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The first record of *Parmotrema pseudocrinitum* (*Parmeliaceae,* lichenized *Ascomycota*) in South America

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Abstract — *Parmotrema pseudocrinitum* is reported for the first time in South America, from northern Argentina. A description of this species and comparisons with related species are presented. A key to species of *Parmotrema* with ciliate isidia and maps of their distribution are included.

Key words — lichens, protected areas, *Parmotrema crinitum, Parmotrema mellissii, Parmotrema melanochaetum*

Introduction

Parmeliaceae is one of the largest families of lichen-forming fungi and has been the subject of much recent research, particularly studies to establish phylogenetic relationships among the parmelioid taxa based on both morphological and molecular data (Crespo et al. 1999, 2001; Divakar et al. 2005, Louwhoff & Crisp 2000, Molina et al. 2004).

Parmotrema A. Massal. is one of the larger genera in the *Parmeliaceae* with approximately 350 species and a center of distribution in the world's tropical regions. As circumscribed by Blanco et al. (2005) based on recent molecular studies, the genus 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.

As a result of research aimed at studying the species diversity of lichenized and non-lichenized fungi in protected areas in northern Argentina, *P. pseudocrinitum* was found for the first time in South America.

Materials and methods

The specimens studied were collected recently by the authors in two National Parks in northern Argentina and are preserved in CTES (Instituto de Botánica del Nordeste Herbarium).

The morphological analysis is based on observations of macroscopic and microscopic characters with stereoscopic and optical microscopes (Leica MZ6 and Olympus BX 50 respectively). Apothecia and pycnidia were cut by hand with a razor blade and then mounted in 5% KOH to study the ascospores and conidia. Measurements were made with objectives at 400 and 1000× magnification.

Chemical substances were identified using spot tests with 10% KOH (K), sodium hypochlorite (C), and K followed by C (KC), UV fluorescence, and Thin Layer Chromatography (TLC). TLC was carried out using solvents A and C according to the methodology proposed by Culberson (1972), Culberson & Kristinsson (1970), Culberson & Ammann (1979), and White & James (1985).

The distribution maps (Figs. E–G) are based on records found in the literature (Calvelo & Liberatore 2002, Chen et al. 2005, Elix 1994, Elix & Gremmen 2002, Eliasaro & Donha 2003, Jungbluth 2006, Hale 1965, 1976; Hale & Kurokawa 1965, Krog 1974, Krog & Swinscow 1981, Kurokawa & Lai 2001, Louwhoff & Elix 1998, 2002; Marcelli & Ribeiro 2002, Nagaoka & Marcelli 1989, Nash & Elix 2002, Osorio 1992, 1994; Osorio & Fleig 1988, 1990; Sipman et al. 2008).

Taxonomy

Key to *Parmotrema* species with ciliate isidia

1a. Medulla K– 2
1b. Medulla K+ persistently yellow (stictic acid present) or yellow turning red (salazinic acid present) 6
2a. Isidia frequently becoming sorediate; medulla UV+ bright blue-green, KC+ orange (alectoronic acid present) ..... ***P. mellissii***
2b. Isidia rarely or not becoming sorediate; medulla UV–, KC– or KC+ 3
3a. Medulla P+ red (protocetraric acid present) ..... ***P. subcorallinum***
3b. Medulla P– (protocetraric acid absent) 4
4a. Medulla C+ salmon pink, KC+ reddish (olivetoric acid present) ..... ***P. horridum***
4b. Medulla C+ rose, KC+ rose (gyrophoric acid present) 5
5a. Upper surface strongly to rather distinctly maculate; rhizines simple ..... ***P. melanochaetum***
5b. Upper surface emaculate to rarely slightly maculate; rhizines simple to irregularly branched ..... ***P. pseudocrinitum***
6a. Medulla K+ yellow turning red (salazinic acid present) 7
6b. Medulla K+ persistently yellow (stictic acid present) 8
7a. Medulla UV+ yellow (liquexanthone present) ..... ***P. ultralucens***
7b. Medulla UV– (liquexanthone absent) ..... ***P. neosubcrinitum***
8a. Medulla uniformly white, yellow-orange pigment absent ..... ***P. crinitum***
8b. Medulla mostly white, yellow-orange pigment (euplectin) present near lower surface ..... ***P. ochrocrinitum***

Parmotrema pseudocrinitum (Abbayes) Hale, Phytologia 28(4): 338 (1974)
≡ *Parmelia pseudocrinita* Abbayes, Bull. Inst. Fr. Afr. Noire, Sér. A, 20: 19 (1958)

