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A new species of the lichen genus *Parmotrema* from Argentina (Parmeliaceae, Ascomycota)

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Abstract

A new *Parmotrema* species, *P. pseudoexquisitum,* was found in *Araucaria angustifolia* forests in northeastern Argentina. It is characterized by a coriaceous thallus with very sparsely ciliate lobes, strictly marginal soralia with farinose to subgranular soredia, a white medulla and containing conalectoronic and subalectoronic acids in addition to alectoronic and α-collatolic acids. It is closely related to *P. exquisitum*, which differs in lacking marginal cilia, in having submarginal to laminal soralia with farinose soredia, and its medullar chemistry. This new species is described and illustrated in this paper. Comparisons with other sorediate *Parmotrema* species with medullary alectoronic acid are included.

Keywords: *Araucaria angustifolia* forests, lichens, *Parmotrema exquisitum*, *Parmotrema rampoddense,* protected areas

Resumen

Una nueva especie de *Parmotrema*, *P. pseudoexquisitum*, fue encontrada en los bosques de *Araucaria angustifolia* en el nordeste de Argentina. Se caracteriza por presentar el talo coriáceo con lóbulos muy escasamente ciliados, soralios estrictamente marginales con soredios farinosos a subgranulares, médula blanca con ácidos conalectorónico y subalectorónico además de ácidos alectorónico y α-colatólico. *Parmotrema pseudoexquisitum* está estrechamente relacionada con *P. exquisitum*, de la que se diferencia por ausencia de cilios marginales, presencia de soralios marginales a laminales con soredios farinosos y la química medular. Esta nueva especie se describe e ilustra en este trabajo. Se incluyen comparaciones con otras especies sorediadas de *Parmotrema* con ácido alectorónico medular.

Palabras clave: áreas protegidas, bosques de *Araucaria angustifolia*, líquenes, *Parmotrema exquisitum*, *Parmotrema rampoddense*

Introduction

Parmotrema A. Massalongo (1860: 248), according to its latest circumscription (Blanco *et al.* 2005, Crespo *et al.* 2010), is characterized by an upper cortex of palisade plectenchyma or paraplectenchyma with vaults, a pored epicortex, the lack of pseudocyphellae, the presence or absence of cilia, laminal perforate or imperforate apothecia, ellipsoid ascospores, and filiform, cylindrical, bacilliform or sublageniform conidia. It is one of the larger genera in the Parmeliaceae with approximately 350 species with a distribution centred in the tropical regions of the world, especially in the Pacific Islands and South America (Blanco *et al.* 2005). Species of *Parmotrema* are common in Argentina where a total of 45 species have so far been recorded (Adler & Calvelo 2007a–b, 2010; Calvelo & Liberatore 2002; Estrabou *et al.* 2006, Ferraro 1981, Michlig & Ferraro 2010, 2012a–b; Popoff & Ferraro 2002). Although well represented in the country, the present knowledge of the genus is rather patchy since the lichen biota is virtually unexplored in some regions.

Following an intensive investigation of the Parmeliaceae from northeastern Argentina over the last seven years, a new sorediate species of *Parmotrema* was discovered and is described and illustrated in this paper.

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Material and methods

The species described in this paper was found in surroundings of San Antonio Natural Strict Reserve, a national protected area created to preserve native *Araucaria angustifolia* (Bertoloni 1819: 411) Kuntze (1898: 375) forests in Argentina which are confined to a very restricted area at the eastern perimeter of Misiones province. Its distribution is extended to adjacent regions in southern-eastern Brazil and it may also be found in eastern Paraguay (De Meijer 2008). These forests constitute one of the fifteen ecoregions of the Atlantic Forest (Di Bitetti *et al.* 2003), which has been considered one of the biodiversity hotspots by Conservation International (Myers *et al.* 2000), and also identified as one of the "Global 200" ecoregions by WWF (Olson & Dinerstein 2002).

The material studied was deposited in the CTES herbarium. Additional type specimens of related species from TNS were also studied. The morphological analysis was carried out based on observations of macroscopic and microscopic characters using stereoscopic and light microscopes (Leica MZ6 and Leica CME respectively). Pycnidia were sectioned by hand with a razor blade and then mounted in 5% KOH and 1% phloxine for examination.

