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High lichen species richness in *Polylepis australis* forest: new records from South America and Argentina

Juan Manuel Rodriguez[1]*, Raúl Enrique Díaz Dominguez[1], Helmut Mayrhofer[2], Alfredo Passo[3] & Daniel Renison[1]

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Abstract. The *Polylepis australis* forests in Central Argentina support a great biodiversity in a relative small area. As a result of this study focusing on the diversity and ecology of the lichen communities of these forests, we present five new species for South America: *Rinodina ficta*, *R. malcolmii*, *R. obscura*, *Usnea glabrata*, *Tetramelas triphragmioides* and eight taxa new for Argentina: *Calicium abietinum*, *Erioderma leylandii* subsp. *leylandii*, *Leptogium microstictum*, *Phaeophyscia endococcinodes*, *Rinodina dolichospora*, *R. intermedia*, *Usnea cirrosa* and *U. flavocardia*. Unidentified *Usnea* species, similar to *U. silesiaca*, were also characterized and discussed.

Key words: *Caliciaceae*, *Collemataceae*, Córdoba, *Pannariaceae*, *Parmeliaceae*, *Physciaceae*, taxonomy.

Introduction

Forest and shrubland patches with canopies dominated by ~28 species of the genus *Polylepis* occupy the uppermost forested slopes of the high mountains of tropical and subtropical South America (Fjeldså & Kessler 2004; Renison et al. 2018; Segovia et al. 2018). These *Polylepis* forests exhibit huge environmental differences with a latitudinal distribution of 4500 km from Venezuela to Central Argentina, elevation ranges from 900 to 5000 m above sea level and includes the world record for the highest elevation displaying tree growth, and a large range of precipitations from 100 to 3000 mm (Harden et al. 2013; Cuyckens et al. 2016; Renison et al. 2018). As a result of their isolation and a relatively stable climate throughout the Pleistocene, many *Polylepis* forests are inhabited by species of birds, rodents, plants and fungi with high levels of endemisms (Tarifa & Yensen 2001; Calvelo & Liberatore 2002; Fjeldsa 2002; Bellis et al. 2009; Robledo & Renison 2010; Sylvester et al. 2017; Ames-Martínez et al. 2019; Quispe-Melgar et al. 2020). The ecology and biodiversity of the heterogeneous forest types classified as '*Polylepis* forests' are still poorly represented in the scientific literature with a recent review reporting 139 published studies, of which only 25 studies centered on *Polylepis* forest biodiversity (Renison et al. 2018).

Studies that report lichen diversity in *Polylepis* forests are particularly scarce. To the best of our knowledge, only two have been published. One in the context of edge effects in two *Polylepis* forest patches in the Andes of Colombia (Pulido Herrera & Ramos Montaño 2016) and a second regarding the effects of fires in the mountains of Central Argentina (Perazzo & Rodriguez 2019). Given the island nature of mountain highlands and the diversity of habitat types for *Polylepis* forests from arid regions to wet cloud forests, the lichen communities of the high mountain *Polylepis* forests of South America are largely unexplored and probably hide a wealth of new species to science.

According to the IUCN, 15 of the approximately 30 described *Polylepis* tree species are considered threatened. Hence, the forests they dominate including their endemic biota are also considered threatened (IUCN 2020). The reasons for their threatened status involve the limited distribution range of many of the *Polylepis* species in combination with an important human pressure on the forests. These forests are subjected to small scale, but continuous logging, burning to produce pastures for domestic livestock or land for agriculture, invasion by

[1] Instituto de Investigaciones Biológicas y Tecnológicas, Centro de Ecología y Recursos Naturales Renovables. CONICET – Universidad Nacional de Córdoba. Av. Vélez Sarsfield 1610. CP 5000, Córdoba
[2] Institute of Biology, Division of Plant Sciences, NAWI Graz, University of Graz, Holteigasse 6, A-8010 Graz, Austria
[3] Instituto de Investigaciones en Biodiversidad y Medioambiente (CONICET – Universidad Nacional de Comahue). Quintral 1250, CP 8400, Bariloche, Río Negro
* Corresponding author e-mail: juan.rodriguez@unc.edu.ar

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exotic species and are vulnerable to quick climate change (Fjeldså 2002; Fjeldså & Kessler 2004; Cingolani et al. 2008; Renison et al. 2013; Cuyckens et al. 2016). The description of the *Polylepis* forests vanishing biodiversity has the potential to promote awareness from conservation agencies and local people about their rich endemic biota. In particular, to date no *Polylepis* forest endemic species for the most studied taxa such as birds, mammals and vascular plants have been described in the southernmost forest. However, new species to science and a host of possible endemics are emerging for wood decaying fungi and lichens in this location (Robledo et al. 2003; Rodriguez et al. 2011, 2017).

The southernmost *Polylepis* forests are dominated by *P. australis* and are located in the Higher Cordoba Mountain range of Central Argentina. These forest patches represent less than 10% of the vegetation cover in this location (Cingolani et al. 2008; Renison et al. 2013). Within the wooded patches, in addition to *P. australis,* as a secondary tree species *Maytenus boaria* may be found, as well as the shrub species *Escalonia cordobensis* and *Berberis buxifolia* and a large number herbaceous plants, ferns and grasses. The plant diversity along with climate gradient provide a wide variety of habitats ideal for the development of very diverse lichen communities. Recently, a review of the lichen genus *Pannaria* in Argentina included two new records in the *P. australis* forests (Passo et al. 2020) and the presence of one *Oropogon* species was rediscovered here (Rodríguez & Filippini 2020). However, the lichen composition in *P. australis* forests is far from complete. The objective of this work is to describe noteworthy lichen species in *Polylepis australis* forests including new records for South America and Argentina.

Material and methods

Between the years 2015 and 2020 more than 1000 lichen collections were made in *Polylepis australis* forests from the mountains of Central Argentina (31°34′S, 64°50′W). The elevation range is 1200–2800 m above sea level (Renison et al. 2002). Mean temperatures of the coldest and warmest months are 5.0°C and 11.4°C, respectively, with no frost-free period. Mean annual precipitation is 920 mm, with 83% of the rainfall being concentrated in the warmer months, between October and April (Colladon 2002; Renison et al. 2002). The vegetation in the mountains of Central Argentina consists of a mosaic of tussock grasslands, grazing lawns, degraded grazing lawns, eroded areas with exposed rock surfaces, granite outcrops, closed and open *Polylepis australis* forests or shrublands (Fig. 1). The lichen collection sites were in the Condorito National Park under permit DRC 321 (Argentinian National Parks Administration) issued to the first author.

The specimens were studied morphologically under stereomicroscope using standard techniques in lichenology. The anatomical characters were studied through handmade sections mounted in water or KOH. The spore measurements are reported with their range. The percentage of cortex, medulla and axis in *Usnea* (%CMA) is reported as min−X−max where ‘min’ and ‘max’ are the extreme observed values and X the arithmetic mean. The lichen substances were identified by TLC (Orange et al. 2001) using A, B´, C and/or G solvents. Also K (5% KOH), C (commercial bleach), KC (K followed by C), PD and UV (fluorescence at 366 nm) were used when necessary (not needed for all species). For the specific morphological characters studied in each genus see the literature in the descriptions. All specimens are preserved in the CORD herbarium.

Results and discussion

Twenty-six lichenized fungi are presented in this work. Five species are new records for South America: *Rinodina ficta*, *R. malcolmii*, *R. obscura*, *Usnea glabrata*, and *Tetramelas triphragmioides.* Eight taxa are new records for Argentina: *Calicium abietinum*, *Erioderma leylandii* subsp. *leylandii*, *Leptogium microstictum*, *Phaeophyscia endococcinodes*, *Rinodina dolichospora*, *R. intermedia*, *Usnea cirrosa* and *U. flavocardia*. Twelve species are new records from central Argentina, all of them from Córdoba province: *Amandinea punctata*, *Cratiria lauricassiae*, *Hypotrachyna sinuosa*, *H. vexans*, *Leptogium brebissonii*, *L. cyanescens*, *L. laceroides*, *L. phyllocarpum*, *Parmelinopsis swinscowii*, *Sticta fuliginosa*, *Usnea igniaria*, *U. subelegans.* One species remains unidentified *Usnea* aff. *silesiaca*.

New records for South America and Argentina

Calicium abietinum Pers., Tentamen dispositionis methodicae Fungorum. Suppl. 59. 1798. (Fig. 2A–C)

For a detailed description see Tibell (1996).

Diagnostic characters. Thallus immersed (Fig. 2A), brown-black stalked ascomata (0.2–0.45 mm long.) without pruina (Fig. 2B); ascospores 1-septate, brown and ellipsoid (Fig. 2A), ornamented when mature, (10–12 × 4.5–6.6 μm).

Chemistry. K–, C–; there are no substances detected by TLC.

Notes. *Calicium* is a genus underestimated in Argentina: only *C. glaucellum*, *C. hyperelloides*, *C. subcurtum* and *C. viride* have been cited from Patagonia or to northeast of the country (Calvelo & Liberatore 2002). In comparison with these species, *C. abietinum* is the only with the combination of an immersed thallus, brown to black stipitate and not pruinose apothecia.

