On the first South American records of widespread linyphiid spiders (Araneae)

Sobre os primeiros registros sul-americanos de aranhas Linyphiidae (Araneae) de ampla distribuição

Manuel Cajade[I] | Everton N. L. Rodrigues[II] | Damián Hagopián[I] | Álvaro Laborda[I] | Antonio D. Brescovit[III] | Miguel Simó[I]

[I]Universidad de la República. Facultad de Ciencias. Montevideo, Uruguay

[II]Universidade Estadual Paulista. Jaboticabal, São Paulo, Brasil

[III]Instituto Butantan. Laboratório de Coleções Zoológicas. São Paulo, São Paulo, Brasil

Abstract: The linyphiid species *Agyneta galapagosensis* (Baert, 1990), *Erigone autumnalis* Emerton, 1882 and *Mermessus fradeorum* (Berland, 1932) are recorded for the first time on the continental South America. In addition, the distribution data of *Neriene redacta* Chamberlin, 1925 is expanded. Figures of the habitus, a distribution map of the new records and new data about the natural history of these species are provided. These results show the high dispersal capacity and adaptability of these linyphiid spiders to different environmental conditions, such as agroecosystems and urban areas.

Keywords: Agrobionts. Invasive species. Cosmopolitan species. Dispersal.

Resumo: *Agyneta galapagosensis* (Baert, 1990), *Erigone autumnalis* Emerton, 1882 e *Mermessus fradeorum* (Berland, 1932), espécies de Linyphiidae, são citadas pela primeira vez para a América do Sul continental. Os dados de distribuição de *Neriene redacta* Chamberlin, 1925 são ampliados. Fornecemos figuras do *habitus*, mapa de distribuição atualizado com os novos registros e informações inéditas sobre a história natural destas espécies. Nossos resultados demonstram a grande capacidade de dispersão e tolerância dessas espécies de aranhas, que as permite viver em diferentes condições ambientais, como agroecossistemas e áreas urbanas.

Palavras-chave: Agrobiontes. Espécies exóticas. Espécies cosmopolitas. Dispersão.

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Corresponding author: Manuel Cajade. Iguá 4225, PC 11400, Montevideo, Uruguay. (mcajade@fcien.edu.uy).

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INTRODUCTION

Linyphiidae Blackwall, 1859 is the second most speciose spider family in the world, with 4855 described species (WSC, 2024). Many species of linyphiids have a wide global distribution or are cosmopolitan (Nentwig, 2015). One the hypothesis for that scenario is their great dispersal ability through ballooning (Thomas et al., 2003) and their tolerance to living in environments modified by human activity, like agroecosystems (Nyffeler & Sunderland, 2003; Thorbek et al., 2004; Rodrigues et al., 2009; Bao et al., 2018) and urban areas (Rodrigues et al., 2008). This study aimed to present new data on the distribution of some linyphiid species in South America, using material deposited in arachnological collections from Uruguay. We report the first records for South America of *Agyneta galapagosensis* (Baert, 1990), *Erigone autumnalis* Emerton, 1882 and *Mermessus fradeorum* (Berland, 1932). Furthermore, new distributional records of *Neriene redacta* Chamberlin, 1925 are registered. We provided detailed images of habitus, genitalia, data of natural history and maps with the updated distribution of all species mentioned above in continental Uruguay.

