New records of mosses from the Dry Chaco forest of Santiago del Estero, Argentina

Nuevos registros de musgos del Bosque Chaqueño Seco en Santiago del Estero, Argentina

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Summary

Background and aims: The bryophyte flora of Argentina is currently under study, nevertheless, there are still extensive areas unexplored, such as Santiago del Estero with only three records of bryophytes to the entire region. The aim of this work was to contribute to the knowledge of the moss flora of Santiago del Estero province, through the collection of samples in Copo National Park and surroundings.

M&M: The specimens were collected in the Copo National Park and surroundings, processed and studied according to traditional techniques for bryophytes. Microscopic characters were observed with stereoscopic and light microscopy. A list of the species found is presented, with comments on the differentiating characters, habitat and distribution.

Results: The following moss taxa were found to be new records for the province: *Aloina rigida*; *Dimerodontium balansae*; *Didymodon umbrosus*; *Fabronia ciliaris*; *Macrocoma tenuis* subsp. *sullivantii; Pseudocrossidium arenicola*; *P. linearifolium*; *Stereophyllum radiculosum*; *Syntrichia chisosa, Trichostomum brachydontium* and *Venturiella glaziovii*. The range of distribution of *Tricherpodium beccarii* is extended to the northeast of the province.

Conclusions: Eleven species and one subspecies, distributed in ten genera and five families, are newly reported for the province of Santiago del Estero. The range of distribution of one species is extended to the northeast of the province. These first studies highlight the unexplored floristic richness of the region and its vulnerability due to the accelerated advance of the agricultural-livestock border.

Key words

Bryophyta, Copo National Park, Erpodiaceae, Fabroniaceae, Pottiaceae, Stereophyllaceae.

Resumen

Introducción y objetivos: La flora briofítica en Argentina se encuentra actualmente en estudio, sin embargo, todavía quedan extensas áreas sin explorar, como lo es la provincia de Santiago del Estero, con solo tres registros de briófitos en toda la región. El objetivo de este trabajo es contribuir al conocimiento de la flora de musgos de la provincia de Santiago del Estero a través de colecciones en el Parque Nacional Copo y sus alrededores.

M&M: Las muestras fueron coleccionadas, procesadas y examinadas de acuerdo a las técnicas clásicas para briófitos. Los caracteres microscópicos fueron observados con microscopio óptico y estereoscópico. Se presenta un listado de las especies hasta el momento encontradas en la provincia, con comentarios sobre el hábitat y la distribución.

Resultados: Los siguientes taxa de musgos se registran por primera vez para la provincia: *Aloina rigida*; *Dimerodontium balansae*; *Didymodon umbrosus*; *Fabronia ciliaris*; *Macrocoma tenuis* subsp. *sullivantii; Pseudocrossidium arenicola*; *P. linearifolium*; *Stereophyllum radiculosum*; *Syntrichia chisosa, Trichostomum brachydontium* y *Venturiella glaziovii*. El rango de distribución de *Tricherpodium beccarii* se amplía hacia el noreste de la provincia.

Conclusiones: Once especies y una subespecie, distribuidas en diez géneros y cinco familias se registran por primera vez para Santiago del Estero. El rango de distribución de una especie se extiende al noreste de la provincia. Estos primeros estudios ponen de manifiesto la riqueza florística inexplorada de la región, y la vulnerabilidad de la misma debido al acelerado avance de la frontera agrícola ganadera.

Palabras clave

Bryophyta, Erpodiaceae, Fabroniaceae, Parque Nacional Copo, Pottiaceae, Stereophyllaceae.

