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Ferns and Lycophytes as new challenges

Rumohra aconquijana (Dryopteridaceae): a new species endemic from Southern Yungas in Argentina

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Abstract

Rumohra aconquijana sp. nov., a restricted endemism of the Montane Jungle district (700–1,500 m asl; Yungas biogeographic province) is reported, described and illustrated. *Rumohra aconquijana* grows as epiphyte on *Ocotea porphyria* (Lauraceae) and *Sambucus peruviana* (Viburnaceae) in humid terraces and slopes of the cloud forest. The new species differs from the widespread *R. adiantiformis*, especially by the dissection of the laminae, the shape and size of the pinnules. Also, there are differences with all Argentinean and Bolivian and Chilean species of *Rumohra* in the ornamentation of the perispore, which is folded with few folds, partially fused, narrow and with ridged margins. Here, we present the first species of *Rumohra* endemic from Argentinean Yungas, as well as a key to identifying the species occurring in Argentina and Bolivia.

Key words: endemism, ferns, Polypodiopsida, South America, Southern Cone.

Resumo

Rumohra aconquijana sp. nov., um endemismo restrito do distrito de Floresta Montana (700–1.500 m asl; província biogeográfica de Yungas) é relatado, descrito e ilustrado. A *Rumohra aconquijana* cresce como epífita em *Ocotea porphyria* (Lauraceae) e *Sambucus peruviana* (Viburnaceae) em locais úmidos e declives de florestas nebulares. A nova espécie difere de *R. adiantiformis*, especialmente pela dissecação das lâminas, a forma e o tamanho das pínulas. Além disso, difere de todas as espécies argentinas, bolivianas e chilenas de *Rumohra* na ornamentação do perisporo, que é cristado, parcialmente fusionado, estreito e com margens estriadas. Aqui, apresentamos a primeira espécie endêmica de Rumohra dos Yungas da Argentina, bem como uma chave para identificar as espécies ocorrentes na Argentina e na Bolívia.

Palavras-chave: endemismo, samambaias, Polypodiopsida, América do Sul, Cone Sul.

Introduction

The southern end of the Andean cloud forests extends as a relatively thin strip (30–100 km wide) stretching along 800 km from Bolivia to the Catamarca province in Argentina. Classically, these environments have been included in the Yungas phytogeographic province (Cabrera 1971) and more recently in the Yungas biogeographic province of the Neotropical region, with a crucial role in the connectivity among different South America biogeographical areas (Arana *et al*. 2021b; Morrone *et al*. 2022). Particularly, the Southern Austral Yungas constitutes one of the centres of fern diversity and endemism in the Southern Cone

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of South America (Ponce *et al*. 2002; Arana *et al*. 2013; Ponce & Arana 2019; Arana & Ponce 2021). Almost at the southern tip of the Yungas strip, the Aconquija system and associated mountain ranges enclose ca. 150,000 Ha of continuous forests considered a biodiversity hotspot and conservation priority due to its species richness and endemism (Brown 2009), including more than 120 fern species (Slanis *et al*. in prep.).

Rumohra is a monophyletic small fern genus belonging to Dryopteridaceae, subfamily Elaphoglossoideae (PPG I 2016). The genus was established by Raddi (1819) based on a species from Brazil, *Rumohra aspidioides* Raddi [= *Rumohra adiantiformis* (G. Forst.) Ching]. It is characterized by a combination of features such as long creeping, dorsivental, densely scaly rhizomes, dictyostelic, with an elongate ventral meristele; with leaves borne in two rows; decompound, lanceolate to deltate two- to three- (to four) pinnate laminae with decurrent leaf margins forming erect wings along the axes, proximal pinnae more developed basiscopically; free veins; and peltate indusia. The architecture of the lamina is fairly uniform across the genus; thus, species are mostly distinguished by rhizome habit, rhizome scales and lamina indument (Bauret *et al*. 2017) as well as characteristics of the spores (Sundue *et al*. 2013; Arana *et al*. 2021a). Within lastreopsid ferns in Dryopteridaceae, *Rumohra* is sister to *Megalastrum* and both diverged from the other lastreopsids about 35 Ma (20.3–52.3), between the Eocene and the Oligocene. Their ancestral area is reconstructed as Neotropics plus Australia. *Rumohra* diverged from *Megalastrum* c. 46.4 Mya in the Neotropics and started to diversify 11.2 Mya. (Schuettpelz & Pryer 2009; Labiak *et al*. 2014).