MATERIAL AND METHODS

Specimens examined are preserved in 70% ethanol and deposited at the Arachnological Collection of Facultad de Ciencias, Universidad de la República, Montevideo, Uruguay (FCE-Ar, curator: M. Simó). Morphological examination was performed using a Leica M205 A stereomicroscope. Female genitalia and male palps were immersed in methyl salicylate (Holm, 1979; Hormiga, 2000; Hormiga et al., 2023) for examination of internal structures. Detailed micro-photographs were obtained using a Nikon SMZ-445 and a Leica DMC 2900 camera, attached with Leica M205 A stereomicroscope enabled with a Leica LAS-X-Z and SW software. *In vivo* photographs of the specimens were taken with a Panasonic DMC-ZS1 Lumix digital camera. Higher-magnification images were taken using a JEOL 5900 scanning electron microscope (SEM) at Facultad de Ciencias, Universidad de la República. Spider corporal structures used in the SEM were cleaned with ultrasonic bath (Álvarez-Padilla & Hormiga, 2007) and sputter-coated with gold. Photographs were edited using GIMP software (GIMP, n. d.) and plates were made in Inkscape software (Inkscape, n. d.). Terminology follows van Helsdingen (1969), Hormiga (1994, 2000), Miller (2007), Tanasevitch (2010), Dupérré (2013) and Irfan et al. (2022). When the exact coordinates of the location of the material examined are unknown, they were estimated using Google Earth (n. d.) and appear in square brackets [ ]. Data on previous distribution of the species was compiled from Word Spider Catalog. A distribution map of the species was made using SimpleMappr (Shorthouse, 2010).

Abbreviations used in the figures: A = atria; APPO = apical pocket of paracymbium; APO = anterior pocket of paracymbium; ARP = anterior radical process; AT = anterior tooth of radix; DP = dorsal plate; DSA = distal suprategular apophysis; DTA = dorsal tibial apophysis; E = embolus; EM = embolic membrane; GD = glabrous depression of cymbium; LC = lamella characteristica; PC = paracymbium; PT = protegulum; R = radix; RTA = retrolateral tibial apophysis; SPT = suprategulum; ST = subtegulum; T = tegulum; TA = terminal apophysis; TP = tailpiece of the radix; VP = ventral plate.

TAXONOMY

Family Linyphiidae Blackwall, 1859

New records

Agyneta galapagosensis (Baert, 1990)

(Figures 1A, 4A and 5)

Material examined. Uruguay: Durazno: Establecimiento Rincón del Río, *Eucalyptus dunnii* Maiden, 1905 plantation, in natural grassland, 32° 33' 9.5" S, 55° 41' 17.9" W, 17.x.2022, collected with pitfall trap, M. Simó leg., 1M (FCE-Ar 15369); Establecimiento La Selva, *E. dunnii* plantation, in natural grassland, 32° 31' 58.8" S, 55° 44' 18.9" W,

Figure 1. Habitus (dorsal and lateral view). A) *Agyneta galapagosensis* (male), B) *Erigone autumnalis* (male), C-D) *Mermessus fradeorum* (C: male, D: female), E-F) *Neriene redacta* (E: male, F: female). Scale bars: 1 mm. Photos: M. Cajade (2024).

17–21.v.2022, collected with G-Vac, M. Simó & B. Maldonado leg., 1M (FCE-Ar 14419); Río Negro: Protected Area Esteros y Algarrobales del Río Uruguay, Establecimiento La Mafalda, in "blanqueal," [32° 53' 00" S, 58° 2' 47" W], 22–23.iv.2022, collected manually, M. Simó leg., 1M (FCE-Ar 15313).

Distribution. Ecuador (Galapagos Islands), Brazil (Fernando de Noronha Island) and Uruguay (Figure 5).

Natural history. In Uruguay it was registered in a natural environment known as "blanquelaes" (alkaline soil areas) and natural grasslands.

Erigone autumnalis Emerton, 1882
(Figures 1B, 2, 3A-3C and 5)