Introduction

Bryophytes are a very ancient group of plants that inhabited earth for over 300 million years and include ca. 15000 species distributed in ca. 1200 genera (Hallingbäck & Hodgetts, 2000; Gradstein *et al*., 2001). In the Neotropics, the bryophyte flora is represented by almost 4000 species (Churchill & Linares, 1995; Delgadillo *et al*., 1995; Churchill *et al*., 2000; Gradstein *et al*., 2001). The first checklist of mosses in Argentina was published in the 20th century by Kühnemann (1938) which included 1002 species distributed in 198 genera. Subsequently, Matteri (2003) updated it and included 990 species distributed in 264 genera. Currently, the bryophyte flora of the country has been continuously updated mainly due to the efforts of local, but also by foreign specialists (Schiavone & Suárez, 2009; Jiménez *et al*., 2010; Cano *et al.*, 2011; Suárez & Schiavone, 2011; Fuertes *et al*., 2012; Suárez *et al.*, 2014; Flores & Suárez, 2014, 2015; Jimenez *et al.*, 2014, 2015; Colotti *et al.,* 2016, 2018; Cano & Alonso, 2017; Colotti & Suárez, 2017; Flores *et al*., 2017; Ellis *et al*., 2020). Although, the bryophyte flora of the region is still poorly known, and extensive areas in the country remain scarcely studied or unknown (Gradstein *et al*., 2001; Matteri, 2003) as Santiago del Estero province, with only two records of mosses (Suárez & Schiavone, 2005, 2010; Pursell, 2017) and one species of liverworts (Hässel de Menéndez & Rubies, 2009) until date.

Santiago del Estero province is located in northern Argentina and borders on with Salta and Chaco to the north, Santa Fe to the east, Catamarca and Tucumán to the west. It covers ca. 140.000 km^2 and comprises the Chaqueña phytogeographic region, which represents the biggest uninterrupted dry forest in the South American territory, from Santa Cruz de la Sierra (Bolivia) to Laguna Mar Chiquita (Argentina) (Giménez & Moglia, 2003). Currently, this phytogeographic region is considered one of South American ecoregions with the highest conservation priority due to its low representation within the system of protected areas, with only 7% of the tropical forests legally protected (Jimenez-Ortega & Mantilla-Meluk, 2008), and its accelerated transformation by the advance of the agricultural-livestock border (Gasparri & Grau, 2009).

The only protected area in Santiago del Estero is The Copo National Park, located at the extreme northeast of the province. It covers ca. 114.000 hectares and protects lowland plains and mountains with deciduous xerophilous forest with a warm continental climate, but also palms, savannas, and halophilic steppes (Cabrera, 1971). The weather is seasonal with 80% of annual precipitation (700 mm.) concentrated between October and March (spring-summer) (Trigo *et al*., 2020).

Protected areas preserve wild landscapes that represent the diversity of natural life and its associated cultural resources. Since most vegetation types are protected by these areas, bryophytes along with other cryptogamic plants, fungi and lichens receive the same level of protection as vascular plants and animal species (Matteri, 2000). Deforestation generates a negative impact in the bryophyte flora of the primary forest and leads to the loss of a considerable number of species (more than 50% or even more), especially those "shaded epiphytes" intolerant to desiccation (Acebey *et al.,* 2003). The disappearance of tropical forests and changes in land use are associated with the irreversible loss of species, mainly those with restricted distributions. However, in many groups of organisms, species disappear before they are studied or even known (Gradstein & Sporn, 2010). This is the case of the bryophyte flora of Santiago del Estero, which despite its uniqueness and the urgent need for protection due to the advance of the agricultural-livestock border, remains understudied with only two records of mosses (Suárez & Schiavone, 2005, 2010; Pursell, 2017) and one species of liverworts (Hässel de Menéndez & Rubies, 2009). The lack of information related to the biodiversity of a region, along with the accelerated loss of native forest, prevents the delineation of adequate strategies for proper conservation.

In order to increase the knowledge of the flora of the Dry Chaco forest from Santiago del Estero, a study of the bryophyte flora in the province, with a strong emphasis in Copo National Park, has been carried out. As a result, eleven species of mosses are newly reported to the province, and the range of distribution of one species is extended. The notes include some morphological differentiation, ecological collection data, global distribution and previous records in the country.