In South America there are reported five endemic taxa: *R. berteriana* (Colla) Duek & Rodr. from Juan Fernández Islands in Chile, *R. glandulosissima* Sundue & J. Prado and *R. quadrangularis* (Fée) Brade from upper elevation openings in the Atlantic Forest of Atlantic Forest fragments of São Paulo and Rio de Janeiro, Brazil (Sundue *et al*. 2013; Ponce & Arana 2016) and *R. ponceana* Arana, Giudice & Luna, from Pampean biogeographic province (Arana *et al*. 2021a). Recently *Rumohra adiantiformis* var. *laciniata* C. A. Brussa & J. Prado, was reported as a new variety endemic to the Sierras del Este Eco Region, Southern Uruguay (Brussa *et al*. 2023), which belongs to Uruguayense district, Pampean biogeographic province (Arana *et al.* 2021b). None of the endemic taxa of *Rumohra* is reported from Southern Yungas, where the highest concentration of plant endemism is registered for Bolivia (Moraes *et al*. 2019) and adjacent Argentina (Arana *et al*. 2021b).

During fieldworks in Sierras del Aconquija mountain systems of the Yungas biogeographic province, in the framework of the project "Recolecciones Botánicas en Tucumán (Argentina): Relevamiento de la Flora Pteridológica del Aconquija", and the re-examination of herbarium specimens from the whole area of distribution in Argentina and Bolivia, we consider that a new undescribed endemic species of *Rumohra* was discovered and hence brought to the light in this contribution. This new taxon constitutes also the first report of *Rumohra* inhabiting the Argentinean Yungas.

Material and Methods

Fresh specimens collected in Yungas from Tucumán and herbarium samples of *R. adiantiformis*, *R. berteriana* and *R. ponceana* where analysed in the following herbaria: BA, CTES, LIL, LP, RCVC and SI (Thiers, continuously updated). Also, high quality digital images of specimens from K, MO, MPU and TO were accessed online. Stem and leaf scales were mounted in 20% glycerin and analyzed under a Nikon SMZ1000 stereoscopic microscope and in Nikon E200 light microscope (LM) (D'Ambroggio de Argüeso 1986). The spores were analysed under LM and scanning electron microscope (SEM). For SEM, the spores from dried specimens were mounted in aluminium stubs, covered with gold in a sputter-coater and observed in a scanning electron microscope (Carl Zeiss Supra 55VP) with an acceleration voltage of 3.0 kV at Integral Center for Electron Microscopy (CIME, INSIBIO-UNT-CONICET, Argentina).

The analysed characteristics were colour, shape in polar and equatorial view, laesura type and perispore ornamentation. The quantitative data refers to the major and minor equatorial diameters, and polar diameter. The measures of spores were randomly estimated on 30 spores in each sample. Morphological terminology follows Tryon & Lugardon (1991) and Lellinger (2002). The microscopic preparations used in this study are stored in the Instituto de Taxonomía Fanerogámica y Palinología, Fundación Miguel Lillo, Tucumán, Argentina. Distribution map was generated using original coordinates from examined specimens and performed with QGIS version 3.18.3-Zürich.

Results & Discussion

Rumohra aconquijana Arana, Bulacio & Slanis, sp. nov.

Type: ARGENTINA. TUCUMÁN: Depto. Chicligasta, Parque Nacional Aconquija, Portal Campo de los Alisos, Arroyo Sufrimiento, 31.VIII.2022, *E. Bulacio*, *A. Slanis & A. Grau 4829* (Holotype LIL accession 617941, Isotypes: LIL accession 617942, RCVC accession 9869).

Fig. 1-5

Rumohra aconquijana is easily recognized and characterized by the laminae proximally 2-pinnate-pinnatifid (*vs*. laminae proximally 3-pinnate-pinnatifid in the widespread *R. adiantiformis*), epiphytic, pendant, herbaceous (vs. terrestrial, erect, chartaceous or subcoriaceous in *R. adiantiformis* and *R. ponceana*), longer pinnules 3–3.5 × 1.3–1.5 cm, and lanceolate to narrowly lanceolate (*vs*. 2.4–2.6 × 1.6–1.7 cm, and elliptic pinnules in *R. adiantiformis*). Rhizome scales with entire margins at the bases and presence of sparse, multicellular cilia on margins near the apices (*vs*. rhizome scales denticulate and conspicuous marginal capitate glands in *R. ponceana*). The spores are light brown, perispore folded with few folds, partially fused, narrow and with ridged margins (*vs*. spores dark brown covered with tubercles, perispore folded, projecting in irregular, large tubercles throughout its surface in *R. ponceana*, and perispore rugulated and folded with scattered and irregular, smaller tubercles in *R. adiantiformis*).