Material examined. Uruguay: Canelones: INIA Las Brujas, in "espinillar", 34° 39' 41.17" S, 56° 20' 25.49" W, 7–14.vii.2014, collected with pitfall trap, Brussa, Da Silva & Muñoz leg., 1M (FCE-Ar 5049); Cerro Largo: Paso Centurión, Aduana, in hillside forest, 32° 8' 1.89" S, 53° 43' 57.31" W, 4.xi.2017, collected with G-Vac (diurnal), Á. Laborda & D. Hagopián leg., 1M (FCE-Ar 8717); same locality, 13–16.iv.2017, collected with G-Vac (diurnal, on foliage), Á. Laborda leg., 1F (FCE-Ar 6384); Durazno: Establecimiento La Teja, in natural grassland, 32° 40' 17" S, 55° 39' 55" W, 17.xii.2021, collected with pitfall trap, M. Simó & Á. Laborda leg., 1M (FCE-Ar 15471); near La Paloma city, in natural grassland, 32° 32' 40.52" S, 55° 42' 51.74" W, 26.viii.2021, collected with pitfall trap, M. Simó & Á. Laborda leg., 1F (FCE-Ar 13543); Establecimiento La Teja, in natural grassland, 32° 40' 11.27" S, 55° 42' 12.02" W, 17.x.2022, collected with pitfall trap, M. Simó & B. Maldonado leg., 2MM (FCE-Ar 15346); Establecimiento La Teja, in firebreak of *E. dunnii* plantation, 32° 40' 12.84" S, 55° 39' 30.34" W, 17–20.v.2022, collected with pitfall trap, M. Simó & Á. Laborda leg., 1F, 2MM (FCE-Ar 14605); Establecimiento La Teja, in natural grassland, 32° 39' 34" S, 55° 40' 46" W, 17.v.2022, collected with G-Vac, Á. Laborda leg., 1M

Figure 2. *Erigone autumnalis* habitus (dorsal). A-B) Male, C-D) female. Photos: M. Cajade (2024).

(FCE-Ar 14609); Establecimiento La Teja, in firebreak of *E. dunnii* plantation, 32° 39' 18.47" S, 55° 39' 3.09" W, 17–21.x.2022, collected with G-Vac, D. Hagopián leg., 1F, 1M (FCE-Ar 15103); Establecimiento La Teja, in natural grassland, 32° 39' 36.15" S, 55° 40' 53.39" W, 17.x.2022, collected with G-Vac, Á. Laborda leg., 1M (FCE-Ar 15013); Establecimiento La Teja, in firebreak of *E. dunnii* plantation, 32° 40' 21.39" S, 55° 40' 22.96" W, 17–21.v.2022, collected with pitfall trap, M. Simó leg., 1F, 1M (FCE-Ar 14826); Establecimiento Rincón del Río, in firebreak of *E. dunnii* plantation in a landscape of natural grassland, 32° 40' 21.12" S, 55° 42' 12.15" W, 17.x.2022, collected with pitfall trap, M. Simó leg., 2MM (FCE-Ar 15356); Establecimiento Rincón del Río, in natural grassland, 32° 33' 7.2" S, 55° 41' 17.88" W, 17.x.2022, collected with pitfall trap, M. Simó & Á. Laborda leg., 1F, 6MM (FCE-Ar 15362); Establecimiento Rincón del Río, in natural grassland, 32° 31' 25.54" S, 55° 44' 23.14" W, 17–21.x.2022, collected with pitfall trap, M. Simó & B. Maldonado leg., 1M (FCE-Ar 15882); Establecimiento Rincón del Río, in firebreak of *E. dunnii* plantation,