Material and Methods

Samples studied in this research belong to our collections performed during 2008 and 2011 at Copo, La Banda and Pellegrini Departments, with a strong emphasis in Copo National Park (Copo Department) since it is the only protected area that preserves remnants of the Dry Chaco Forest. The specimens were processed and stored in CTES and LIL. Morpho-anatomical studies were carried out with conventional techniques for bryophytes and mounted in Hoyer's solution (Anderson, 1954). KOH 2% was applied for the color reaction in Pottiaceae according to Zander (1993). Specialized literature (Zander, 1993; Sharp *et al.*, 1994; Gradstein *et al*., 2001) was used for taxonomic identification.

Results

The new moss records from Santiago del Estero are listed below, family placement is given in brackets. Notes on distinguishing characters of the species, ecological preferences and range of distribution are also provided.

1. Aloina rigida (Hedw.) Limpr. [Pottiaceae Hampe]

Specimen examined. ARGENTINA. Santiago del Estero. *Depto. Pellegrini*, Quebracho Coto, Ruta provincial 37, cerca del río Urueña, 26.2°S 64.4'W; 208 m, 10/03/2008, G. Suárez 1034, 1036a (CTES, LIL).

Distribution and habitat. It is widespread in North and South America, Europe, Asia, Africa and Australia (Delgadillo, 1975; Gallego *et al*., 1999; Zander, 1993; Delgadillo & Schiavone, 2004). In Argentina, it was previously known from Tucumán and Salta (Delgadillo & Schiavone, 2004). In Santiago del Estero it was found growing on exposed soil.

Comments. This species is recognized by the presence of lingulate leaves, a hyaline border that extends downward from the shoulders, and a costa with 3-6 stereid layers (Cano *et al.,* 2008).

2. Didymodon umbrosus (Müll. Hal) R.H. Zander [Pottiaceae]

Specimen examined. ARGENTINA. Santiago del Estero. *Depto. Pellegrini*, Ruta Provincial 37, cerca del rio Urueña, 26°S 64°W; 208 m, 10/03/2008, G. Suárez 1027a, 1029 (CTES, LIL).

Distribution and habitat. It is distributed in South Africa, Europe, North and South America (Zander, 1993; Jiménez *et al*., 2005). In Argentina, it was previously recorded to Salta and Tucumán (Matteri, 2003). It was found growing on soil in extended cushions.

Comments. This species is recognized in the field by its olive-green color and its curled-lanceolate leaves when dry. It is characterized among the other Pottiaceae species from Santiago del Estero by the presence of leaves with margins bistratose above midleaf.

3. Dimerodontium balansae Müll. Hal. [Fabroniaceae Schimp.]

Specimen examined. ARGENTINA. Santiago del Estero. *Depto. Copo*, Parque Nacional Copo, 25º51´15.6´´S 61º42´45.10´´W; 158 m, cortícola en el interior del monte, seco y sombrío, 02/03/2011, S. Jimenez & N. Niveiro 115 (CTES, LIL).

Distribution and habitat. This species was recorded in South America, and South Africa (Matteri, 2003; O'shea & Price, 2008; Câmara & Magill, 2009). In Argentina it was previously recorded from Buenos Aires, Chaco, Córdoba, Corrientes, Entre Ríos, Formosa, Mendoza, Misiones and Tucumán (Matteri, 2003; Câmara & Magill, 2009). It grows on trunks and exposed roots of trees (Câmara & Magill, 2009).

Comments. It is characterized by its ovate to orbicular, concave leaves, strong broad costa and variable leaves.