Distribution and ecology. *Calicium abietinum* is a very common species in temperate regions (high mountains in tropical area). In South America, it is known from Paraguay and Venezuela (Tibell 1996). In *P. australis* forests, this species grows in well illuminated stands on deadwood.

Specimens examined. ARGENTINA. Córdoba. Los Gigantes, 2088 m, 31°24′17.0″S, 64°48′29.4″W, on dead wood, 22 Sep.

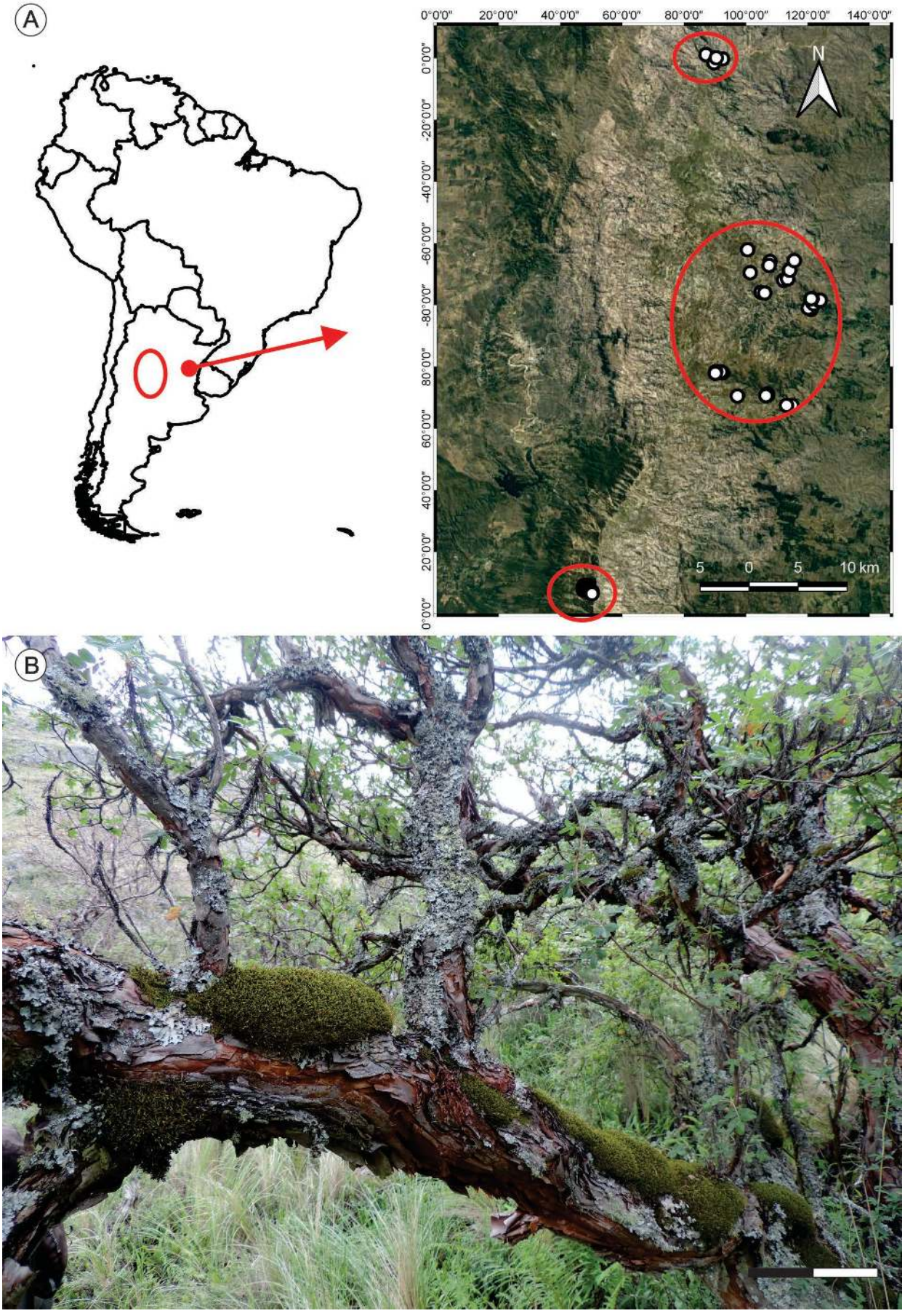


Figure 1. A. Location of the collection sites. B. Typical lichen communities in *Polylepis australis* forests.

2018, Rodriguez 4674 (CORD). Parque Nacional Quebrada del Condorito, 2132 m, 31°44′26.5″S, 64°48′24.3″W, on dead wood, 26 Dec. 2018, Rodriguez 4677 (CORD); *ibid.*, 1827 m, 31°45′52.4″S, 64°45′38″W, on dead wood, 29 Jan. 2019, Rodriguez 4690 (CORD).

Erioderma leylandii subsp. ***leylandii*** (Taylor) Müll. Arg., Flora 71: 24. 1888. (Fig. 2D–E)

For a detailed description see Jørgensen & Arvidsson (2002).

Diagnostic characters. Thallus foliose, more or less orbicular, grey to buff, shallowly incised (Fig. 2D); upper surface smooth to scabrid, glabrous centrally, otherwise covered with a soft arachnoid tomentum (Fig. 2E), with aggregated stiff hairs near the involute margins; lower surface whitish, mostly naked, with bundles of blackish rhizohyphae; apothecia marginal, disc brown, flat to convex, margin thin, finely hairy (Fig. 2E).

Chemistry. Medulla PD+ orange, C–, K–; TLC: pannarin.

Notes. This subspecies is similar to *E. leylandii* subsp. *velligerum* (Tuck) Jørg., cited for Patagonia in cold temperate *Nothofagus* ssp. forests, which is characterized by the presence of argopsin instead of pannarin, and a more conspicuously hirsute upper surface (Jørgensen 2001).

Distribution and ecology. In South America, *Erioderma leylandii* subsp. *leylandii* is a fairly common taxon in the central Andes, from Venezuela to Peru, and costal SE Brazil (Jørgensen & Arvidsson 2002). It has been found growing on stone under the canopy.

Specimens examined. ARGENTINA. Córdoba. El Hueco, 1887 m, 31°58′17.1″S, 64°56′48.1″W, on stone, 19 Oct. 2018, Rodriguez & Díaz Dominguez 4678 (CORD).

Leptogium microstictum Vain., Dansk Botanisk Arkiv Udgivet af Dansk Botanisk Forening. Copenhagen 4: 18. 1926. (Fig. 2F–H)

For a detailed description see Sierk (1964) and Kitaura (2012).

Diagnostic characters. Thallus foliose, loosely attached to substratum grey-bluish, thin, rather papery (Fig. 2F); lobes rounded, margins crisped; upper surface smooth to minutely bullate-foveolate (Fig. 2G); lower surface naked with a few hapters; apothecia small, up to 1.5 mm, laminar, disc orange-brown, subpedicellate, flat, margin pale; ascospores fusiform, 18–25 × 6–8 µm, 3–6 septated, with 1 or 2 transverse septum (Fig. 2H).

Notes. This rare and poorly known species is characterized by its minute foveolae on the upper surface. It is similar to *L. foveolatum* Nyl. that has larger foveolae and spores (Kitaura 2012).

Distribution and ecology. It is the first record for the country and for southern South America, previously cited for USA, Mexico (Sierk 1964; Kitaura 2012), and Venezuela (Marcano et al. 1996). So far, it is only known from one specimen, growing among mosses on a shaded place.

Specimens examined. ARGENTINA. Córdoba, El Hueco, 1887 m, 31°58′17.1″S, 64°56′48.1″W, on stone, 19 Oct. 2018, Rodriguez & Díaz Dominguez 4691 (CORD).

Phaeophyscia endococcinodes (Poelt) Essl. Mycotaxon 7(2): 301. 1978. (Fig. 2I–L)

For a detailed description see Moberg (1995).

Diagnostic characters. Thallus foliose, gray, without pruina (Fig. 2I); medulla orange-red (Fig. 2J); lower surface black, rhizines simple and black; apothecia frequent, 2–3 mm diam., sessile (Fig. 2K), margin concolorous with upper surface; ascospores ellipsoid, 20.3–27 × 8.5–2 µm, of *Pachysporaria*-type (Fig. 2L).

Chemistry. Cortex K–, medulla K+ purple, TLC: skyrin.

Notes. This species is easily recognizable by the presence of orange-red pigment in the medulla.

Distribution and ecology. In South America the species is known from Brazil, Chile, Colombia, Peru and Venezuela (Moberg 1993; Sipman et al. 2008). Here, it has been found growing over bryophytes on stone.

Specimens examined. ARGENTINA. Córdoba. Parque Nacional Quebrada del Condorito, seccional Condorito, 1995 m, 31°42′55.8″S, 64°45′14.9″W, on bryophytes, 15 Dec. 2016, Rodriguez & Perazzo 4646 (CORD).

Rinodina dolichospora Malme, Bihang till Kungliga svenska Vetenskaps-Akademiens Handlingar 28(1): 30. 1902. (Fig. 3A–D)

For a detailed description see Mayrhofer et al. (1999).