The identification of lichen substances was made with spots tests with 10% KOH (K), sodium hypochlorite (C), and K followed by C (KC), UV fluorescence, thin layer chromatography (TLC) with solvent C, high performance liquid chromatography (Elix *et al.* 2003) and by comparison with authentic samples according to Culberson (1972), Culberson & Kristinsson (1970), Culberson & Ammann (1979), Orange *et al.* (2010), and White & James (1985).

Taxonomic treatment

Parmotrema pseudoexquisitum Michlig, Elix & L. I. Ferraro, *spec. nov.* (Fig. 1) Mycobank MB805955

Thallus as in *Parmotrema exquisitum*, but differing in having strictly marginal soralia and in containing additional conalectoronic and subalectoronic acids in the medulla.

Type:—ARGENTINA. Misiones: General Manuel Belgrano, San Antonio Natural Strict Reserve surroundings, in INTA's property, 26º 2' 14.2'' S 53º 47' 24.8'' W, elev. 526 m, in *Araucaria angustifolia* plantation, 29 May 2009, *A. Michlig & N. Niveiro* 2046 (holotype, CTES!).

Thallus foliose, mineral grey, corticolous, loosely attached to substrate, coriaceous, up to 18 cm in diameter; lobes subirregular, irregularly branched, 3–9 mm wide, slightly imbricate, with rounded apices; margin entire to crenate, rarely ciliate; cilia very sparse, simple or bifurcate, 0.7–1.4 mm long. *Upper surface* shiny, rugose in most part of the thallus, irregularly cracked towards the center, emaculate to slightly irregularly maculate. *Soralia* present, marginal, linear irregular; soredia farinose to subgranular. *Isidia, pustulae* and *dactyls* absent. *Medulla* white. *Lower surface* black, smooth to rugose, shiny, sparsely rhizinate, with a broad, erhizinate marginal zone, and a relatively narrow pale brown margin, smooth, shiny; rhizines black, simple to irregularly branched, sparse, distributed in scattered groups. *Apothecia* absent. *Pycnidia* present, submarginal, ostiole black; conidia not seen.

Chemistry:—Cortex K+ yellow, UV–; medulla K+ yellow, C+ pale orange, KC+ rose, UV+ bluish white [atranorin (minor), chloroatranorin (minor), α-collatolic acid (trace), alectoronic acid (major), conalectoronic acid (minor), subalectoronic acid (minor), det. J. A. Elix (2011)].

Etymology:—The epithet refers to its close similarity to *P. exquisitum*.

Distribution:—It is a rare species, currently known only from the type locality.

Discussion

Parmotrema pseudoexquisitum is characterized by its large, coriaceous, loosely adnate thallus (Fig. 1a), with lobes very sparsely ciliate (only 3–4 cilia) (Fig. 1b, c), non-pustular marginal soralia (Fig. 1b, d), and a white medulla with conalectoronic and subalectoronic acids in addition to alectoronic and α-collatolic acids. The medullary reactions (K+ yellow, C+ pale orange, KC+ rose) differ from the typical reactions for the alectoronic acid (KC+ orange) due to the additional conalectoronic and subalectoronic acids, which have not previously been described nor their structures determined.