Thallus foliose, mineral grey to grey green, corticolous, loosely to moderately attached to substrate, 4–15 cm in diameter; lobes rounded, (3–)5–10 mm wide, contiguous to partially imbricate, margin crenate, densely ciliate; cilia simple, occasionally furcate, (0.2–)0.4–1.3(–2) mm long, mostly present in the incisions of the margin, ascending. Upper surface smooth, rugose in some areas in the center of the thallus, rarely fissurate, emaculate to rarely slightly maculate, densely ciliate. Isidia laminal to occasionally marginal or submarginal, simple to coralloid, frequently with simple cilia, 0.2–1 mm long, or brown-tipped. Soralia absent. Pustulae absent. Medulla white; K+ purple pigment absent. Lower surface black, smooth to rugose, shiny, moderate to densely rhizinate, with a narrow, brown erhizinate marginal zone, smooth to rugose; rhizines black, long, generally simple, sometimes furcate. Apothecia absent or present, sparse, (0.6–)1.5–6 mm wide, thalline exciple moderately to densely isidiate, the isidia frequently ciliate, simple or branched; disc imperforate, pale to dark brown, epruinose, ±rugose; mature ascospores not seen. Pycnidia rarely present, sparse, submarginal; conidia filiform, (6.6–)7–9.3(–13.28) µm.

Chemistry — Cortex K+ yellow, UV– (atranorin); medulla K–, C+ rose, KC+ rose, UV– (gyrophoric acid).

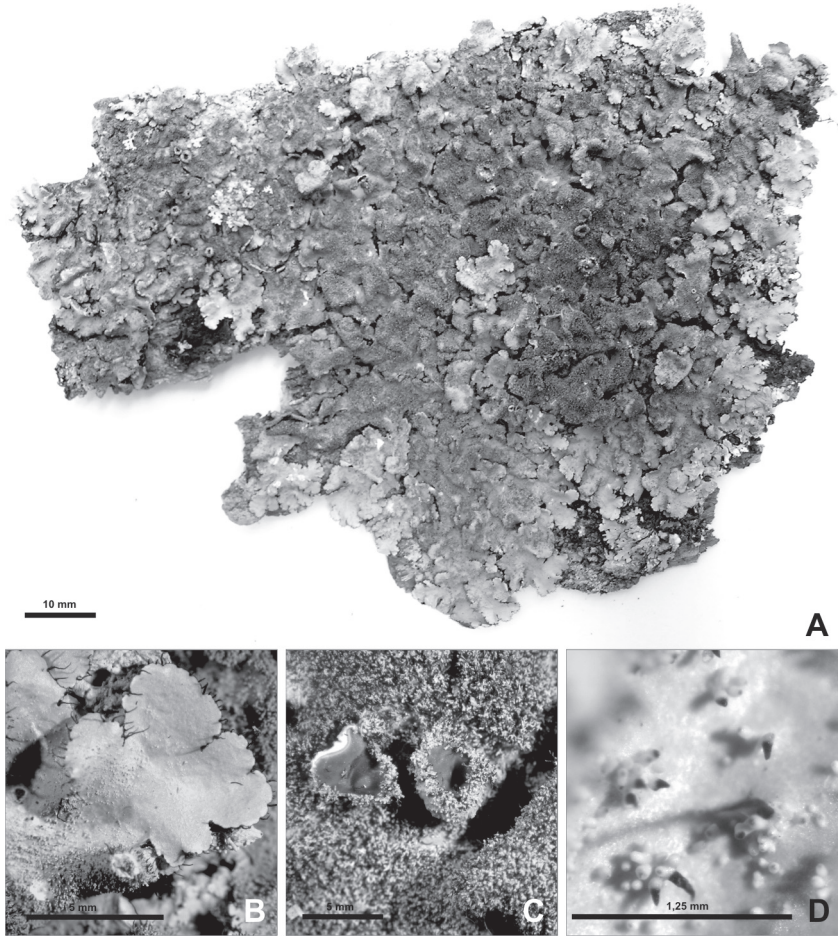
Specimens_examined — Argentina. Corrientes Province, Depto. Mburucuyá, Mburucuyá National Park, Estancia Santa Teresa, on *Enterolobium contortisiliquum,* 28/II/07, *Michlig, Niveiro & Meza Torres* 311 (CTES); Estancia Santa Teresa, in front of the historical center, on *Tabebuia heptaphylla,* 20/VII/2006, Ferraro et al. 8088 (CTES), Estancia Santa Teresa, near the historical center, 28° 01' S, 58° 01' W. Ferraro et al. 8094 (CTES), idem., 8101 (CTES). Misiones Province, Depto. Iguazú, Iguazú National Park, Camping site Ñandú, 28/IV/2004, Ferraro & Popoff 7426 (CTES).