Diagnostic characters. Thallus variable: crustose, thin and effuse, granulose (Fig. 3A) to thicker and areolate or phyllydiate (Fig. 3B); apothecia lecanorine, sessile and ± frequent, thalline margin prominent, concolorous with the thallus, disc brown, epruinose, 0.75 × 1.51 mm (Fig. 3C); ascospores *Pachysporaria*-type, 1-septate, brown, 22–31 × 13–14.0 µm, frequently with minute granular or globular inclusions (Fig. 3D). There are no substances detected by TLC.

Notes. The type (*Pachysporaria* with granular inclusions) and size of spores separate *Rinodina dolichospora* from the other species of *Rinodina* from *Polylepis* forests studied in this contribution.

Distribution and ecology. The species has been described from Brazil (Malme 1902). It is also known from Australia (Mayrhofer et al. 1999), North America (Sheard 2010) and southern Europe (Giralt et al. 2009). In the forest stands of *P. australis*, this species is very common growing on trunks and twigs.

Selected specimens examined. ARGENTINA. Córdoba, Parque Nacional Quebrada del Condorito, 1894 m, 31°37′07.9″S, 64°43′16.8″, on *Polylepis australis*, 21 Dec. 2018, Rodriguez 4670 (CORD). El Hueco, 1865 m, 31°58′12.8″S, 64°56′54.6″, on *Polylepis australis*, 19 Oct. 2018, Rodriguez 4676 (CORD).

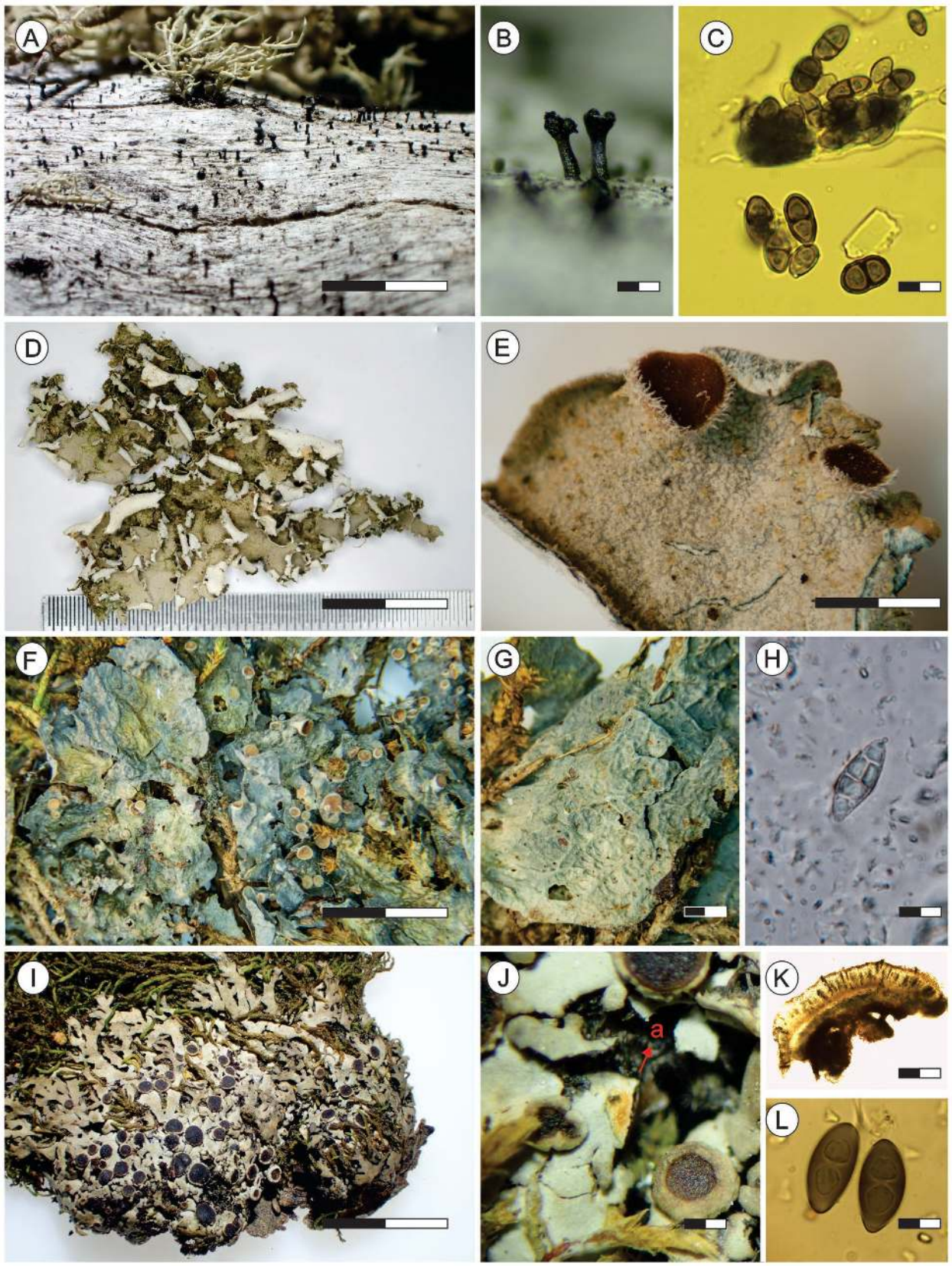
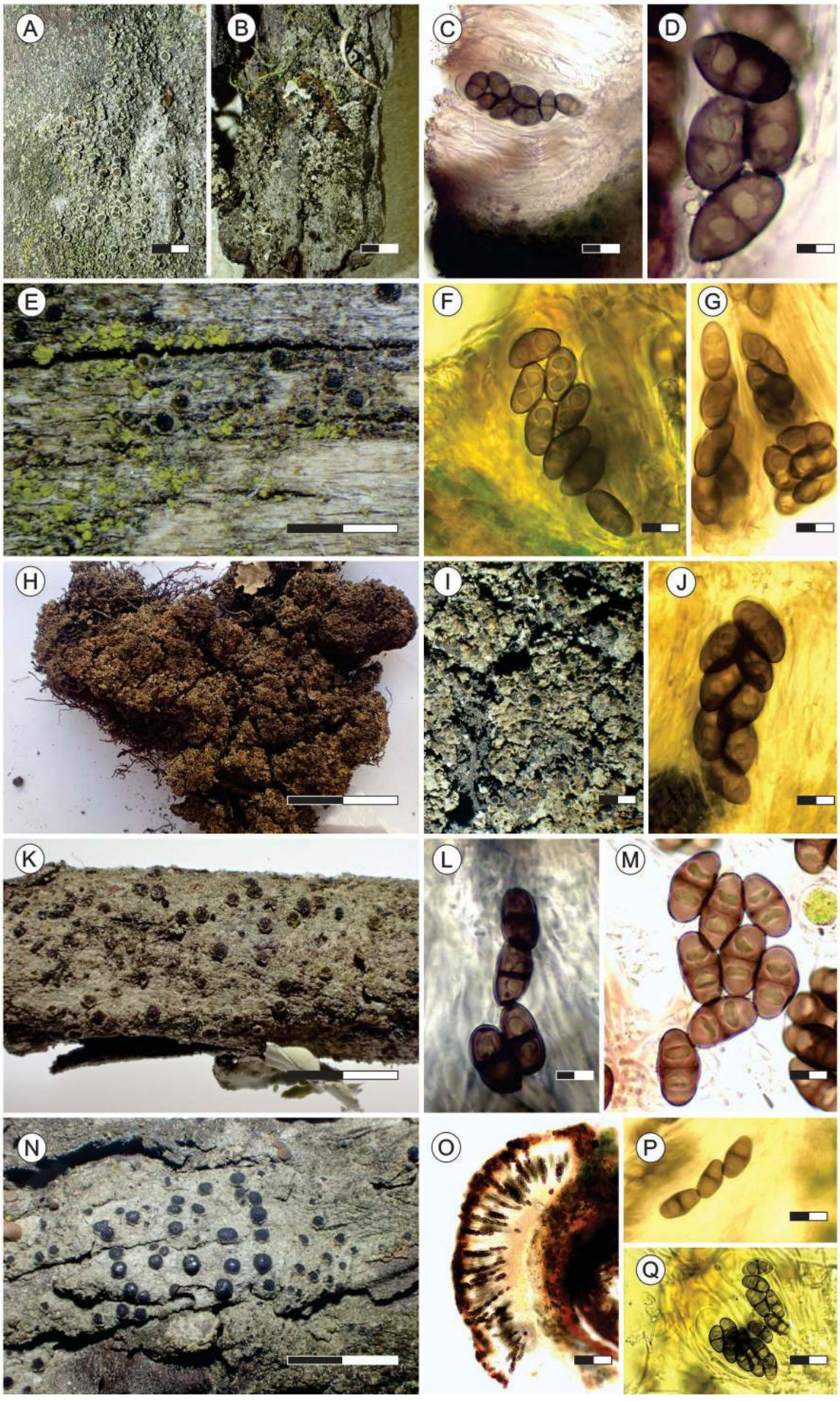


Figure 2. New records for Argentina. A–C. *Calicium abietinum* (Rodriguez 4674). A – thallus; B – stalked apothecia; C – 1-septate, brown and ellipsoid ascospores; D–E – *Erioderma leylandii* subsp. *leylandii* (Rodriguez & Díaz Dominguez 4678); D – thallus; E – apothecia; F–H – *Leptogium microstictum* (Rodriguez & Díaz Dominguez 4691); F – thallus; G – foveolae; H – 5-septated, fusiform ascospore with 1 transverse septum; I–L – *Phaeophyscia endococcinodes* (Rodriguez 4646); I – thallus; J – orange pigment in the medulla (letter a); K – apothecia; L – ascospores of *Pachysporaria* type. Scales: A = 3 mm; B = 0.1 mm; C = 11 µm; D = 1.5 cm, E = 2 mm; F = 0.5 cm; G = 2 mm; H = 10 µm; I = 2.4 cm; J = 0.2; K = 48 µm; L = 10 µm.