Plants epiphytic; roots inserted ventrally; rhizomes creeping, 15 mm diam., densely scaly, the scales up to 6–11 × 1–2 mm, ovate to lanceolate, basifixed, base slightly cordate, the apex long-attenuate to filiform, tortuous, the margins entire at the bases and denticulate to ciliate at the apices, with a tuft of cilia at the apex, cilia 0.5–1 mm long, pale brown, sub-clathrate; leaves dorsal, remote, 40–76 cm long, monomorphic; petioles 20–33 × 0.2–0.4 cm, pale brown to straw, grooved adaxially, scarcely to moderately scaly at the bases, the scales basifixed, medium-brown, concoloured, sub-clathrate, the apices acute, the margins entire to denticulate similar to those to the rhizome but shorter; laminae 35–43 × 22–39 cm, herbaceous, concoloured, pendant, triangular to broadly lanceolate, proximally 2-pinnate-pinnatifid (only the basal segment), becoming gradually less divided toward the pinnatifid apex; rachises abaxially rounded, adaxially with a central raised ridge flanked on both sides by a groove and lateral ridge, the lateral ridges continuous with the leaf margin; rachis with deciduous ovate lanceolate scales basifixed, up to 1.5 mm long, pale-brown, concoloured, sub-clathrate, the apex acute to tortuous, margins entire to denticulate, up to 1.5 mm; 8–10 pinnae pairs subopposite to alternate, erect, lanceolate, slightly asymmetrical and enlarged basiscopically, with 5–12 segments, pinnules 14–20, 3.5–5.2 × 0.9–1.1 cm, lanceolate to narrow lanceolate proximally, margins toothed to coarsely serrate, apex long attenuate, lamina surface glabrous or with caducous scales similar to the rachis but shorter on the abaxial side, and concolorous; sori roundish, medial, indusiate, paraphyses absent, receptacle brown, indusium peltate, roundish, 0.5–0.9 mm diam., deciduous, glabrous, pale brown to whitish when dried; spores ellipsoidal, monolete, pale brown, 29–32 µm in equatorial diameter and 18–20 µm in polar diameter, laesura tenuimarginate. Perispore folded with few folds, partially fused, narrow and with ridged margins (Fig. 4 b-c).

Additional examined material (Paratypes): ARGENTINA. Tucumán: Depto. Río Chico, Santa Ana, 29.VI.1914, *Castillón 3660* (LIL). Depto. Chicligasta, Parque Nacional Aconquija, Portal Campo de los Alisos, Sendero mirador del Mirlo, 16.VI.2023, *E. Bulacio, A. Slanis & M. Arana* (LIL 618004).

Rumohra aconquijana has a very restricted distribution area, growing as epiphytic in the Montane Jungle district of the Yungas (Fig. 2a-c) between 700 and 1,500 m asl. The Yungas biogeographic province comprises the eastern slopes of the Andes, between 500 and 3,500 meters, from northern Peru to north-western Argentina (Morrone *et al*. 2022). *Rumohra aconquijana* has been observed growing as epiphyte on *Ocotea porphyria* (Griseb.) van der Werff (Lauraceae) and *Sambucus peruviana* Kunth (Viburnaceae) in the Aconquija National Park and the Santa Ana province Reserve (Fig. 3). In those sites the Yungas forest is dominated also by *Juglans australis* Griseb. (Juglandaceae), *Zantoxylum coco* Gillies *ex* Hook. & Arn. (Rutaceae), *Duranta serratifolia* (Griseb.) Kuntze (Verbenaceae) and several Myrtaceae tree species as *Blepharocalyx salicifolius* (Kunth) O. Berg (Fig. 2a) Furthermore, we believe that *R. aconquijana* may occur on other tree species, not limited to *S. peruviana* or *O. porphyria*. The climate where *R. aconquijana* growths is