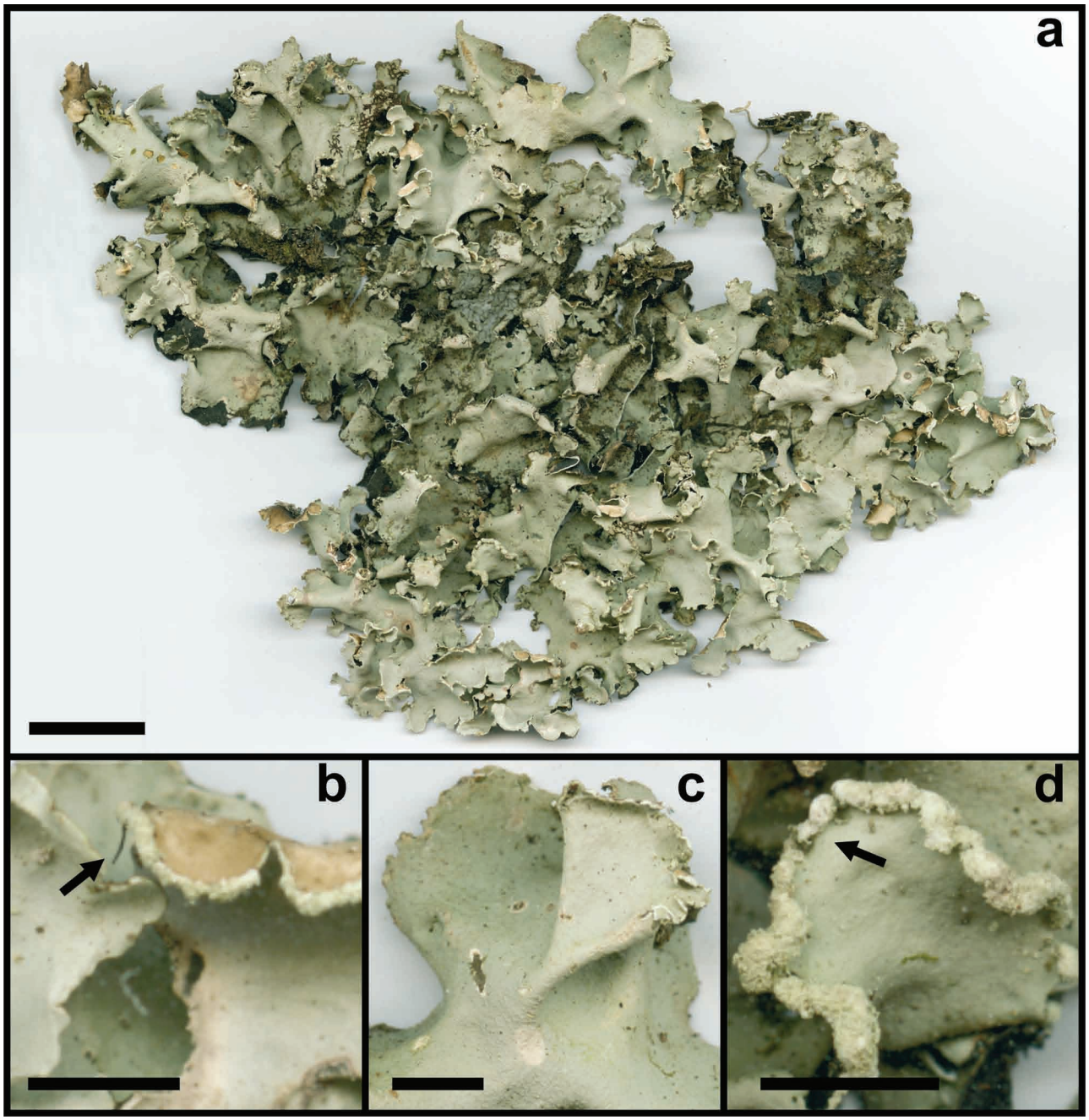

FIGURE 1. *Parmotrema pseudoexquisitum* (holotype, CTES) **A.** Complete thallus; **B.** Sorediate lobe margin with a cilia (arrow); **C.** Lobe with a nonsorediate and eciliate margin; **D.** Lobe showing the marginal soralia (arrow). Scale bars: **A=** 2 cm, **B=** 2.5 mm, **C**–**D=** 5 mm.

Other sorediate *Parmotrema* species with alectoronic and α-collatolic acids in the medulla include *P. exquisitum* (Kurokawa 1987: 11) DePriest & B. W. Hale (1998: 204), *P. poolii* (C. W. Dodge 1959: 146) Krog & Swinscow (1983: 130), *P. rampoddense* (W. Nylander 1900: 6) Hale (1974: 338), *P. arnoldii* (Du Rietz 1924: 80) Hale (1974: 335), and *P. louisianae* (Hale 1971: 92) Hale (1974: 337). All of them differ chemically as they lack conalectoronic and subalectoronic acids.