A
B
C
D
E
F
G
H
I
J
K
L
M
N
O
P
Q

Rinodina ficta (Stizenb.) Zahlbr., Catalogus Lichenum Universalis 7: 518. 1931. (Fig. 3E–G)

For a detailed description see Giralt & Mayrhofer (1991) as *R. boleana* Giralt & H. Mayrhofer.

Diagnostic characters. Thallus thin, crustose, inconspicuous, white to pale gray (Fig. 3E); apothecia lecanorine, sessile, 0.25 – 0.38 mm wide, thalline margin developed; disc plane, black, without pruina; ascospores *Pachysporaria*-type, ontogeny of type B (apical thickenings visible before the insertion of the septum), 11.2–14.7 × 6.1–7.2 µm (Fig. 3F–G). There are no substances detected by TLC.

Notes. This species is separated from the other *Rinodina* species studied here based on the very thin thallus, the smaller *Pachysporaria*-type spores and their ontogeny of type B.

Distribution and ecology. *Rinodina ficta* is new for South America. It is described from South Africa (Stizenberger 1890; Mayrhofer et al. 2014). It occurs also in New Zealand (Mayrhofer et al. 2007, as *R. boleana*) and Mediterranean Europe (Mayrhofer et al. 2014). It has been found on dead wood in well conserved *Polylepis* forest stands.

Specimen studied. ARGENTINA. Córdoba, Parque Nacional Quebrada del Condorito, 2132 m, 31°44′26.5″S, 64°48′24.3″W, on dead wood, 26 Dec. 2018, Rodriguez 4677 (CORD).

Rinodina intermedia Bagl., Commentario della Società Crittogamologica Italiana 1(4): 315. 1863. (Fig. 3H–J)

For a detailed description see Mayrhofer et al. (2001)

Diagnostic characters. Thallus light-gray-green or ochraceous to light brown (Fig. 3H), frequently with marginal lobes; apothecia sessile, broadly attached, frequent, often contiguous with dark brown to black disc (Fig. 3I); ascospores large, 20–31 × 12–15 µm, submuriform with typically more than four locules at maturity (Fig. 3J).

Chemistry. K–, C–; TLC: deoxylichesterinic acid (Mayrhofer et al. 2001, Sheard 2010).

Distribution and ecology. *Rinodina intermedia* is widely distributed in dry regions at low altitudes; known from Colombia and Ecuador in South America, the Caribbean, western North America, Macaronesia, southern Europe, and north to the Channel Islands, U.K., eastwards to the Himalaya and as far south as Kenya and the Cape Verde Islands in Africa (Mayrhofer et al. 2001, Sheard 2010). It grows on soil or terricolous bryophytes, often in crevices between rocks, rarely on horizontal stems of dead shrubs (Mayrhofer et al. 2001, Sheard 2010). In *Polylepis* forests, it grows on soil under the canopy.

Selected specimen examined. ARGENTINA. Córdoba. Los Gigantes, 31°24′17.0″S, 64°48′29.4″W, 2088 m, on soil, 22 Sep. 2018, Rodriguez 4665 (CORD).

Rinodina malcolmii Elix, Ch.Edler & H.Mayrhofer, Australasian Lichenology 86: 96. 2020. (Fig. 3K–M)

For a detailed description see Elix et al. (2020).

Diagnostic characters. Thallus thin, continuous, crustose to verruculose, pale grey (Fig. 3K); apothecia frequent, lecanorine, adnate to sessile, 0.32 – 0.58 mm wide, thalline margin developed; disc plane to concave, brown to black, plane when mature; ascospores *Pachysporaria*-type when immature (14–17.5 × 7–9.2 µm) to *Mischoblastia*-type (Fig. 3M) when mature (17–21.6 × 8–9.5 µm). There are no substances detected by TLC.

Distribution and ecology. *Rinodina malcolmii* is new from South America. This species has been recently discovered (Elix et al. 2020) in New Zealand. Here it grows on *P. australis* bark and on twigs of *Maytenus boaria* or *Berberis buxifolia* mixed with many other crustose species (*Lecanora* spp., *Caloplaca* spp.) and small fruticose *Ramalina* and *Usnea* species.

Selected specimens studied. ARGENTINA. Córdoba, Los Gigantes, 31°23′45.1″S, 64°49′78.0″W, 1834 m, on twigs of *Polylepis australis*, 09 Aug 2018, Rodriguez 4671 (CORD). El Hueco, 1880 m, 31°58′19.7″S, 64°56′59.1″W, on *Polylepis australis*, 19 Oct. 2018, Rodriguez 4672 (CORD).

Rinodina obscura Müll. Arg., Bulletin de l'Herbier Boissier 1: 40. 1893. (Fig. 3N–Q)

For a detailed description see Mayrhofer et al. (1999).

Diagnostic characters. Thallus crustose thin, continuous, ± rimose, pale grey to olive-grey (Fig. 3N); apothecia sessile, frequent, lecanorine at least when young, thalline margins poorly developed (Fig. 3O), thin or absent when mature; disc 0.3–0.7 mm, brown to black, convex with age, epruinose; ascospores *Physcia*-type, 1-septate, brown, 12–15 × 5.5–9 µm (Fig. 3P–Q). There are no substances detected by TLC.

Distribution and ecology. *Rinodina obscura* is new from South America. It has been described in Australia (Müller 1893) and is widely distributed in southeastern mainland Australia and Tasmania (Mayrhofer et al. 1999). It is a rare species in *P. australis* forests.

Specimens examined. ARGENTINA. Córdoba, Los Gigantes, 1882 m, 31°24′01.9″S, 64°47′56.1″W, on *Polylepis australis*, 21 Sep. 2018, Rodriguez 4666 (CORD). Parque Nacional

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Figure 3. New *Rinodina* species for Argentina. A–D – *Rinodina dolichospora* (Rodriguez 4670); A – thallus granulose; B – thallus phyllidiate; C – detail of the hymenium; D – *Pachysporaria* type ascospores; E–G – *Rinodina ficta* (Rodriguez 4677); E – thallus; F – inmature ascospores in ascus; G – overmature ascospores; H–J – *Rinodina intermedia* (Rodriguez 4665); H – thallus; I – thallus and apothecia; J – submuriform ascospores in ascus; K–M – *Rinodina malcolmii* (Rodriguez 4671); K – thallus; L – overmature ascospores; M – ascospores of *Mischoblastia* type; N–Q – *Rinodina obscura* (Rodriguez 4679); N – thallus; O – hymenium; P – ascospores of *Physcia* type; Q – ascospores in ascus. Scales: A, B = 4 mm; C = 20 µm; D = 6 µm; E = 2.1 mm; F & G = 40 µm; H = 2.5 cm; I = 2 mm; J = 15 µm. K = 2.1 mm; L = 12 µm; M = 15 µm; N = 5.6 mm; O = 120 µm; P = 15 µm; Q = 16 µm.

Quebrada del Condorito, 2127 m, 31°44′21.6″S, 64°48′03.4″W, on *Polylepis australis*, 26 Dec. 2018, Rodriguez 4679 (CORD).

Usnea cirrosa Motyka, Lichenum Generis *Usnea* Studium Monographicum. Pars Systematica 2: 514. 1937. (Fig. 4A–D)

For a detailed description and taxonomical notes see Clerc (2007) and Gerlach et al. (2017).

Diagnostic characters. Thallus shrubby, erect, up to 7 cm long, yellowish-grey (Fig. 4A); branches tapering, secondary branches constricted at ramification point (Fig. 4C), segments cylindrical to inflate, terete; papillae verrucose irregularly distributed, fibrils scarce to numerous; apothecia terminal and subterminal sometimes with red pigment in the margin (Fig. 4B); ascospores: ellipsoid 6.4–8.8 × 3.2–6.4 µm; cortex thin and shiny 3.7–*5,6*–9.6%; medulla moderately thick to thick 21–*31*–35% lax to dense; central axis thin to moderately thin, 17–*26.5*–41.5% (Fig. 4D).

Chemistry. K+ yellow turning orange to red, C–, KC–; TLC: usnic and norstictic acids.

Distribution and ecology. *Usnea cirrosa* has been recorded from USA, Mexico, Colombia and Brazil (Gerlach et al. 2017). In *Polylepis* forests, it is a rare species.

Selected specimens examined. ARGENTINA. Córdoba, Parque Nacional Quebrada del Condorito, 1827 m, 31°45′52.4″S, 64°45′38.0″W, on *Polylepis australis*, 29 Jan. 2019, Rodriguez & Díaz Dominguez 4653 (CORD). *Ibid.*, 2090 m, 31°44′25.5″S, 64°47′56.3″W, 27 Dec. 2018, Rodriguez 4654 (CORD).