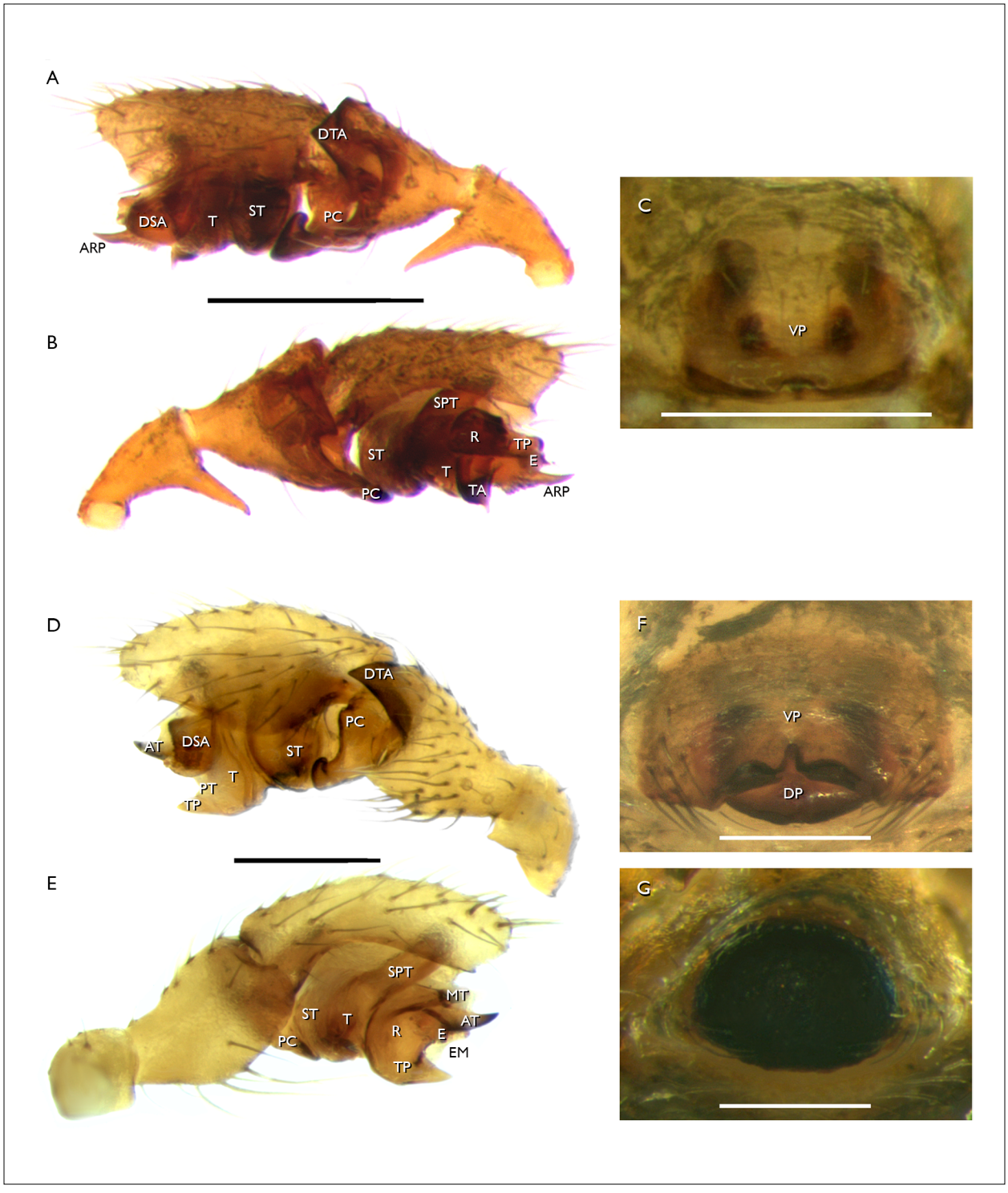

Figure 3. A-C) *Erigone autumnalis*, D-G) *Mermessus fradeorum*. A-B, D-E: male pedipalp in retrolateral (upper) and prolateral (down) view. C, F: female epigynum (ventral view). G: female epigynum with epigynal plug (ventral view). Scale bars: 0.2 mm. Photos: M. Cajade (2024).