4. Fabronia ciliaris (Brid.) Brid. [Fabroniaceae]

Specimens examined. ARGENTINA. Santiago del Estero. *Depto. Copo,* Parque Nacional Copo, 25º51´15.6´´S 61º42´45.10´´W; 158 m, cortícola en la base de Fabaceae, escaso, sombrío, 01/03/2011,

S. Jimenez & N. Niveiro 104, (CTES, LIL). Cortícola en la base de Fabaceae, al costado del sendero, abundante, soleado y seco, 01/03/2011, S. Jimenez & N. Niveiro 105a, 107, 110, (CTES, LIL). 25°51´15,5´´S 61° 42´ 45,9´´W; 140 m, cortícola, escaso, en el interior del monte, escaso, seco y sombrío, S. Jimenez & N. Niveiro 113, 116, (CTES, LIL). 25° 49´ 07,8´´S 61° 42´40,8´´ W; 165 m, cortícola en la base de Fabaceae, seco y soleado, S. Jimenez & N. Niveiro 117 (CTES, LIL).

Distribution and habitat. It is known from North, Central and South America, Europe, eastern Asia, Pacific Islands, and Australia (Caners, 2017). In Argentina it was previously recorded from Buenos Aires, Chaco, Corrientes, Formosa, Jujuy, Misiones, Salta, Santa Cruz, Tucumán (Matteri, 2003).

Comments. This is a very delicate plant with stems readily breaking when leaves are removed during dissecting. The species is corticulous and grows forming lax and wide mats on bark of tree trunks and bases.

5. Macrocoma tenuis subsp. **sullivantii** (Müll. Hal.) Vitt [Orthotrichaceae Arn.]

Specimen examined. ARGENTINA. Santiago del Estero. *Depto. Copo*, Parque Nacional Copo, 25°51´15,5´´S 61°42´45,9´´W; 158 m, cortícola, escaso, en arbolito en el interior del monte, seco y sombrío, 01/03/2011, S. Jimenez & N. Niveiro 114 (CTES, LIL).

Distribution and habitat. This subspecies has been recorded in North and South America (Churchill & Linares, 1995; Matteri, 2003; Valente *et al*., 2020) and Asia (Readfern *et al.*, 1986). In Argentina, this taxon has been previously recorded (as *Macrocoma "tenue"* spp. *sullivantii* (Müll. Hal.) Vitt) from Corrientes (Matteri, 2003).

Comments. This species is distinguished by the brown to olive-green color of the plants with light-green younger tips, leaves erect-appressed when dry, wide-spreading when wet, sometimes producing rhizoids at back, keeled; laminal cells rounded-quadrate to rounded, prominently bulging.

6. Pseudocrossidium arenicola (Dusén) M.J. Cano [Pottiaceae]

Specimens examined. ARGENTINA. Santiago del Estero. *Depto. La Banda*, Dique "Los Quiroga", 27° 39' 59.22''S 64° 22' 00.38''W; 204 m, 30/09/2003, G. Suárez 291, 293 (CTES, LIL). *Depto. Pellegrini*, Quebracho Coto, Ruta provincial 37, cerca del río Urueña, 26.2°S 64.4'W; 208 m, 10/03/2008, G. Suárez 1027b, 1032b, (CTES, LIL). *Depto. Copo*, Parque Nacional Copo, 25º51´15.6´´S 61º42´45.10´´W; 158 m, terrícola en suelo arcilloso y seco, formando importantes montículos, rodeado de *Selaginella* sp., muy abundante, 01/03/2011, S. Jimenez & N. Niveiro 109 (CTES, LIL).

Distribution and habitat. It is a South American species recorded from Argentina and Bolivia. In Argentina, it was previously recorded from Buenos Aires, Catamarca, Chubut, Jujuy, Salta, Tucumán (Cano *et al.,* 2016). This species grows on soil and forms dense turfs.

Comments. Diagnostic characters include ligulate leaves, margin recurved, apex rounded-obtuse below the awn, costa in transverse section with a single stereid band and leaf ending in an awn (Cano *et al*., 2009).