Usnea flavocardia Räsänen, Revista Universitaria (Santiago) 21: 139. 136. (Fig. 4E–G)

For a detailed description see Clerc (2007) and Truong et al. (2011).

Diagnostic characters. Thallus shrubby, up to 5 cm, yellowish-green frequently with red dots (Fig. 4E–F); branches tapering, secondary branches constricted at ramification point, segments cylindrical to inflated and terete; fibrils scarce, up to 3 mm long.; tubercles and papillae present; soralia circular to irregular, partially confluent, sometimes excavate; isidiomorphs present on immature soralia; cortex shiny, 4.1–*5,9*–8.2%; medulla lax, white or with a yellow pigment around axis, 21.3–*29.4*–37.9%; axis 16.1–*29.4*–43.6 (Fig. 4G).

Chemistry. Medula K+ yellow turning orange. TLC: usnic and norstictic acids; K–. TLC: usnic and psoromic acids. There are other chemotypes in this species (Truong et al. 2011), also in Argentina (unpubl. data). However, the specimens studied here belongs to the norstictic or psoromic acids chemotypes.

Distribution and ecology. *Usnea flavocardia* is known from North America, Europe, Macaronesia and North Africa (Clerc 2007) and South America (Truong et al. 2011). *Usnea flavocardia* grows on *Maytenus boaria*, *Berberis buxifolia* and *P. australis* mixed with *U. cornuta*, *U. parvula* thalli.

Selected specimens examined. ARGENTINA. Córdoba. Parque Nacional Quebrada del Condorito, seccional Condorito, 31°44′42.6″S, 64°46′49.7″W, 2052 m, on *Polylepis australis*, Oct. 2016, Rodriguez & Perazzo 4647 (CORD). *Ibid.,* 31°44′21.6″S, 64°48′03.4″W, 2127 m, on *Polylepis australis*, 26 Dec. 2018, Rodriguez 4664 (CORD).

Usnea glabrata (Ach.) Vain., Annales Academiae Scientiarum Fennicae 6(7): 7. 1915. (Fig. 4H–J)

For a detailed description see Clerc (2011).

Diagnostic characters: Thallus shrubby, erect to tufted, up to 3.5 cm, greyish-green (Fig. 4H); branches tapering to fusiform, secondary branches constricted at ramification point, segments inflated to cylindrical, terete; fibrils up to 2 mm mainly on the base; tubercles absent and papillae verrucose inconspicuous; soralia originated from the cortex ad initio, irregular to circular, plane, excavate to slightly convex, larger than the half of the branch, totally fusing toward terminal branches upturning the apices (Fig. 4I); soredia granular and isidiomorphs absent; cortex shiny, thin 4.1–*6,3*–10.2%; medulla lax thick 16.3–*27.8*–34.3%; axis thin, 20.3–*31.8*–47.0% (Fig. 4J).

Chemistry. K+ yellow turning red, TLC: usnic and salazinic acids; K–, TLC: usnic acid.

Notes. The recently published *U. subaranea* and *U. subglabrata* (Truong & Clerc 2016) are similar to *U. glabrata*. The former developed circular soralia that remain isolated, the cortex is rigid and the medullary hyphae arranged in bundles. The second species presents more conspicuous papillae and stictic acid in medulla. The characteristics observed fit well with the variation of *U. glabrata* described in Halonen et al. (1998), Herrera Campos et al. (2001) and Clerc (2007).

Distribution and ecology. *Usnea glabrata* is known from North America and Europe. This is the first record in South America. It grows on twigs of all of the woody plants present in the *Polylepis* forest. It is common to observe twigs fully covered with thalli of *U. parvula*, *U. cornuta* and *U. glabrata* together with *Ramalina* and *Teloschistes* species.

Selected specimen examined. ARGENTINA. Córdoba. Parque Nacional Quebrada del Condorito, seccional Condorito, 2058 m 31°44′40.8″S, 64°46′41.8″W, on *Polylepis australis*, Oct. 2016, Rodriguez & Perazzo 4692 (CORD).

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Figure 4. New *Usnea* species for Argentina. A–D – *Usnea cirrosa* (Rodriguez 4653); A – thallus; B – reddish apothecia; C – secondary branches constricted at ramification point (letter a, arrow); D – longitudinal section; E–G – *Usnea flavocardia* (Rodriguez 4647); E – thallus; F – red dots on secondary branches; G – longitudinal section and slightly yellowish medulla; H–J – *Usnea glabrata* (Rodriguez & Perazzo 4692); H – thallus; I – detail of soralia on terminal branches; J – longitudinal section; K–N – *Usnea* aff. *silesiaca* (Rodriguez 4683); K – thallus; L – black and annulated base; M – detail of soralia on terminal branches; N – longitudinal section. Scales: A = 2.5 cm; B = 1 mm; C = 1 mm; D = 0.3 mm; E = 5 cm; F = 1 mm; G = 1.7 mm; H = 3 cm; I = 0.5 mm; J = 0.1 mm; K = 2.5 cm; L = 1 cm; M = 2 mm; N = 3 mm.


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Usnea aff. ***silesiaca*** (Fig. 4K–N)

Diagnostic characters. Thallus subpendulous to shrubby, up to 10 cm long, yellowish – green, sometimes slightly pruinose (Fig. 4K); ramifications anisotomic dichotomous; trunk and basal part of main branches jet black sometimes with reddish pigment, with numerous and conspicuous annular cracks extending upwards (Fig. 4L); branches cylindrical or tapering; secondary branches not narrowed at attachment points; segments cylindrical and terete in transverse section; papillae present, verrucous, mainly on main branches; fibrils slender, frequently in a fish-bone pattern, up to 5 mm; soralia variable: initially punctiform then rounded to irregular, planar to concave, larger than half of the diameter of the branch, remaining discrete, sometimes confluent (Fig. 4M); isidiomorphs rare, generally absent on mature soralia; cortex matte to ± glossy, thick 10.7–*12.9*–15.2%; medulla white, compact to dense, very thin 4.4–*12.3*–16.2%; axis thick 39.8–*49.1*–61.7% (Fig. 4N).

Chemistry. K–, TLC: usnic acid.

Ecology. This species has been found growing on *P. australis* and rarely on *M. boaria* or fences.

Notes. *Usnea* aff. *silesiaca* is very similar to *Usnea silesiaca* (Clerc 1991, 2006, 2007) sharing the extended black pigment and anulate base, the CMA value and the morphology of branches and segments. Also the variation of soralia characteristics is in the range of *U. silesiaca*. However, the chemistry of *Usnea* aff. *silesiaca* without medullary compounds has not been observed previously in *U. silesiaca* and the medulla is compact to dense. Also there are specimens with a red tinge when the black pigmentation finishes in the first mm of main branches. For all these reasons, up to the moment, *Usnea silesiaca* cannot be confirmed in South America and more studies are needed to confirm the identity of *Usnea* aff. *silesiaca*. This species is similar to *U. columbiana*, a common subpendulous (to pendulous) species with an extended jet black base and thick cortex. However, *U. columbiana* possesses tuberculate soralia, tubercles and salazinic acid.

Selected specimens examined. ARGENTINA. Córdoba, Parque Nacional Quebrada del Condorito, 2064 m, 31°42′59.3″S, 64°46′16.1″W, on *Polylepis australis*, 17 Sep. 2016, Rodriguez & Perazzo 4683 (CORD). *Ibid*., 1791 m, 31°39′36.5″S, 64°42′11.0″W, on *Polylepis australis*, 21 Dec. 2018, Rodriguez 4684 (CORD).

Tetramelas triphragmioides (Anzi) A. Nordin & Tibell, The Lichenologist 37(6): 497. 2005. (Fig. 5A–C)

For a detailed description see Bungartz et al. (2007) as *Buellia triphragmioides* Anzi.

Diagnostic characters. Thallus crustose, continuous to granulose, pale yellow (Fig. 5A); apothecia frequent, lecideine, abundant, 0.2–1 mm in diam., sessile; disc black, sometimes slightly pruinose , flat to convex, margin conspicuous and excluded when mature; ascospores brown, 3–septate, ellipsoid to curved (Fig. 5B–C), 17.1–20.4 × 7.0–8.5 µm.

Chemistry. K–, C+ orange, UV+ orange; TLC: arthothelin.

Notes. This species is very notable because of the pale yellow color. *Cratiria lauricassiae* is another common buellioid species with triseptate spores in *Polylepis* forests. However, the thallus is green, K+ yellow-orange, because of the presence of norstictic acid and UV–.

Distribution and ecology. *Tetramelas triphragmioides* is known from Europe, Asia and North America (Bungartz et al. 2007). This is the first mention in South America. It grows on wood of *P. australis*.

Selected specimens examined. ARGENTINA. Córdoba. Parque Nacional Quebrada del Condorito, seccional Condorito, 2020 m, 31°42′30.8″S, 64°05′20.9″W, on *Polylepis australis*, 15 Feb. 2019, Rodriguez, Díaz Dominguez & Estrabou 4641 (CORD). *Ibid*., 1841 m, 31°45′54.3″S, 64°45′07.4″W, 29 Jan. 2019, Rodriguez 4673 (CORD).