32° 31' 26.54" S, 55° 44' 32.46" W, 17–22.x.2022, collected with pitfall trap, M. Simó & B. Maldonado leg., 3MM (FCE-Ar 15890); Establecimiento Rincón del Río, in firebreak of *E. dunnii* plantation, 32° 32' 41.06" S, 55° 42' 41.04" W, 17.v.2022, collected with pitfall trap, M. Simó leg., 2FF, 2MM (FCE-Ar 15613); Establecimiento Rincón del Río, in natural grassland, 32° 32' 40.69" S, 55° 42' 48.6" W, 17–21.v.2022, collected with pitfall trap, M. Simó leg., 1M (FCE-Ar 14967); Establecimiento Rincón del Río, in natural grassland, 32° 32' 40.67" S, 55° 42' 48.6" W, 17–21.x.2022, collected with G-Vac, D. Hagopián leg., 2FF, 1M (FCE-Ar 15074); Establecimiento Rincón del Río, in firebreak of *E. dunnii* plantation, 32° 33' 8.89" S, 55° 41' 19.72" W, 17–21.v.2022, collected with pitfall trap, M. Simó leg., 2MM (FCE-Ar 14960). Flores: Establecimiento Rincón de Piedra, in pasture, 33° 52' 21" S, 56° 58' 49" W, 1. viii. 2019, G. Pompozzi leg., 2MM (FCE-Ar 11339); Maldonado: Sierra de Carapé, in natural grassland, 34° 30' 32.2" S, 54° 58' 59.7" W, 12.x.2019, collected with pitfall trap, M. Simó leg., 1F (FCE-Ar 13215); same locality, 30.iv.2019, collected with pitfall trap, M. Simó leg., 1M (FCE-Ar 10102); Montevideo: Malvín Norte, Facultad de Ciencias field campus, [34° 52' 55.59" S, 56° 7' 7.85" W], 10.x.2000, M. Martínez leg., 9MM (FCE-Ar 15971); Río Negro: Negro river, Establecimiento El Matorral, in riparian forest, 33° 1' 12" S, 57° 33' 57.2" W, 28.v.2020, collected manually, D. Hagopián leg., 1F (FCE-Ar 11723); Salto: Establecimiento Corrales Viejos, in natural grassland, 31° 21' 36" S, 56° 46' 10" W, 14.xi.2019, G. Pompozzi leg., 9FF, 7MM (FCE-Ar 14356); Treinta y Tres: Charqueada, in rice crop of first year, 33° 12' 8.15" S, 53° 50' 47.98" W, 9.ix.2014, L. Bao leg., 2MM (FCE-Ar 11207).

Distribution. Antarctica, Azores, Bermuda, Canada, Czech Republic, Cuba, France, Germain, Hawaii, Italy, New Caledonia, Puerto Rico, Slovenia, Russia, Spain, Panama, Trinidad and Tobago, United Arab Emirates, United States of America and Uruguay (Figure 5).

Natural history. In Uruguay, these species inhabit mainly in open areas like natural grasslands, firebreaks in *E. dunnii* plantations, pastures, rice crops and urban parks. Also, can be found in woodlands like: riparian forests, hillside forests and "espinillares" (park forests of *Vachellia caven* (Molina) Seigler & Ebinger).

Mermessus fradeorum (Berland, 1932)
(Figures 1C-1D, 3D-3G and 5)

Material examined. Uruguay: Durazno: Establecimiento San Eduardo, in natural grassland, 32° 35' 32" S, 55° 42' 43" W, 16.iv.2019, G. Pompozzi leg., 2FF (FCE-Ar 15959); Establecimiento San Eduardo, in sown pasture (mainly *Avena* sp.), 32° 35' 59" S, 55° 42' 2" W, 12.viii.2019, G. Pompozzi leg., 1F (FCE-Ar 11350); Establecimiento La Teja, in two years old *E. dunnii* plantation, 32° 31' 57.75" S, 55° 44' 30.34" W, 17–20.v.2022, collected with G-Vac and leaf litter examination, M. Simó & D. Hagopián leg., 3MM (FCE-Ar 14299); Rivera: Establecimiento Mi lucha, in pasture, 31° 25' 3.7" S, 55° 16' 5.3" W, 10.vii.2019, G. Pompozzi leg., 3FF, 2MM (FCE-Ar 14658); Treinta y Tres: Da Fonseca, in rice crop of second year, 33° 11' 1.57" S, 54° 2' 4.90" W, 4.xi.2015, L. Bao leg., 1M (FCE-Ar 7022).

Distribution. Known for North America. Introduced to Azores, China, Cyprus, Saudi Arabia, South Africa, New Zealand (WSC, 2024), and now in Uruguay (Durazno, Rivera and Treinta y Tres Departments) (Figure 5).

Natural history. In Uruguay *M. fradeorum* was found in natural grasslands, pastures, rice crops and young *E. dunnii* plantations.

