidae). G. *Epicadus rubripes* (Thomisidae). H. *Miagrammopes guttatus* (Uloboridae).

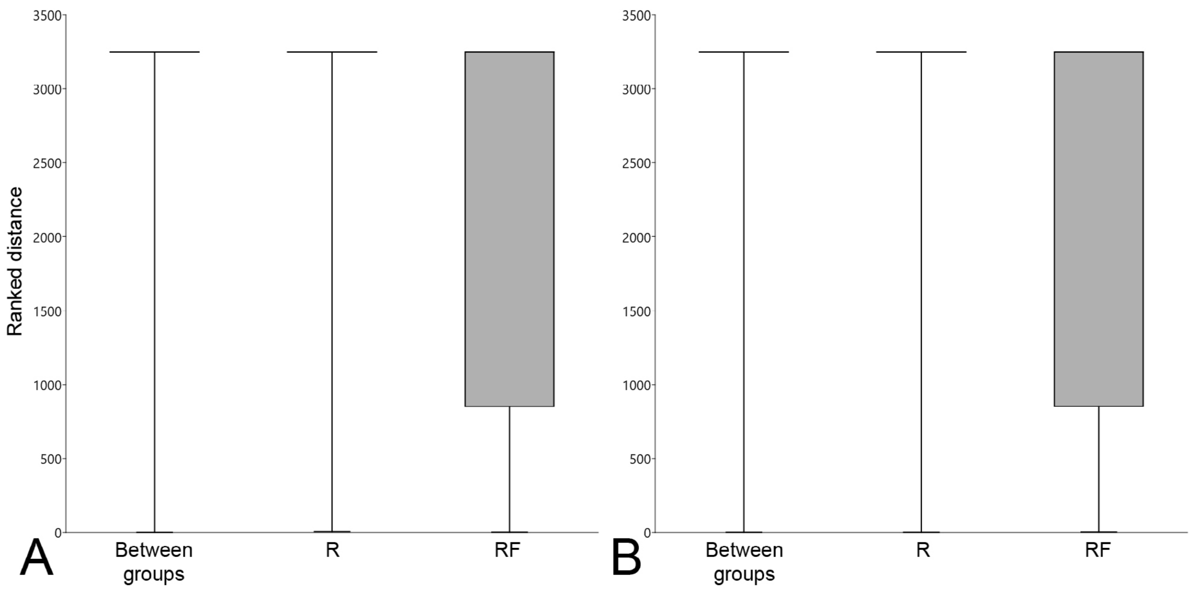

Fig. 5. Boxplot of ranked distance obtained in the ANOSIM test for the groups and between them. A. Bray-Curtis index R=0.1054, p=0.0001. B. Morisita index R=0.1074, p=0.0001. R = Ravine; RF = Riparian Forest.

Table 2. Relative abundance of spiders (%) and number of species (S) per guild in the two environments.

	Riparian Forest		Ravine	
	%	S	%	S
Other Hunters	25	51	19	14
Orb Weaver	24	50	34	25
Ground Hunters	14	28	17	13
Space Web	21	43	12	9
Sheet Hunters	6	12	8	6
Sheet Web	2	5	3	2
Sensing Web	1	2	3	2
Specialists	1	2	4	3
Ambush Hunters	6	12	0	0

2016; Munévar *et al.* 2020). Oliveira *et al.* (2015), applying the analysis of the Geographic Interpolation of Endemism, delimited the areas of endemism of spider species for Brazil. Santos *et al.* (2017), using the Kernel density estimator, identified the areas of greatest richness for the family Araneidae in the Neotropical Region. Both studies reported areas of endemism and highest spider species richness in southern Brazil bordering eastern Uruguay. Considering the high spider species richness found in Paso Centurión and Sierra de Ríos, this protected area should probably be influenced by the terrestrial connections with these Brazilian hotspots. This topic should be tested in the future. Vegetation heterogeneity provides more microhabitats for webs building (Rodrigues *et al.,* 2014; Rodrigues *et al.,* 2015). In our study, spider guilds constituted a wide variety of strategies where orb-weavers were the richest. This is consistent with the high availability of shelters for the construction of their webs. In addition, the great abundance and diversity of weaver species explains the presence of several kleptoparasitic spiders (e.g. *Argyrodes*, *Ariamnes* and *Faiditus*), which live and feed on the webs of the larger spiders. In the specific case of *Faiditus plaumanni*, its greater abundance in the riparian forest could be explained by the presence of *Trichonephila clavipes* in the same environment, a large orb weaver indicated as a common host of this kleptoparasitic species (Exline & Levi, 1962).

Statistical analysis revealed that both forest types are different in terms of spider composition and the low contribution of species to this dissimilarity indicates that species are more equitably represented. In addition, species replacement between them revealed high beta diversity. For instance, conservation efforts in the area should take into account the conservation plans of the different forest types in which the high species richness and structure of spider community are located.

This study showed that biodiversity assessments in megadiverse groups such as spiders could provide important taxonomic and ecological data that represent tools for conservation management at local and regional scales in protected areas and their biogeographic connections. Future studies should focus on exploring at a regional scale the role of Paso Centurión and Sierra de Ríos as a link between Atlantic Forest ecoregions.

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