New records from central Argentina

Amandinea punctata (Hoffm.) Coppins & Scheid., The Lichenologist 25(4): 343. 1993. (Fig. 5D–F)

For a detailed description see Bungartz et al. (2007) as *Buellia punctata* (Hoffm.) A.Massal.

Diagnostic characters. Thallus crustose, rimose, continuous, pale gray (Fig. 5D); apothecia frequent, lecideine, abundant, 0.2–0.4 mm in diam., sessile; disc black, flat to convex, margin soon excluded; ascospores brown, 1-septate, ellipsoid to slightly curved (Fig. 5E–F), 10.4–12.9 × 3.9–6.2 µm.

Chemistry. K–, C–; there are no substances detected by TLC.

Distribution and ecology. *Amandinea punctata* is a very common and widespread species (Bungartz et al. 2007). It has been cited for Argentina in Patagonia (Calvelo & Liberatore 2002). In *Polylepis* forests, it is corticolous growing on trees, shrubs, fences or wood.

Selected specimen examined. ARGENTINA. Córdoba, Parque Nacional Quebrada del Condorito, 2090 m, 31°44′25.5″S, 64°47′56.3″W, 27 Dec. 2018, Rodriguez 4654 (CORD).

Cratiria lauricassiae (Fée) Marbach, Bibliotheca Lichenologica 74: 160. 2000. (Fig. 5G–I).

For a detailed description see Nordin (2001) as *Buellia lauricassiae* (Fée) Müll. Arg.

Diagnostic characters. Thallus crustose, verruculose, continuous, greenish gray (Fig. 5G); apothecia frequent, lecideine, crowded in central part of the thallus, 0.2–0.4 mm in diam., sessile; disc black, flat, margin persistent; ascospores brown, 3–septate (Fig. 5H–I), 17.7–20.6 × 5.8–8.9 µm.

Chemistry. K+ yellow – red, C–; TLC: atranorin and norstictic acid (Nordin 2001). For differences with *Tetramelas triphragmioides* see under this species.

Distribution and ecology. *Cratiria lauricassiae* is a pantropical species occurring in Asia, Australia, North

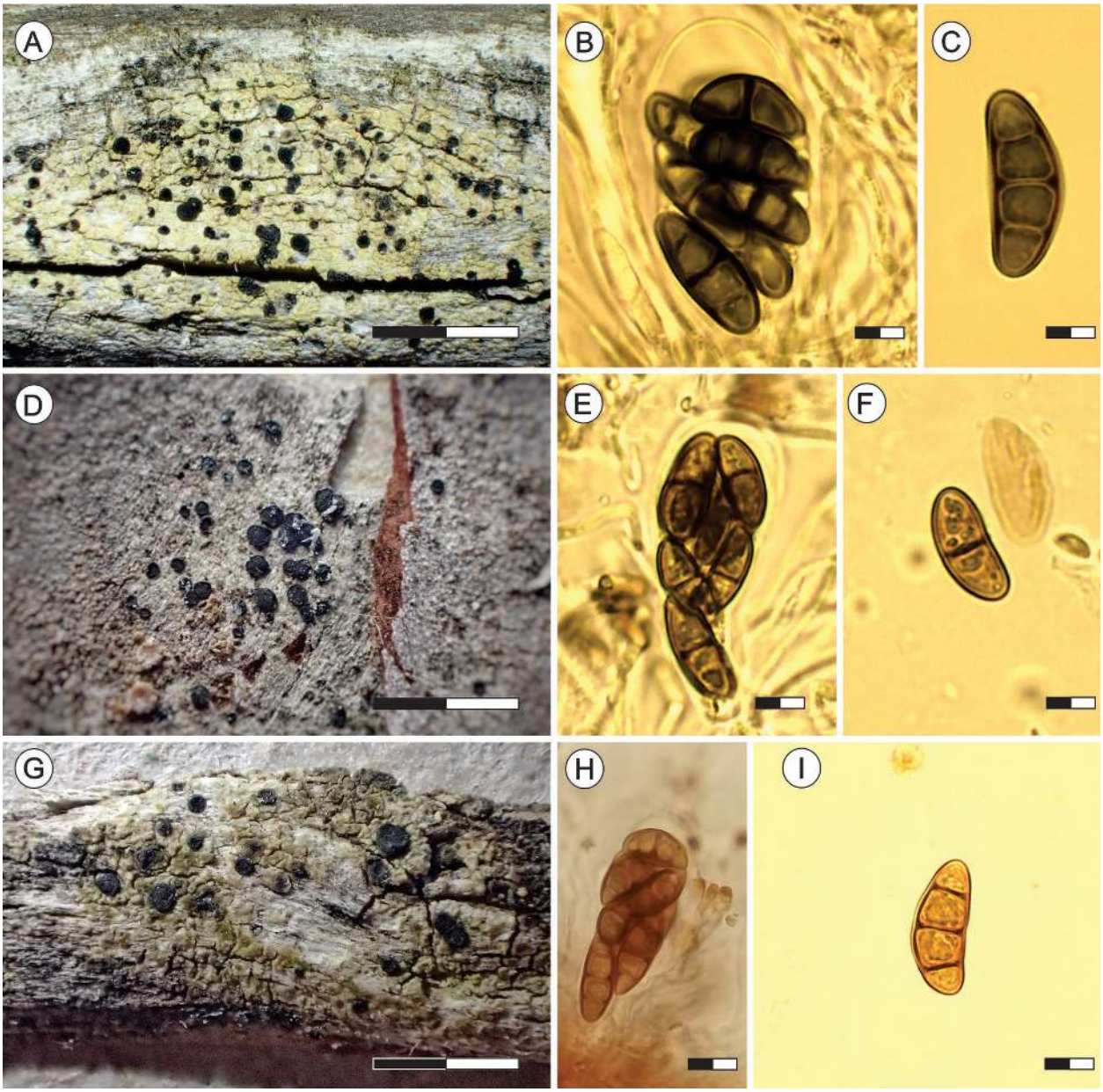


Figure 5. New crustose lichens for Argentina and Central Argentina. A–C – *Tetramelas triphragmioides* (Rodriguez, Díaz Dominguez & Estrabou 4641); A – thallus; B – ascospores in ascus; C – 3-septate brown ascospore; D–F – *Amandinea punctata* (Rodriguez 4654); D – Thallus; E – ascospores in ascus; F – 1-septate brown ascospore; G–I – *Cratiria lauricassiae* (Rodriguez 4090, 4094); G – thallus; H – ascospores in ascus; I – 3-septate brown ascospore. Scales: A = 10 mm; B = 19 µm; C = 8 µm; D = 3.6 mm; E = 15 µm; F = 6.7 µm; G = 1.5 mm; H = 15 µm, I = 8 µm.

and South America (Nordin 1999; Cáceres 2007; Elix 2011). It has been cited for the Northeast of Argentina as *Buellia lauricassiae* by Osorio & Ferraro (1975). To the best of our knowledge, this is the southernmost record for South America. This species has been collected on shrubs and trees of *Polylepis* and other woody plants.

Selected specimen examined. ARGENTINA. Córdoba, Parque Nacional Quebrada del Condorito, 2020 m, 31°42′45.78″S, 64°46′36.87″W, on shrubs, 15 Jan. 2017, Rodriguez 4090, 4094 (CORD).

Hypotrachyna sinuosa (Sm.) Hale, Smithsonian Contributions to Botany 25: 63. 1975. (Fig. 6A–B)

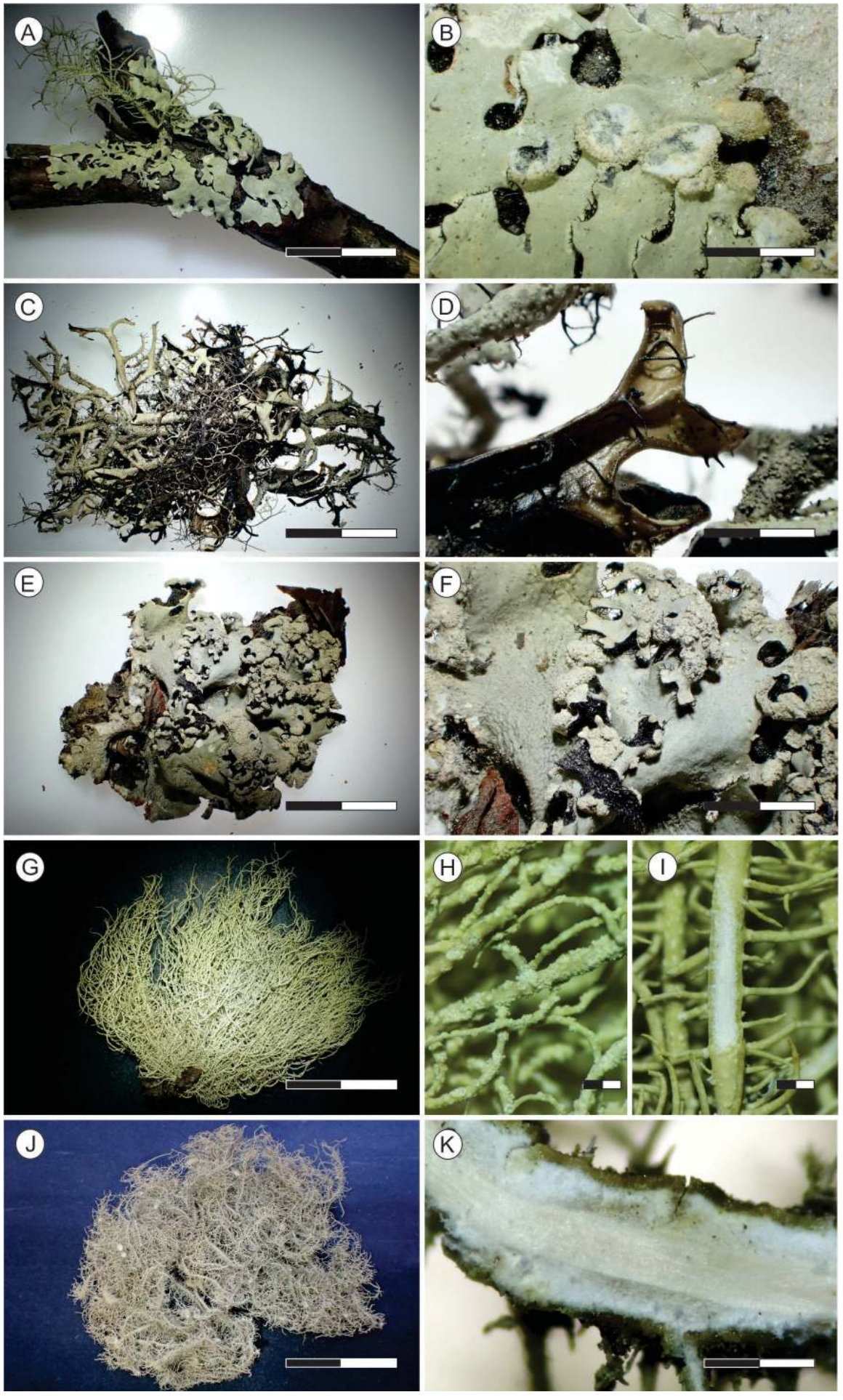
For a detailed description see Adler & Calvelo (2007).