Neriene redacta Chamberlin, 1925
(Figures 1E-1F, 4B-4E and 5)

Material examined. Uruguay: Artigas: Rincón de Franquía, in park forest, [30° 12' 21.01" S, 57° 37' 37.02" W], 17–18.xi.2015, collected with G-Vac, M. Simó leg., 1F (FCE-Ar 7722); same locality, in grassland of tall tall tussock grasses,

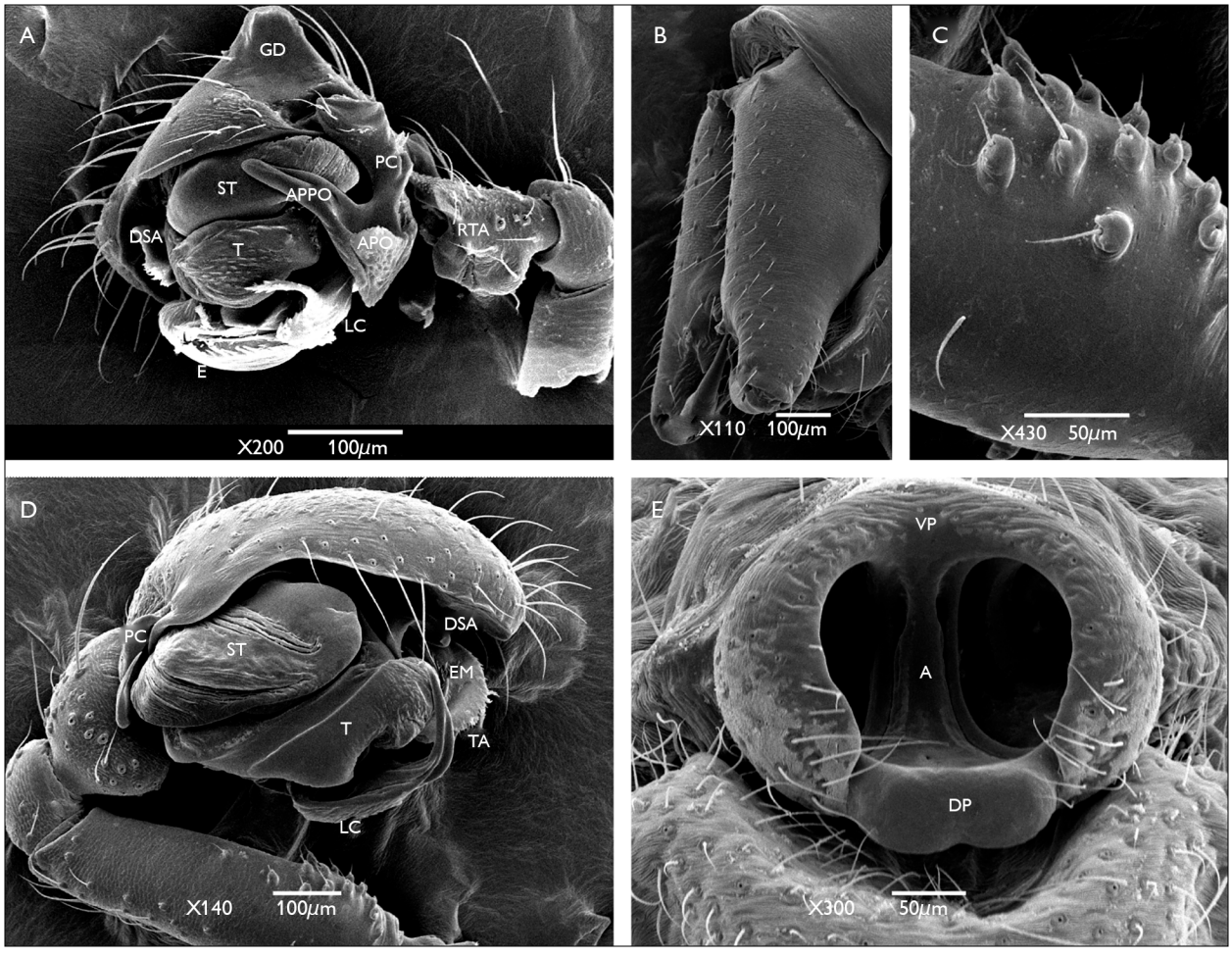

Figure 4. SEM images. A) *Agyneta galapagosensis*, male pedipalp in retrolateral view, B-E) *Neriene redacta*: chelicerae (male) (B), male pedipalp femur (C), male pepipalp in retrolateral view (D), epigynum in ventral view (E). Photos: M. Simó (2023).