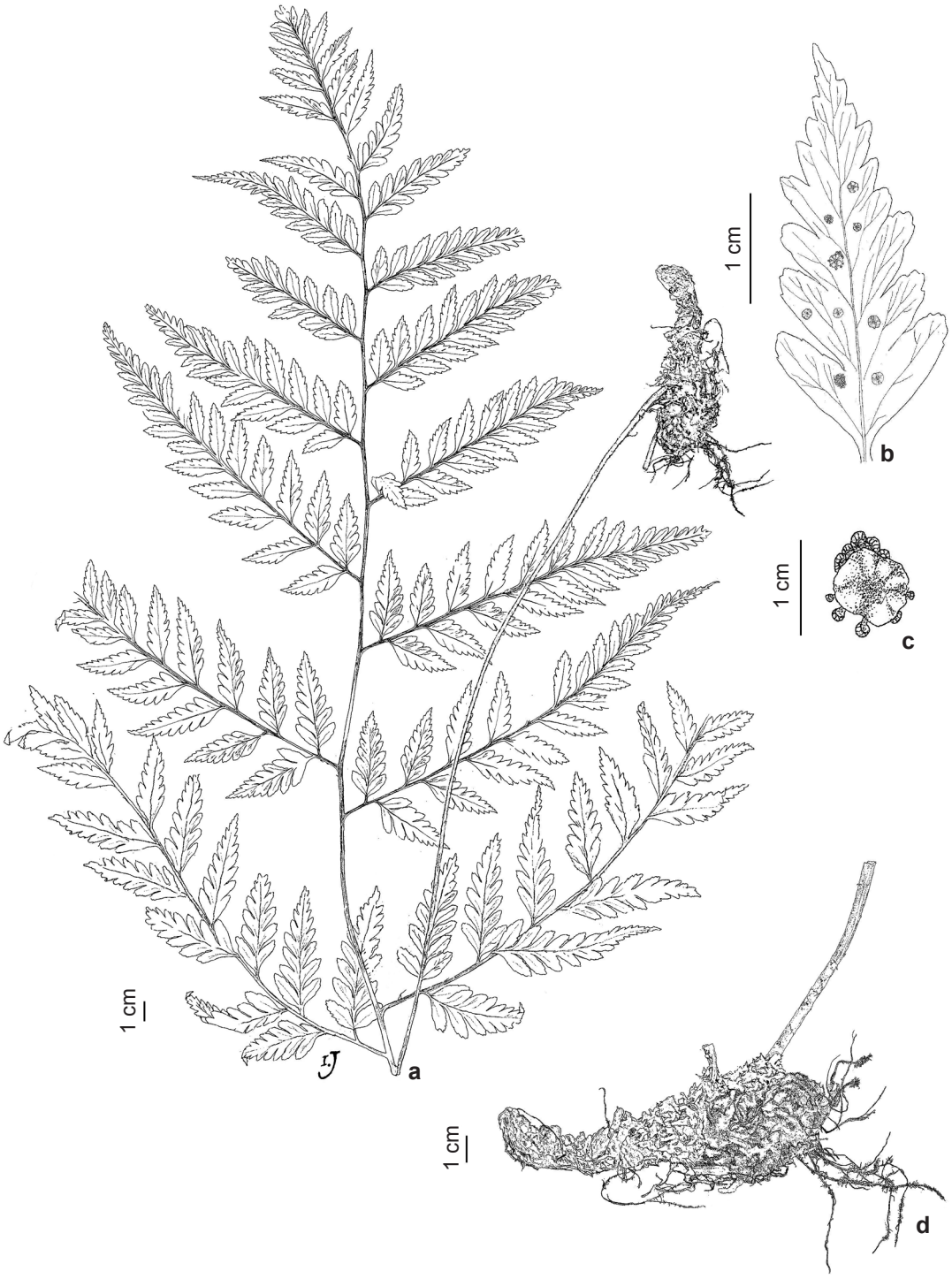

Figure 1 – a-d. *Rumohra aconquijana* – a. general habit; b. pinnule; c. sorus; d. rhizome (a-d. from E. Bulacio *et al.* 4829, Holotype).

moderately mild, humid, and cloudy from October to April, and dry and cool, with occasional snowfall in winter (Minetti 2012). However, drizzle and fog are frequent even during the low rain period.

The specific epithet refers to the mountain range and National Park, Aconquija, where the species was collected.