Diagnostic characters. Thallus foliose, green yellowish, lobes eciliate (Fig. 6A); lower surface black, rhizines dense, dicotomous, black; soralia subterminal, capitate to orbicular (Fig. 6B); apothecia not seen.

Chemistry. Cortex K–, medulla K+ yellow to red; TLC: usnic, norstictic and salazinic acids.

Distribution and ecology. This species is widely distributed in the world mainly in temperate areas (Adler & Calvelo 2007). In Argentina, it is common for Patagonia (Adler & Calvelo 2007). *Hypotrachyna sinuosa* has been found growing on *Polylepis* and twigs of other shrubs.

Selected specimen examined. ARGENTINA. Córdoba, Parque Nacional Quebrada del Condorito, 1827 m, 31°45′52.4″S, 64°45′38″W, on *Polylepis australis*, 29 Jan. 2019, Rodriguez 4689 (CORD).


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Hypotrachyna vexans (Zahlbr. ex W.L. Culb. & C.F. Culb.) Divakar, A. Crespo, Sipman, Elix & Lumbsch, in Divakar, Crespo, Núñez-Zapata, Flakus, Sipman, Elix & Lumbsch, Phytotaxa 132(1): 33. 2013. (Fig. 6C–D)

For a detailed description see Calvelo & Estrabou (1997) as *Everniastrum vexans*.

Diagnostic characters. Thallus foliose, lobes linear, up to 4 cm long., subdichotomously branched, up to 3 mm wide (Fig. 6C); underside black, brown to beige through the lobes apices (Fig. 6D); rhizines black, simple or branched, up to 2 mm isidia laminal, frequently branched, with an apical black cilia.

Chemistry. Cortex K+ yellow, medula K+ yellow – red, C–; TLC: atranorin and salazinic acid.

Notes. The presence of isidia and the type of rhizines separate *Hypotrachyna vexans* from *H. americana*, a very common species in *Polylepis* forests that possesses coacervate rhizines and no isidia or soredia (Calvelo & Estrabou 1997).

Distribution and ecology. *Hypotrachyna vexans* has been recorded from Asia, North America and South America: Argentina, Brazil, Ecuador and Venezuela (Calvelo & Estrabou 1997; Spielmann 2006). Previously, it has been recorded from northwest Argentina as *Everniastrum vexans* (Calvelo & Estrabou 1997). It is rare in the *Polylepis* forest.

Specimen examined. ARGENTINA. Córdoba, Los Cajones, en parches de bosque, on *Polylepis australis*, 05 Jan. 2017, Rodriguez 4694 (CORD).

Leptogium brebissonii Mont., Histoire naturelle des Iles Canaries 3: 130. 1840. (Fig. 7A–B)

For a detailed description see Galloway & Jørgensen (1995).

Diagnostic characters. Thallus dark laden-green, lobate, thin and papery when dry (Fig. 7A), conspicuously swelling when wet; lobes poorly developed, irregularly branched, complexly ridged-plicate, isidiate; isidia marginal or laminal on ridges, granular and small (Fig. 7B); apothecia not seen.

Distribution and ecology. A widespread species, found in western Europe, North America and New Zealand (Galloway & Jørgensen 1995). In Argentina, previously cited from northeast provinces (Calvelo & Liberatore 2002). It occurs in shaded places, growing among mosses.

Selected specimen examined. ARGENTINA. Córdoba, El Hueco, 1865 m, 31°58′12.8″S, 64°56′54.6″W, 19 Oct. 2018, Rodriguez 4695 (CORD).

Leptogium cyanescens (Ach.) Körb., Systema lichenum Germaniae: 420. 1855. (Fig. 7C)

For a detailed description see Galloway & Jørgensen (1995).

Diagnostic characters. Thallus lobate, flat, loosely attached to substrate, pale to dark gray; lobes orbicular, irregularly folded, wavy, more or less ascending; upper surface slightly roughened, isidiate; isidia laminal or marginal, granular to cylindrical; lower surface glabrous; apothecia rare, circular, disc orange, margin thin.

Distribution and ecology. The species is widespread globally, especially in temperate and subtropical regions. In Argentina, it has been cited for Buenos Aires and Patagonia (Calvelo & Liberatore 2002). *Leptogium cyanescens* grows on bark, rarely on stone and it is very common in *Polylepis* forests.

Selected specimen examined. ARGENTINA. Córdoba, El Hueco, 1865 m, 31°58′12.8″S, 64°56′54.6″W, 19 Oct. 2018, Rodriguez 4697 (CORD).

Leptogium laceroides B. de Lesd., Annales de Cryptogamie Exotique 6: 112. 1933. (Fig. 7D)

For a detailed description see Galloway & Jørgensen (1995).

Diagnostic characters. Thallus involute to flat, greyish-blue to brownish, loosely attached; lobes irregular, rather fragile, elongate-flabellate; margins usually ragged, crisped, and profusely isidiate; upper surface smooth, sometimes with whitish patches of short hairs; isidia terete, styliform, simple to coralloid, then lobulate-phyllidiate; lower surface minutely white pubescent; apothecia not seen.

Distribution and ecology. The species has been previously recorded for Patagonia (Calvelo & Liberatore, 2002). It has been found on the bark of *Polylepis*.

Specimen examined. ARGENTINA. Córdoba, Parque Nacional Quebrada del Condorito, 2123 m, 31°39′56.8″S, 64°42′0,6″W, 14 Nov. 2018, Rodriguez 4698 (CORD).

Leptogium phyllocarpum (Pers.) Mont., Annales des Sciences Naturelles Botanique 10: 134. 1848. (Fig. 7E)

For a detailed description see Galloway & Jørgensen (1995)

Diagnostic characters. Thallus subpulvinated, swelling with wet, loosely adnate, pale to dark gray; lobes oblong, anastomosing, with undulating margins; uppers surface with numerous prominent wrinkles or outgrowths; lower surface paler, also wrinkled, without hairs; apothecia submarginal to laminal, short pedicelate to sessile, with thick swelling margins.

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Figure 6. New *Parmeliaceae* for Central Argentina. A–B – *Hypotrachyna sinuosa* (Rodriguez 4689); A – thallus; B – marginal soralia; C–D – *Hypotrachyna vexans* (Rodriguez 4694); C – thallus; D – rhizines and lower surface and isidia on upper side; E–F – *Parmelinopsis swinscowii* (Rodriguez 4688); E – thallus; F – soralia subterminal; G–I – *Usnea igniaria* (Rodriguez & Perazzo 4701); G – thallus; H – soralia; I – longitudinal section; J–K – *Usnea subelegans* (Rodriguez & Perazzo 4700); J – thallus; K – longitudinal section. Scales: A = 2.5 cm; B = 0.5 mm; C = 2 cm; D = 6 mm; E = 2 cm; F = 3 mm; G = 3 cm; H, I = 0.5 mm; J = 5 cm; K = 1 mm.