Parmotrema exquisitum (holotype, TNS!) seems to be the most closely related species to *P. pseudoexquisitum*. It is characterized by the absence of marginal cilia, an emaculate to slightly irregularly maculate upper surface with irregular cracks extending to the margin, and submarginal to laminal soralia with farinose soredia. The laminal soralia in *P. exquisitum* are abundant, differing of those in *P. pseudoexquisitum* which are strictly marginal. The shape and size of the conidia were not mentioned in the original description. The holotype was re-examined and found to have submarginal pycnidia, but no conidia were found. It is a rare species, known only from Uruguay (Kurokawa 1987) and Taiwan (Kurokawa & Lai 2001). Kurokawa & Lai (2001) mentioned that *P. exquisitum* may also have marginal soralia, but the chemical reactions are those typical of alectoronic acid, and clearly different from *P. pseudoexquisitum*.

Parmotrema rampoddense has ciliate lobes, marginal to submarginal soralia, and bacilliform to filiform conidia, 5–9 µm long (Spielmann & Marcelli 2009). According to Elix (1994) the cilia in this species are moderately dense to dense and the conidia are bacilliform, 5–6 µm long. According to Krog & Swinscow (1981) lobes are involute and the laminal soralia abundant; this latter character was not observed in the material studied. According to Kurokawa (1987), the cilia are conspicuous in all specimens of *P. rampoddense*, differing from *P. pseudoexquisitum*, where the cilia are very sparse. Although *Parmotrema rampoddense* is a pantropical species (Kurokawa & Lai 2001) and considered to be widely distributed, is not common in Argentina, with only three specimens recorded, from Salta (Adler & Calvelo 2007a), Tucumán (Adler & Calvelo 2010), and Misiones provinces (Osorio 1981).

In *P. arnoldii* the thallus is membranaceous, with dentate marginal ciliate laciniae, submarginal soralia developing mostly on the laciniae, and filiform conidia (Chen *et al.* 2005, Hale 1965). *Parmotrema poolii* is characterized by a loosely adnate, coriaceous thallus, lobes which are sparsely to moderately densely ciliate with marginal to rarely laminal soralia, and sublageniform conidia, 7–8 µm long (Elix 1994). In *P. louisianae* the soralia are submarginal and the lower surface black with an ivory to tan marginal zone (Chen *et al.* 2005).

Other similar sorediate species containing alectoronic acid include *P. lobulascens* (J. Steiner 1903: 234) Hale (1974: 337) and *P. pseudonilgherrense* (Asahina 1954: 370) Hale (1977: 441) (lectotype, TNS!), with a markedly maculate upper surface and conspicuously developed lobules (Kurokawa & Lai 2001). *Parmotrema lobulascens* also differs by containing minor quantities of gyrophoric acid in the medulla. Kurokawa & Lai (2001) and Krog & Swinscow (1981) consider *P. pseudonilgherrense* a synonym of *P. lobulascens*, although some authors consider them as separate species (Chen *et al.* 2005, Elix 1994). Both are distinctive ciliate species differing from *P. pseudoexquisitum*.

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References

Adler, M.T. & Calvelo, S. (2007a) Ampliación de las distribuciones de especies de Parmeliaceae (Ascomycota liquenizados) en la República Argentina. *Boletín de la Sociedad Argentina de Botánica* 42: 1–11.

Adler, M.T. & Calvelo, S. (2007b) *Flavoparmelia amplexa* and *F. springtonensis* (Parmeliaceae) new to the Americas and additions to the lichen flora of Argentina. *In*: Kärnefelt, I. & Thell, A. (Eds.) *Lichenological Contributions in Honour of David Galloway*. *Bibliotheca Lichenologica* 95: 121–129.

Adler, M.T. & Calvelo, S. (2010) *Flavoparmelia baltimorensis*, *Parmotrema yodae* y *Xanthoparmelia braziliensis*, primeras citas para Argentina y ampliación de distribuciones de otras Parmeliaceae (Ascomycota liquenizados). *Boletín de la Sociedad Argentina de Botánica* 45: 5–16.

Asahina, Y. (1954) Lichenologische Notizen (112–113). *The Journal of Japanese Botany* 29(12): 370–372.

Bertoloni, A. (1819) Piante del Brasile. *Opuscoli scientifici d'una Società di professori della Pontifical Università di Bologna* 3: 411–412.