Field observations and observations in herborized specimens from the whole distributional range in Argentina and Bolivia, led us to determine the existence of various distinguishing characteristics of the new species. Given the overall appearance of the plant and the leaf shape, *Rumohra aconquijana* is easily distinguished from *R. adiantiformis* (the widespread species in South America) by the epiphytic habit and the laminae proximally 2-pinnate-pinnatifid in *R. aconquijana* (Fig. 1; Fig. 2b-c), being proximally 3-pinnate-pinnatifid in *R. adiantiformis*, with no records for the Argentinean Yungas, but being the only species mentioned for adjacent Bolivia (Kessler *et al.* 2018). The other species growing in Argentina, *R. ponceana*, has the division of the laminae similar to *R. aconquijana*, but grows in sunny rock crevices, with scant soil development and low water retention in the Serranean grass steppe dominated by many species of *Nassella* (von Trinius) Desv. (Poaceae), combined by shrublands in the Pampean biogeographic province (Arana *et al*. 2021b). Furthermore, the presence of conspicuous, capitate glandular hairs with exudate on the scale margins of rhizome and petiole distinguish *R. ponceana* from *R.*

Figure 2 – a-d. *Rumohra aconquijana* – a. habitat; b. habit; c. *R. aconquijana* growing with *Aechmea distichanta* (Bromeliaceae), a typical epiphyte of the Yungas; d. comparative pinnae abaxial and adaxial view.

aconquijana (scales without such hairs, Fig. 4a) and *R. adiantiformis* (Arana *et al*. 2021a).

Rumohra aconquijana is known for just two populations (Fig. 3) and the species could be assessed as Data Deficient status. But IUCN guidelines (IUCN 2021) state that the Data Deficient status should only be assigned as a last resort, due to the potential for these species to be overlooked. Under this scenario, and according to IUCN categories and criteria (IUCN 2021), we suggest that *Rumohra aconquijana* should be listed as Endangered (B1a, Roberts *et al*. 2016; IUCN 2021), given the Yungas original extension is reduced in more than 31% and are threatened by anthropogenic disturbances such as oil exploitation, extensive ranching, agricultural activities, and urban expansion (Malizia *et al.* 2012). As the number of recorded specimens is limited, we are unable to estimate the extent of occurrence (EOO) and area of occupancy (AOO) of this species.

Rumohra aconquijana is the only species of *Rumohra* from Argentinean Yungas, with a very restricted distribution in the Aconquija mountain system. Due to resembling morphology and the epiphytic habit usually at great heights, some specimens of *Rumohra aconquijana* may be misidentified as another Dryopteridaceae species, *Dryopteris patula* (Sw.) Underw., a common species occurring at Yungas. The new species of *Rumohra* could be easily differentiated from *D. patula* by its coriaceous fronds (*vs.* herbaceous in *D. patula*); the indusia is peltate in *R. aconquijana* (Figs. 2d; 5b), whereas is reniform in *D. patula*. Also, field observations yield additional and useful distinctions. *R. aconquijana* has creeping rhizomes (Fig. 5a); slender petioles, scarsely to moderately scaly at base; remote fronds (Fig. 5a) with blades