Distribution — *Parmotrema pseudocrinitum,* previously known from Africa (Hale 1965, Krog & Swinscow 1981), was recently reported for the first time from the Neotropics by Boom et al. (2007), who recorded it for Guatemala (Fig. e). This is the first record of the species for South America.

Discussion

Parmotrema pseudocrinitum is characterized by the ciliate lobes, the simple or branched, often ciliate isidia (Figs. a,b,d), the white medulla and the presence of atranorin and gyrophoric acid as principal chemical substances. Boom et al. (2007) also mention the presence of minor quantities of lecanoric acid in the medulla.

Hale (1965) noted that the medulla in this species could have K+ purple pigmented areas near the lower surface, but in the material we examined, the medulla is completely white and no K+ purple pigment is present.



Figs. A–D. *P. pseudocrinitum*. A: Complete thallus (scale bar = 10 mm). B: Lobes margins (scale bar = 5 mm). C: Apothecia with imperforate disc (scale bar = 5 mm). D: Ciliate isidia (scale bar = 0.6 mm).

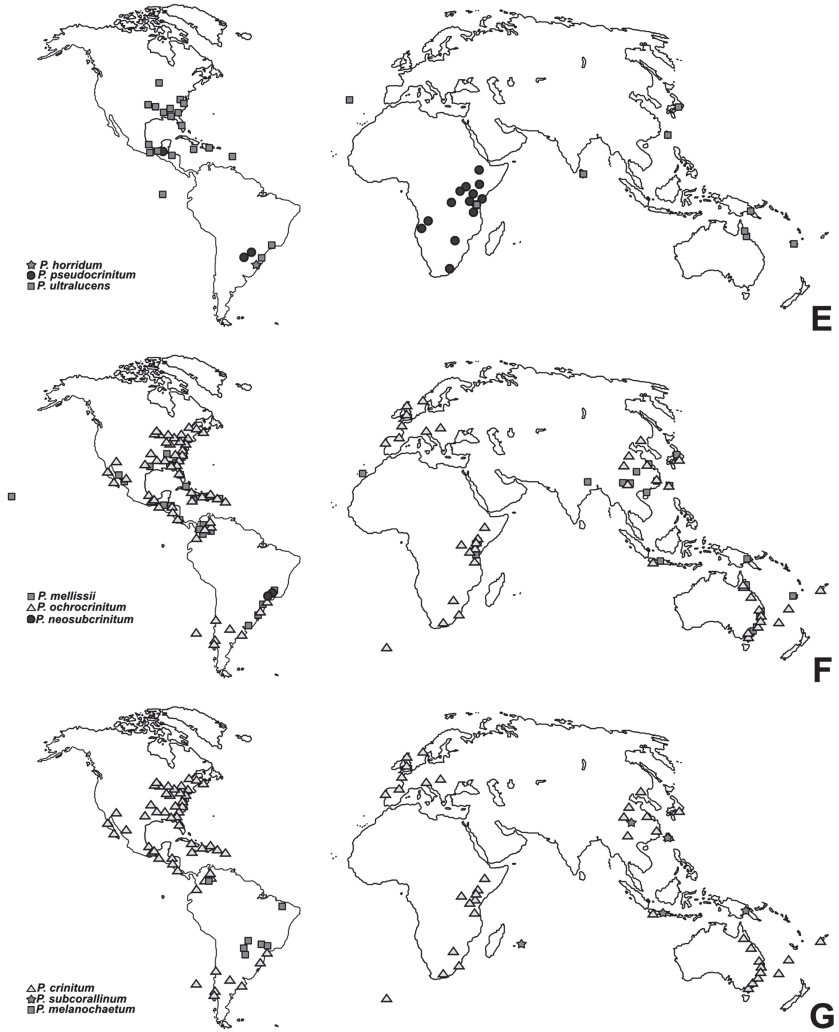
Apothecia with imperforate disc were present in many of the specimens studied (Fig. c) but as the ascospores were immature, their characteristics were not reported here. According to Krog & Swinscow (1981), the disc may become perforate and the ascospores measure 15–18 × 6–8(–10) µm. Pycnidia were only found in one specimen (Ferraro 8094). The observed conidia were slightly shorter than reported by Krog & Swinscow (1981) [(6.6–)7–9.3(–13.3) versus 10–12 µm long]. All Argentinean specimens were found on bark, but Krog & Swinscow (1981) mentioned that this species may also occur on rock.