Blanco, O., Crespo, A., Divakar, P.K., Elix, J.A. & Lumbsch, H.T. (2005) Molecular phylogeny of parmotremoid lichens (Ascomycota, Parmeliaceae). *Mycologia* 97: 150–159.
http://dx.doi.org/10.3852/mycologia.97.1.150

Calvelo, S. & Liberatore, S. (2002) Catálogo de los líquenes de la Argentina. *Kurtziana* 29(2): 7–170.

Chen, J.B., Wang, S.L. & Elix, J.A. (2005) Parmeliaceae (Ascomycota) lichens from China's Mainland III. The genus *Parmotrema*. *Mycotaxon* 91: 93–113.

Culberson, C.F. (1972) Improved conditions and new data for the identification of lichen products by standarized thin-layer chromatographic method. *Journal of Chromatography* 72: 113–125.
http://dx.doi.org/10.1016/0021-9673(72)80013-X

Culberson, C.F. & Kristinsson, K. (1970) A standarized method for the identification of lichen products. *Journal of Chromatography* 46: 85–93.
http://dx.doi.org/10.1016/S0021-9673(00)83967-9

Culberson, C.F. & Ammann, K. (1979) Standardmethode zur Dünnschicht-Chromatographie von Flechtensubstanzen. *Herzogia* 5: 1–24.

Crespo, A., Kauff, F., Divakar, P.K., del Prado, R., Pérez-Ortega, S., Amo de Paz, G., Ferencova, Z., Blanco, O., Roca-Valiente, B., Núñez-

Zapata, J., Cubas, P., Argüello, A., Elix, J.A., Esslinger, T.L., Hawksworth, D.L., Millanes, A., Molina, M.C., Wedin, M., Ahti, T., Aptroot, A., Barreno, E., Bungartz, F., Calvelo, S., Candan, M., Cole, M., Ertz, D., Goffinet, B., Lindblom, L., Lücking, R., Lutzoni, F., Mattsson, J.E., Messuti, M.I., Miadlikowska, J., Piercey-Normore, M., Rico, V.J., Sipman, H.J.M., Schmitt, I., Spribille, T., Thell, A., Thor, G., Upreti, D.K. & Lumbsch, H.T. (2010) Phylogenetic generic classification of parmelioid lichens (Parmeliaceae, Ascomycota) based on molecular, morphological and chemical evidence. *Taxon* 59: 1735–1753.

De Meijer, A.A.R. (2008) *Notable macrofungi from Brazil's Paraná Pine forests*. Embrapa Foresty, Colombo, PR, Brasil, 154 pp.

DePriest, P.T. & Hale, B.W. (1998) New combinations in parmelioid genera (Ascomycotina; Parmeliaceae). *Mycotaxon* 67: 201–206.

Di Bitetti, M.S., Placci, G. & Dietz, L.A. (2003) *Una visión de biodiversidad para la ecorregión del Bosque Atlántico del Alto Paraná: diseño de un paisaje para la conservación de la biodiversidad y prioridades para las acciones de conservación*. World Wildlife Fund, Washington, D. C., 431 pp.

Dodge, C.W. (1959) Some lichens of Tropical Africa, III, Parmeliaceae. *Annals of the Missouri Botanical Garden* 46: 39–193. http://dx.doi.org/10.2307/2394567

Du Rietz, G.E. (1924) Kritische bemerkungen über die *Parmelia perlata*-gruppe. *Nyt Magazin for Naturvidenskaberne* 62: 63–83.

Elix, J.A. (1994) *Parmotrema*. *Flora of Australia* 55: 140–162.

Elix, J.A., Giralt, M. & Wardlaw, J.H. (2003) New chloro-depsides from the lichen *Dimelaena radiata. Bibliotheca Lichenologica* 86: 1–7.

Estrabou, C., Rodriguez, J.M., Prieri, B. & Litjeroff, R. (2006) Contribución al conocimiento de los macrolíquenes del extremo Sur del Gran Chaco (Argentina). *Kurtziana* 32(1–2): 25–43.

Ferraro, L.I. (1981) Contribución al estudio de las Parmeliáceas (líquenes) de Corrientes, Rep. Argentina. *Bonplandia* 5(12): 83–99.