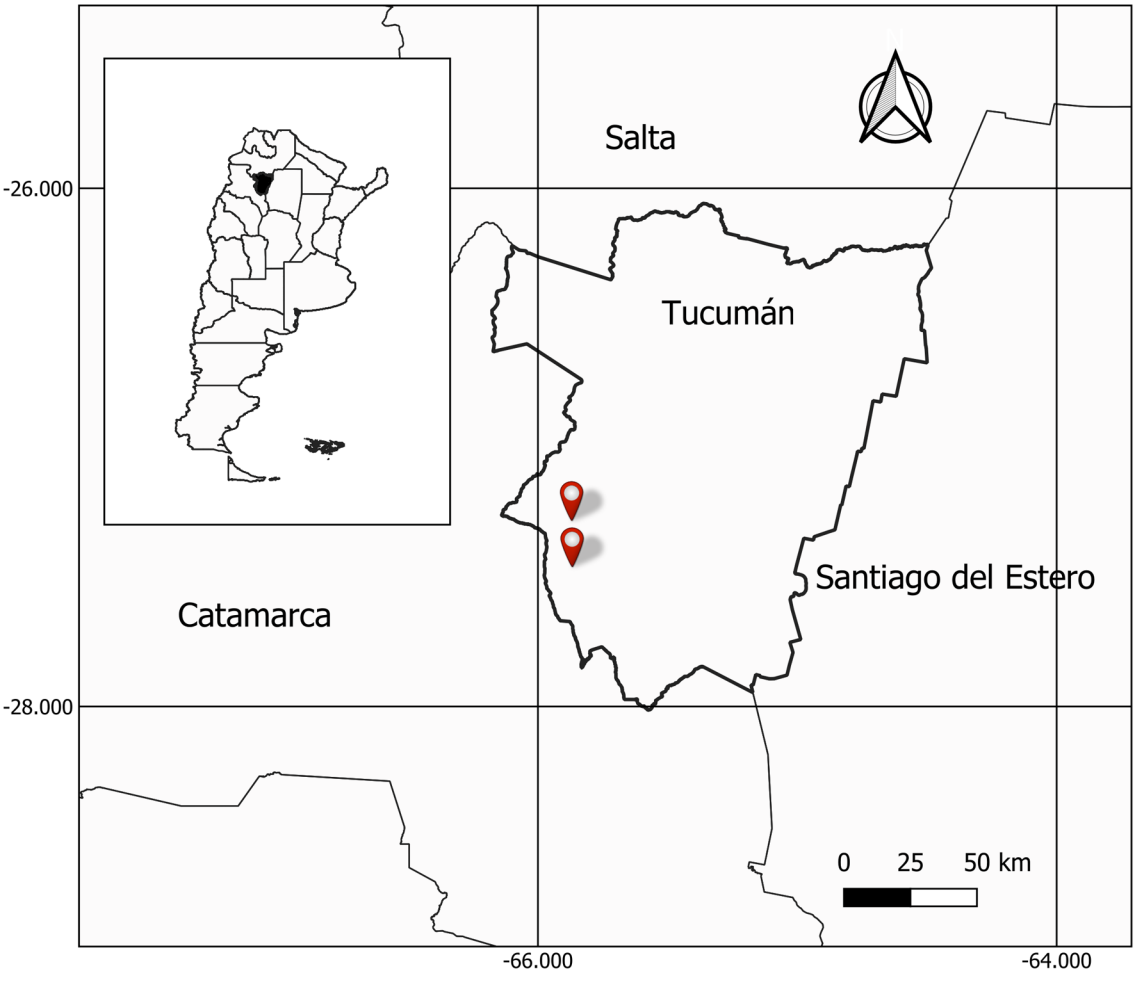

Figure 4 – *Rumohra aconquijana* distribution map.

proximally bipinnately pinnatifid, triangular to broadly lanceolate in outline, with fugacious, scattered, ovate pale brown scales (*vs.* ascending rhizomes covered by persistent leaf bases; stout petioles, densely scaly at base; polystic fronds with blades proximally bipinnately pinnatifid to tripinnate, deltoid to ovate-deltoid in outline with glandular hairs in *D. patula*).