collected with G-Vac, 29–30.iv.2015, collected with G-Vac, S. Fabius leg., 1F (FCE-Ar 7024); Canelones: INIA Las Brujas, in "espinillar", 34° 40' 10.08" S, 56° 20' 42.09" W, 7–14.vii.2014, Brussa, Da Silva & Muñoz leg., 3FF, 1Juv. (FCE-Ar 5834); same data, 3FF, 2Juv. (FCE-Ar 5036); same location and collectors, 21–28.iv.2014, 3FF, 3Juv. (FCE-Ar 4989); same data, 2MM (FCE-Ar 5010); same location and collectors, 29.x.2014, 2FF, 1Juv. (FCE-Ar 5873); same data, 1M (FCE-Ar 5916); Cerro Largo: Paso Arriera, in natural grassland, 32° 00' 34.4" S, 54° 26' 29.4" W, 5.vi.2020, collected manually, M. Simó & D. Hagopián leg., 1F (FCE-Ar 12304); same location, 10.xi.2019, collected with G-Vac, M. Simó & D. Hagopián leg., 1F (FCE-Ar 11599); Durazno: Establecimiento La Teja, in natural grassland, 32° 31' 25.78" S, 55° 44' 30.55" W, 17–21.v.2022, A. Laborda & M. Cajade, leg, 1M (FCE-Ar 13593); same data 1F (FCE-Ar 13594); same locality and collectors, 26.viii.2021, collected with pitfall trap, 1M (FCE-Ar 13452); same data, 1F (FCE-Ar 11599); Establecimiento La Teja, in natural grassland, 32° 32' 40.52" S, 55° 42' 51.74" W, 17–21.v.2022, collected with G-Vac, A. Laborda & M. Cajade leg, 1F, 1Juv. (FCE-Ar 13620). Montevideo: Melilla, in natural grassland, 34° 43' 57.10" S, 56° 19' 21.48" W, 24.xi.2021, D. Hagopián leg., 2F, 1Juv. (FCE-Ar 10507).

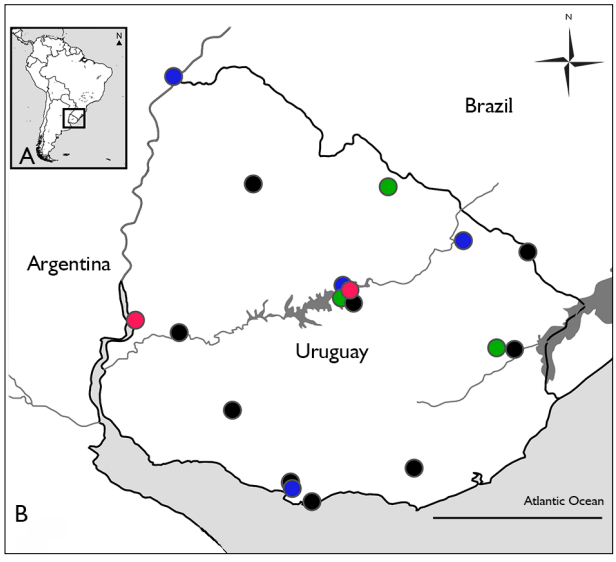

Figure 5. Distribution map. A) South America, B) rectangle in A enlarged. Red circles: *Agyneta galapagosensis*, black circles: *Erigone autumnalis*, green circles: *Mermessus fradeorum* and blue circles: *Neriene redacta*. Scale bar: 279 km. Map: M. Cajade (2024).

Distribution: Brazil, USA and Uruguay (Figure 5).