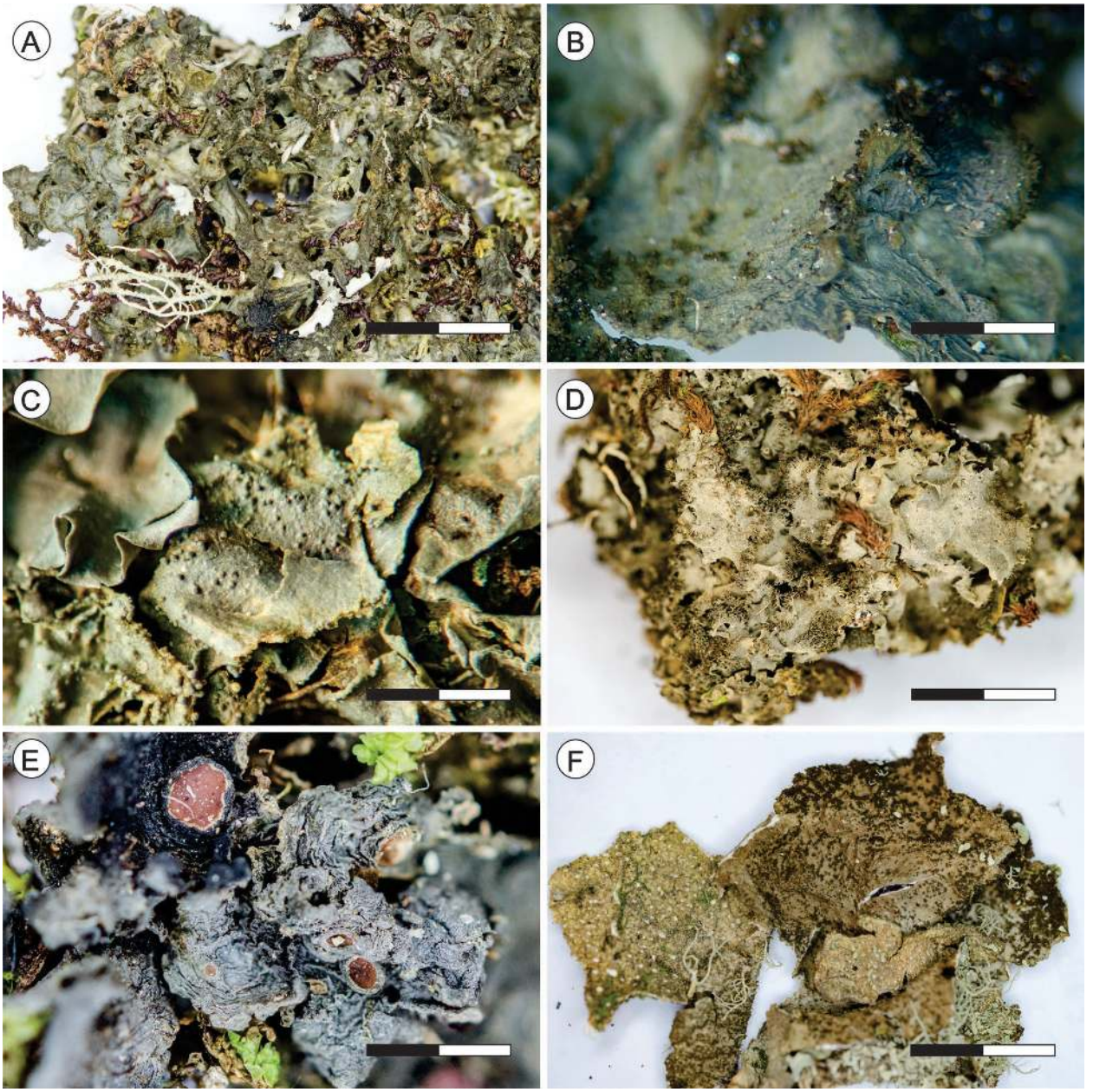


Figure 7. New *Leptogium* and *Sticta* records for Central Argentina. A–B – *Leptogium brebissonii* (Rodriguez 4695); A – general aspect; B – detail of isidia; C – isidiate upper surface of *Leptogium cyanescens* (Rodriguez 4697); D – general aspect of *Leptogium laceroides* (Rodriguez 4698); E – general aspect of *Leptogium phyllocarpon* (Rodriguez 4696); F – general aspect of *Sticta fuliginosa,* left fragment showing cyphelae on underside (Rodriguez 4699). Scales. A, F = 1.5 cm; B, C = 0.5 mm; D = 4 mm; E = 5 mm.

Distribution and ecology. It has been recorded in different regions of Argentina, probably a widely distributed species (Calvelo & Liberatore 2002). This species is very common on *Polylepis* forest and it grows on bark and stone under the canopy.

Selected specimen examined. ARGENTINA. Córdoba, El Hueco, 1900 m, 31°58′16.6′′S, 64°56′44,7″W, Rodriguez 4696 (CORD).

Parmelinopsis swinscowii (Hale) Elix & Hale, Mycotaxon 29: 243. 1987. (Fig. 6E–F)

For a detailed description see Adler & Calvelo (1993).

Diagnostic characters. Thallus foliose, grey, lobes subdichotomously branched, up to 3 mm wide (Fig. 6E); marginal cilia present up to 0.3 mm long; soralia subterminal to terminal, enlarging through the lamina (Fig. 6F); lower side black, rhizines simple, apothecia not seen.

Chemistry. Cortex K–, medulla K+ yellow to red, TLC: usnic, salazinic and lobaric (trace) acids.

Distribution and ecology. It is known from Africa, New Zealand and southern Argentina (Benatti 2012; Elvebakk et al. 2014). *Parmelinopsis swinscowii* has been described growing on stone or soil (Adler & Calvelo 1993). However, it has been found on the bark in *Polylepis* forests.

Specimen examined. ARGENTINA. Córdoba. Los Gigantes, 2088 m, 31°24′17.0″S, 64°48′29.4″W, on *Polylepis australis*, 22 Sep. 2018, Rodriguez 4688 (CORD).

Sticta fuliginosa (Dicks.) Ach., Methodus Lichenum: 280. 1803. (Fig. 7F)

For a detailed description see Galloway (1994).

Diagnostic characters. Thallus foliose, submonophilous, more or less orbicular, centrally attached to substratum, dark brown to ochraceous; lobes wide, upper surface irregular, covered by small globose to coralloid isidia; lower surface cream-whitish, covered by fine tomentum, with broad white cyphellae; apothecia very rare, not seen.

Distribution and ecology. The species is a cosmopolitan species. In Argentina, it is widely distributed (Rodriguez et al. 2016). It is usually found growing on bark or covered stones, in more or less exposed places.

Selected specimens examined. ARGENTINA. Córdoba, Parque Nacional Quebrada del Condorito, 2127 m, 31°44′21.6″S, 64°48′03.4″W, on stone, 26 Dec. 2018, Rodriguez 4699 (CORD).

Usnea igniaria Motyka, Lichenum Generis *Usnea* Studium Monographicum. Pars Systematica 1: 108. 1936. (Fig. 6G–I).

Diagnostic characters. Thallus shrubby, caespitous, up to 5 cm (Fig. 6G), yellowish-green; branches irregular; secondary branches not constricted at ramification point, terminal branches long and sinuous, segments cylindrical to slightly inflated and irregular to terete; fibrils scarce; papillae scarce to numerous, foveolae present, sometimes numerous; soralia originate from the cortex ad initio, irregular, plane to slightly excavate, isolated to partially confluent (Fig. 6H); isidiomorphs rare; cortex moderately thin 4.6–*7.1*–10.3%; medulla moderately thin 18.4–*23.9*–27.7% lax; central axis moderately thick 31.3–38.*0*–48.1%, (Fig. 6I).

Chemistry. K–, C–, KC–; TLC: usnic or usnic and psoromic acids.

Distribution and ecology. This species is common in Patagonia (Calvelo & Liberatore 2002). However, it presents a wider distribution in Argentina (unpubl. data). It is corticolous and very common on shrubs or fences.

Selected specimen examined. ARGENTINA. Córdoba. Parque Nacional Quebrada del Condorito, seccional Condorito, 31°44′42.6″S, 64°46′49.7″W, 2052 m, on shrubs, Oct. 2016, Rodriguez & Perazzo 4701 (CORD).

Usnea subelegans **(**Vain.) Motyka, Annales de Cryptogamie Exotique 6: 122. 1933. (Fig. 6J–K)

For a detailed description see Clerc (2007).

Diagnostic characters. Thallus shrubby to subpendulous, up to 8 cm, yellowish-green (Fig. 6J); branches cylindrical, secondary branches not constricted to slightly constricted at ramification point, segments cylindrical and terete; fibrils dense, spinulous, up to 3 mm long.; apothecia frequent lateral; ascospores ellipsoid 6.4–9.6 × 3.2–6.4 µm; cortex thin and shiny 3.6–*6.7*–10.9%; medulla moderately thin 10.3–*24.1*–31.1% lax to dense; central axis moderately thin, 11.5–*38.3*–68.8%. (Fig. 6K).

Chemistry. K+ yellow turning orange to red, C–, KC–, TLC: usnic, norstictic, galbinic and salazinic acids.

Distribution and ecology. *Usnea subelegans* is widespread from Mexico to Argentina (Gerlach et al. 2017). It is a very common apotheciate species widely distributed in Central and North Argentina (unpubl. data). It grows on *Polylepis*, several shrubs and fences.

Selected specimen examined. ARGENTINA. Córdoba. Parque Nacional Quebrada del Condorito, seccional Condorito, 31°44′42.6″S, 64°46′49.7″W, 2052 m, on shrubs, Oct. 2016, Rodriguez & Perazzo 4700 (CORD).

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