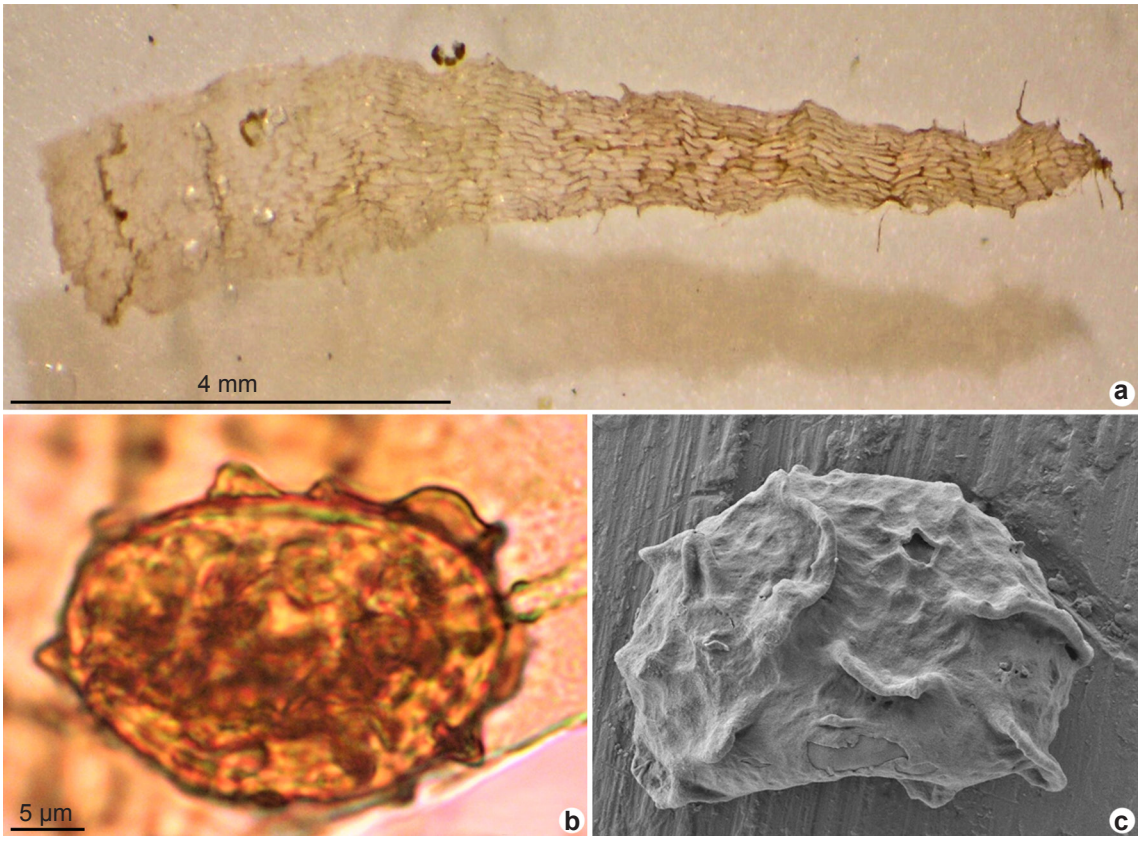

Figure 4 – a-c. *Rumohra aconquijana* – a. rhizome scale showing ciliate margins at the apex; b. LM micrograph of a spore in distal view, perispore folded is evident; c. SEM micrograph of a spore in equatorial view showing perispore folded with few folds, partially fused, narrow and with ridged margins (a. from the Isotype; b, c. from the Holotype).

Key for Argentinean and Bolivian species of *Rumohra*

1. Laminae proximally 2-pinnate-pinnatifid.
   2. Epiphytic. Rhizome scales eglandular, with entire margins at the bases and scarce multicellular cilia near the apices. Fronds patent to pendant with pinnae remote, not overlapping. Spores light brown, perispore folded, folds few, partially fused, narrow and with ridged margins. Yungas biogeographic province..... *Rumohra aconquijana*
   2'. Terrestrial. Rhizome scales with conspicuous marginal capitate glands, with exudate. Fronds erect, with pinnae proximate, overlapping at lateral sides. Spores dark brown, perispore folded, densely projecting in irregular tubercles throughout its surface. Pampean biogeographic province..... .....*Rumohra ponceana*
1'. Laminae proximally 3-pinnate-pinnatifid .....*Rumohra adiantiformis*

Figure 5 – a-b. *Rumohra aconquijana* – a. creeping rhizome on a trunk of *Sambucus peruviana*; b. abaxial view of a pinnae showing the fugacious scales and sorus.

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Data availability statement

In accordance with Open Science communication practices, the authors inform that all data are available within the manuscript.

References

Arana MD, Luna ML, Berrueta PC, Martinenco ML & Giudice G (2021a) *Rumohra ponceana* (Polypodiales: Dryopteridaceae): a new species from Pampean biogeographic province in Argentina. Phytotaxa 521: 27-38. DOI: https://doi.org/10.11646/phytotaxa.521.1.3

Arana MD, Morrone JJ, Ponce M & Oggero AJ (2013) Patrones biogeográficos de los helechos de las sierras de Córdoba (Argentina) y sus implicancias en la conservación. Gayana Botánica 70: 357-376. <http://dx.doi.org/10.4067/S0717-66432013000200013>.

Arana MD, Natale E, Oggero A, Ferreti N, Romano G, Martínez G, Posadas P & Morrone JJ (2021b) Esquema biogeográfico de la República Argentina. Opera lilloana 56: 1-240.

Arana MD & Ponce MM (2021) Contribución de licofitas y helechos endémicos al esquema biogeográfico evolutivo de la Argentina. Boletín de la Sociedad Argentina de Botánica 56: 16.

Bauret L, Selosse M, Gaudeul M, Rouhan G, Hirai RY, Perrie L, Prado J, Salino A, Senterre B, Shepherd L & Sundue M (2017) Molecular data, based on an exhaustive species sampling of the

fern genus *Rumohra* (Dryopteridaceae), reveal a biogeographical history mostly shaped by dispersal and several cryptic species in the widely distributed *Rumohra adiantiformis*. Botanical Journal of the Linnean Society 185: 463-481. DOI:10.1093/BOTLINNEAN/BOX072

Brown AD (2009) Las selvas pedemontanas de las Yungas: manejo sustentable y conservación de la biodiversidad de un ecosistema prioritario del noroeste argentino. *In*: Brown AD, Blendinger P, Lomáscolo T & García Bes P (eds.) Selva pedemontana de las Yungas, historia natural, ecología y manejo de un ecosistema en peligro. Ediciones del Subtrópico, Fundación ProYungas, Tucumán. Pp. 13-36.