7. Pseudocrossidium linearifolium (Müll. Hal.) J.A. Jiménez & M.J. Cano [Pottiaceae]

Specimens examined. ARGENTINA. Santiago del Estero. *Depto. Copo*, Parque Nacional Copo, 22º55´18´´S 61º42´45.22´´W; 158 m, cortícola en la base de un arbolito, 01/03/2011, S. Jimenez & N. Niveiro 111b (CTES, LIL). *Depto. Pellegrini*, Ruta Provincial 37, cerca del rio Urueña, 26°S 64°W; 208 m, 10/03/2008, G. Suárez 1035 (CTES, LIL).

Distribution and habitat. It is a South American species found in Argentina, Bolivia, and Ecuador. In Argentina, it has previously been recorded from Córdoba, Salta and Tucumán (Jiménez *et al.,* 2009).

Comments. This species is characterized by its ligulate to lingulate leaves, which are strongly

channelled near the rounded or obtuse apex, widely recurved margins of undifferentiated cells above mid-leaf, percurrent or excurrent costa in a short mucro (Jiménez *et al.*, 2009).

8. Stereophyllum radiculosum (Hook.) Mitt. [Stereophyllaceae W.R. Buck & Ireland]

Specimens examined. ARGENTINA. Santiago del Estero. *Depto. Copo*, Parque Nacional Copo, 25º55´18´´S 61º42´45,10´´W; 158 m, en bordes del sendero entrando al monte, cortícola en tronco caído, abundante, 01/03/2011, S. Jimenez & N. Niveiro 102b (CTES, LIL). 25º55'18''S 61º42'45.21''W; 158 m, cortícola en la base de arbolito, abundante, 01/03/2011, S. Jimenez & N. Niveiro 111a (CTES, LIL). 25º55´18´´S 61º42´45,23´´W; 158 m, cortícola en la base de arbolito, abundante, sombreado y seco, 01/03/2011, S. Jimenez & N. Niveiro 112 (CTES, LIL).

Distribution and habitat. It was recorded from North, Central and South America (Bartram, 1949; Anderson *et al*., 1990; Buck, 1998; Matteri, 2003; O'Shea & Price, 2008) and Africa (O'Shea, 2006). In Argentina, this species was previously recorded from Chaco, Corrientes, Formosa, Jujuy and Misiones (Matteri, 2003).

Comments. It is distinguished by the dull, complanate leaves with a single costa ending below the apex, and the presence of rhomboidal laminal cells with single papillae over the lumen. This plant grows on the base of trees and branches forming extensive mats.

9. Syntrichia chisosa (Magill, Delgad. & L.R. Stark) R.H. Zander [Pottiaceae]

Specimens examined. ARGENTINA. Santiago del Estero. *Depto. Pellegrini*, Quebracho Coto, Ruta provincial 37, cerca del río Urueña, 26.2°S 64.4'W; 208 m, 10/03/2008, G. Suárez 1023 (CTES, LIL). *Depto. Copo*, Parque Nacional Copo, 22º55´18''S 61º42´45.17´´W; 158 m, al borde del sendero sobre corteza, 01/03/2011, S. Jimenez & N. Niveiro 108 (CTES, LIL).

Distribution and habitat. This is an Afro-American species recorded from North and South America and South Africa (Zander, 1993; Churchill & Fuentes, 2005; Gallego & Cano, 2007). In Argentina, it was recorded from Salta (Gallego & Cano, 2007). This species is found growing on bark and is recognized by the small size and the yellowish-brown to reddish-brown color of the plants.

Comments. Diagnostic characters include plants small, red-brown with leaves infolded and twisted when dry, erect-spreading when wet, ligulate to spathulate, distally 2-stratose; costa excurrent in a short mucro.