Parmotrema pseudocrinitum is morphologically similar to the cosmopolitan species *P. crinitum* (Ach.) M. Choisy and *P. mellissii* (C.W. Dodge) Hale (Figs. F–G), characterized by the presence of ciliate lobes and isidia, but they are easily differentiated by their respective medullary chemistries. *Parmotrema crinitum* is clearly distinguished by stictic acid, which shows a persistent K+ yellow reaction. The ascospore size and conidial size and shape also differ. According to Elix (1994), the conidia of *P. crinitum* are sublageniform and 3–4 µm long, while those in *P. pseudocrinitum* are filiform and (6.6–)7–9.3(–13.28) µm long. The ascospores of *P. crinitum*, which are larger than those in *P. pseudocrinitum,* are 25–35 × 12–18 µm (Elix 1994, Krog & Swinscow 1981).

Parmotrema mellissii can be distinguished from *P. pseudocrinitum* by the presence of coralloid isidia that eventually become sorediate and the presence of alectoronic acid in the medulla (KC+ light orange and UV+ bright blue-green). Krog & Swinscow (1981) and Elix (1994) observed that the medulla in *P. mellissii* could have areas with an ochraceus K+ purple pigment (skyrin), the same reaction that was cited by Hale (1965) for *P. pseudocrinitum.* In *P. mellissii* apothecia are rarely found, the disc is imperforate, and the ascospores measure 10–14 × 16–22 µm (Hale 1965, Elix 1994); furthermore, pycnidia are not commonly found (Elix 1994, Krog & Swinscow 1981, Nash & Elix 2002). Eliasaro & Donha (2003) describe the conidia as filiform and 7–10 µm long, thus similar to those found in *P. pseudocrinitum.*

Parmotrema ochrocrinitum Elix & J. Johnst., *P. subcorallinum* (Hale) Hale, *P. horridum* Fleig, *P. ultralucens* (Krog) Hale, and *P. neosubcrinitum* C.H. Ribeiro & Marcelli are also characterized by the presence of ciliate isidia. *Parmotrema ochrocrinitum* and *P. subcorallinum* both resemble *P. crinitum.* The first is endemic to Australia (Fig. F) and can be distinguished by the presence of a yellow-orange pigment (euplectin) in the lower medulla (Elix & Johnston 1988). *Parmotrema subcorallinum*, a scattered species known mainly in southeast Asia (Fig. G), differs in producing protocetraric acid rather than stictic acid (Kurokawa & Lai 2001, Chen et al. 2005). *Parmotrema ultralucens* is a cosmopolitan species (Fig. E) distinguished by the presence of atranorin in the cortex and lichexanthone and salazinic acid in the medulla (Krog 1974). *Parmotrema neosubcrinitum,* known only from Brazil (Fig. F), resembles *P. ultralucens* but differs in the medullar chemistry (Marcelli & Ribeiro 2002). *Parmotrema horridum,* a Brazilian endemic (Fig. E), resembles *P. mellissii* but differs in containing olivetoric acid in the medulla (Fleig 1999).

Parmotrema melanochaetum (Kurok.) O. Blanco et al. is a South American species (Fig. G) characterized by the presence of ciliate isidia and gyrophoric acid in the medulla, similar to *P. pseudocrinitum.* According to Hale & Kurokawa (1965) and Hale (1976) the upper cortex is strongly to rather distinctly white maculate and the rhizines are simple, which differs on the material found in



Figs. E–G. Maps showing the world distribution of *P. pseudocrinitum* and related species.
E: *P. horridum, P. pseudocrinitum,* and *P. ultralucens.*
F: *P. mellissii, P. ochrocrinitum,* and *P. neosubcrinitum.*
G: *P. crinitum, P. subcorallinum,* and *P. melanochaetum.*

Argentina. In the specimens studied, Only one specimen studied has a slightly maculate upper cortex and the rhizines are simple to irregularly branched. Due to these differences, we identify our material as *P. pseudocrinitum.* Nonetheless, a thorough revision of the types of these species is needed.

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