Brussa CA, Prado J, Bonifacino JM, Brussa P & Hirai RY (2023) *Rumohra adiantiformis* var. *laciniata* (Dryopteridaceae), a New variety endemic to Southeastern Uruguay. American Fern Journal 113: 1-13. <https://doi.org/10.1640/0002-8444-113.1.1>.

Cabrera AL (1971) Fitogeografia de la República Argentina. Boletín de la Sociedad Argentina de Botánica 14: 1-42.

D'Ambroggio de Argüeso A (1986) Manual de técnicas en histología vegetal. Hemisferio Sur, Buenos Aires. 83p.

IUCN (2021) The IUCN Red List of Threatened Species. Version 2021-3. Available at <https://www.iucnredlist.org/>. Access on 10 April 2023.

Kessler M, Moran, RC, Mickel JT, Matos FB & Smith AR (2018) Prodromus of a fern flora for Bolivia. XXXV. Dryopteridaceae. Phytotaxa 353: 1-114. <https://doi.org/10.11646/phytotaxa.353.1.1>.

Labiak PH, Sundue M, Rouhan G, Garrison Hanks J, Mickel T & Moran RC (2014) Phylogeny and historical biogeography of the lastreopsid ferns (Dryopteridaceae). American Journal of Botany 101: 1207-1228. DOI: 10.3732/ajb.1400071

Lellinger DB (2002) A modern multilingual glossary for taxonomic pteridology. Pteridologia 3: 1-263. <https://doi.org/10.5962/bhl.title.124209>.

Malizia L, Pacheco S, Blundo C & Brown AD (2012) Caracterización altitudinal, uso y conservación de las Yungas Subtropicales de Argentina. Ecosistemas 21: 53-73.

Minetti L (2012) El clima del Noroeste Argentino. Fundación Caldenius, Tucumán. 410p.

Morrone JJ, Escalante T, Rodríguez-Tapia G, Carmona A, Arana M & Mercado-Gómez JD (2022) Biogeographic regionalization of the Neotropical region: new map and shapefile. Anais da Academia Brasileira de Ciências 94: e20211167. DOI 10.1590/0001-3765202220211167

Ponce MM & Arana MD (2016) *Rumohra* Raddi (Dryopteridaceae). *In*: Ponce MM & Arana MD (coord.) Flora vascular de la República Argentina 2. IBODA, Buenos Aires. Pp. 165-166.

Ponce MM & Arana MD (2019) Diversidad de helechos y licofitas de Argentina, situación actual del conocimiento. *In*: Picón G, Valdebenito H, Argüello A, Neill D, Asanza M, Franco W & Freire-Fierro A (eds.) La Botánica en Latinoamérica, realidad y desarrollo virtual. 2ª ed. Universidad Técnica de Cotopaxi y Universidad Central del Ecuador, Latacunga. 91p.

Ponce MM, Mehltreter K & de la Sota ER (2002) Análisis biogeográfico de la diversidad pteridofítica en Argentina y Chile continental. Revista Chilena de Historia Natural 75: 703-717.

PPG - The Pteridophyte Phylogeny Group-I (2016) A community-derived classification for extant lycophytes and ferns. Journal of Systematics and Evolution 54: 563-603.

Raddi G (1819) Synopsis filicum brasiliensium. Opuscoli Scientifici d'una Società di Professori della Pontifical Università di Bologna 3: 279-297.

Roberts DL, Taylor L & Joppa LN (2016) Threatened or data deficient: assessing the conservation status of poorly known species. Diversity and Distributions 22: 558-565. <https://doi.org/10.1111/ddi.12418>.

Schuettpelz EH & Pryer KM (2009) Evidence for a Cenozoic radiation of ferns in an angiosperm-dominated canopy. Proceedings of the National Academy of Sciences of the United States of America 106: 11200-11205.

Sundue M, Hirai RY & Prado J (2013) *Rumohra glandulosissima* (Dryopteridaceae) a new species from the Atlantic Rainforest, and revision of the species occurring in Brazil. Systematic Botany 38: 915-924.

Thiers B (continuously updated) Index Herbariorum: a global directory of public herbaria and associated staff. New York Botanical Garden's Virtual Herbarium. Available at <http://sweetgum.nybg.org/science/ih/>. Access on 10 march 2023.

Tryon AF & Lugardon B (1991) Spores of the Pteridophyta. Springer-Verlag, New York. <https://doi.org/10.1007/978-1-4613-8991-0>.

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