10. Tricherpodium beccarii (Müll. Hal.) Pursell [Erpodiaceae Broth.]

Specimen examined. ARGENTINA. Santiago del Estero. *Depto. Copo*, Parque Nacional Copo, 26°06'49.6´´S 61°5736.3´´W; 161 m, al costado del camino, en el interior del monte, 02/03/2011, S. Jimenez & N. Niveiro 105a, 106, 108a, 113b, 118 (CTES, LIL).

Distribution and habitat. This species is distributed in North, Central, Western and Southern South America; Northeast and East Tropical Africa, Southern Africa, Western Indian Ocean and Asia (Allen, 2002; Costa *et al.,* 2011; Pursell, 2017). In Argentina, it was previously recorded from Chaco, Corrientes, Jujuy, Misiones and Tucumán (Matteri, 2003; Biasuso & Hladki, 2011). Pursell (2017) reports this taxon from Santiago del Estero to the west of the province, in Río Hondo Department. Here we extend the distribution to the northeast of the province to Copo Department. This species is common on bark of tree trunks and branches. In the Chaco Serrano forest of Tucuman, it was found growing in dark places within forests, on exposed rocks, trunks and roots (Suárez, 2002).

Comments. The species is characterized by ovate leaves, apex long acuminate in a hyaline subula, laminal cells hexagonal, pluripapillose. *Tricherpodium beccarii* is a common species on bark of tree trunks and branches and is easily recognized in the field by the greenish-grey color of the plants, and the immersed capsule of the sporophytes.

11. Trichostomum brachydontium Bruch [Pottiaceae]

Specimens examined. ARGENTINA. Santiago del Estero. *Depto. Copo*, Parque Nacional Copo, 22º55´18´´S 61º42´45.11´´W; 158 m, cortícola en tronco caído entrando al monte, abundante, 01/03/2011, S. Jimenez & N. Niveiro 102a, 103 (CTES, LIL). 22º55´18´´S 61º42´45.18´´W; 158 m, terrícola en suelo arcilloso seco, rodeado de *Selaginella sellowii*, muy abundante, formando montículos, 01/03/2011, S. Jimenez & N. Niveiro 109a (CTES, LIL). 22º55´18´´S 61º42´45.22´´W; 158 m, cortícola en la base de arbolito, abundante, 01/03/2011, S. Jimenez & N. Niveiro 111b (CTES, LIL).

Distribution and habitat. This species is distributed worldwide in North, Central and South America; Europe; Asia, Africa, and Australia (Zander, 1993; Allen, 2002). In Argentina, it was previously recorded from Salta (Matteri, 2003). This species grows in dense turfs on soils and tree bark.

Comments. It is characterized by the incurved, ligulate leaves with a short-excurrent costa, two well-developed stereids bands, and basal laminal cells differentiated across the leaf.

12. Venturiella glaziovii (Hampe) Pursell [Erpodiaceae]

Specimen examined. ARGENTINA. Santiago del Estero. *Depto. Copo*, Parque Nacional Copo, 25°5518´´S 61°42´´45.9´´W; 158 m, al borde del sendero, cortícola en árbol al borde del sendero, escaso, 01/03/2011, S. Jimenez & N. Niveiro 105b, 119a (CTES, LIL).

Distribution and habitat. This species was reported in North and South America, and Africa (Matteri, 2003; O'Shea & Price, 2008; Costa *et al.,* 2011; Pursell, 2017). In Argentina, it was previously known from Chaco, Corrientes, Misiones and Tucumán (Matteri, 2003; Biasuso & Hladki, 2011). This species is very common on bark of tree trunks and branches.

Comments. Diagnostic characters that distinguish this species include the leaves ovate, with apex acute to obtuse, laminal cells rhombic and smooth; capsule eperistomate, annuli rudimentary. It is easily recognized by the dark green color of the plants and the immersed capsule of the sporophytes (Sharp *et al.*, 1994; Pursell, 2017).

Authors Contributions

MSJ & GMS collected and determined the samples. All authors have worked simultaneously on the manuscript.

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