Hale, M.E. (1965) A Monograph of the *Parmelia* subgenus *Amphigymnia*. *Contributions from the United States National Herbarium* 36: 193–358.

Hale, M.E. (1974) New combinations in the lichen genus *Parmotrema* Massalongo. *Phytologia* 28: 334–339.

Hale, M.E. (1977) New species in the lichen genus *Parmotrema* Mass. *Mycotaxon* 5(2): 432–448.

Krog, H. & Swinscow, T.D.V. (1981) *Parmelia* subgenus *Amphigymnia* (lichens) in East Africa. *Bulletin of the British Museum (Natural History)* 9: 143–231.

Krog, H. & Swinscow, T.D.V. (1983) A new species and new combinations in *Parmotrema* (Parmeliaceae). *The Lichenologist* 15: 127–130. http://dx.doi.org/10.1017/s0024282983000195

Kurokawa, S. (1987) New or noteworthy species of *Parmelia*, subgenus *Amphigymnia* (Lichenes) producing alectoronic and α-collatolic acids. *Bulletin of the National Science Museum, Tokyo. Ser. B, Botany* 13: 11–15.

Kurokawa, S. & Lai, M.J. (2001) Parmelioid lichens genera and species in Taiwan. *Mycotaxon* 77: 225–284.

Kuntze, O. (1898) *Revisio Generum Plantarum* 3: 1–576.

Massalongo, A. (1860) Esame comparative di alcuni generi di licheni. *Atti dell´ Istituto Veneto di Scienze, Lettere ed Arti* 5(3): 247–276.

Michlig, A. & Ferraro, L.I. (2010) The first record of *Parmotrema pseudocrinitum* (Parmeliaceae, lichenized Ascomycota) in South America. *Mycotaxon* 112: 275–282. http://dx.doi.org/10.5248/112.275

Michlig, A. & Ferraro, L.I. (2012a) Diversidad de macrolíquenes del Parque Nacional Mburucuyá (Corrientes, Argentina). *Boletín de la Sociedad Argentina de Botánica* 47: 287–302.

Michlig, S.A. & Ferraro, L.I. (2012b) Nuevos registros de especies sorediadas de *Parmotrema* con ácido protocetrárico (Ascomycota, Parmeliaceae) en el sur de Sudamérica. *Darwiniana* 50: 323–331.

Myers, N., Mittermeier, R.A., Mittermeier, C.G., da Fonseca, G.A.B. & Kent, J. (2000) Biodiversity hotspots for conservation priorities. *Nature* 403: 853–858. http://dx.doi.org/10.1038/35002501

Nylander, W. (1900) Lichenes Ceylonenses et additamentum ad lichens Japoniae. *Acta Societatis Scientiarum Fennice* 26(10): 1–33.

Olson, D.M. & Dinerstein, E. (2002) The global 200: priority ecoregions for global conservation. *Annals of the Missouri Botanical Garden* 89: 199–224. http://dx.doi.org/10.2307/3298564

Orange, A., James, P.W. & White, F.J. (2010) *Microchemical methods for the identification of lichens*. British Lichen Society, London, 101 pp.

Osorio, H.S. (1981) Contribution to the lichen flora of Argentina XIII. Lichens from Misiones province. *Comunicaciones Botánicas del Museo de Historia Natural de Montevideo* 4(63): 1–18.

Popoff, O.F. & Ferraro, L.I. (2002) Hongos y Líquenes. *In*: Arbo, M.M. & Tressens, S.G. (Eds.) *Flora del Iberá*. EUDENE, Buenos Aires, Argentina, pp. 381–415.

Spielmann, A.A. & Marcelli, M.P. (2009) *Parmotrema s.l.* (Parmeliaceae, lichenized Ascomycota) from Serra Geral slopes in central Rio Grande do Sul State, Brazil. *Hoehnea* 36: 551–595. http://dx.doi.org/10.1590/s2236-89062009000400002

Steiner, J. (1903) *Fletchen von Kamerun und dem Kamerunberg (Fako), gesammelt von Alfred Bornmüller in den Jahren 1897 und 1898.* vol. 53., pp. 227–336.

White, F.J. & James, P.W. (1985) A new guide to microchemical techniques for the identification of the lichen substances. *British Lichen Society Bulletin* 57: 1–41.