Natural history: In Uruguay *N. redacta* was found in natural grasslands, park forests and young *E. dunnii* plantations. Females webs were found inside tussock grasses in natural grasslands.

DISCUSSION

Many spider species have worldwide distribution (WSC, 2024), and most of them are a consequence of human transport and trade in the last centuries (Kobelt & Nentwig, 2008). Synanthropic species were favored in this process, expanding their distribution in urban habitats around the world, as reported for some spider species (Simó et al., 2011; Pompozzi et al., 2013). Other exotic species invaded new areas, displacing native species (Nentwig, 2015). Linyphiids show are highly dispersed and many species are associated with human activities, in this way several species show a cosmopolitan or widespread distribution (WSC, 2024). In Europe, Linyphiidae is the third most commonly established family in order of the number of alien species (Nentwig, 2015).

Agyneta galapagosensis, previously known for Galapagos Islands and Fernando de Noronha Island (WSC, 2024), is recorded for the first time for continental South America. This finding constitutes the southernmost records of this species. In Uruguay, *A. galapagosensis* is associated with natural grasslands and "blanquealeS". Previous studies found this species in island urban areas, crops and volcanic areas (Baert, 1990; Rodrigues et al., 2008). As hypothesized by Rodrigues et al. (2008, p. 252) "if *A. galapagosensis* is widely distributed in South America, it has not been detected because of the few studies involving the Neotropical linyphiid fauna".

Erigone autumnalis, is native to North America but has a wide global distribution (Nentwig, 2015). In Uruguay, it is recorded for natural grasslands, pastures, urban parks, *Eucalyptus dunnii* plantations and riparian forests. This species is formally cited for the first time in South America. Also, these findings constitute the southernmost records of this species. In addition, in the Global Biodiversity Information Facility (GBIF) exist previous records from Argentina of unconfirmed (cf.) individuals of this species. *Erigone autumnalis* seems to be one of the most common of the epigean spider species in Uruguay (in a wide variety of environments). Males leave the webs (if they actually spin ones) to search for prey or find a female.

Mermessus fradeorum is a widespread species (WSC, 2024). In Uruguay, we found specimens of *M. fradeorum* in natural grasslands, pastures, rice crops and young *E. dunnii* plantations. It is formally recorded for the first time for the continent, in spite of the existence of records in GBIF for Brazil (but unpublished in any taxonomic or biodiversity work) and it is mentioned in Zapata and Grismado (2015), but without the reference to material examined. *Neriene redacta* was originally described for the United States of America and was known from a single specimen in Brazil for sugarcane crops (Rinaldi et al., 2002). In Uruguay, this species is distributed in natural grasslands, park forests and young *E. dunnii* plantations. We hypothesize that this species may have arrived to the continent by the plant traffic of sugarcane, since alien species may be transported by

agrciculture crops (Hulme et al., 2008), and then dispersed and adapted to natural grasslands and other open or semi-open environments with herbaceous vegetation.

Some studies (Levine & D'Antonio, 2003; Kobelt & Nentwig, 2008) expect the introduction of at least one alien spider species per year in Europe as well as plants, molluscs and insects in the USA. Based on those, is not farfetched to expect similar rates in other parts of the world such as South America. Future faunistic studies or revision of material in arachnological collections may reveal new South American records of linyphiid species with widespread distribution.

These results confirm the great dispersion of the studied species, mainly by human activities and their tolerance to live in different environmental conditions.

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AUTHORS' CONTRIBUTION

M. Cajade contributed to project administration, formal analysis, conceptualization, data curation, investigation, methodology, validation, visualization, and writing (original draft, review and editing); E. N. L. Rodrigues to formal analysis, supervision, validation, and writing (review and editing); D. Hagopián to data curation, investigation, and writing (review and editing); Á. Laborda to data curation, investigation, and writing (review and editing); A. D. Brescovit to formal analysis, supervision, validation, and writing (review and editing); M. Simó to acquisition of funding, formal analysis, data curation, resources, software, supervisión, validation, and writing (review and editing).