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The disjunct distribution of *Cladonia dimorphoclada* Robbins (Ascomycota: Cladoniaceae): first record in South America

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ABSTRACT - (The disjunct distribution of *Cladonia dimorphoclada* Robbins (Ascomycota: Cladoniaceae): first record in South America). Previously known only from the North and Central America, the lichenized fungi *Cladonia dimorphoclada* Robbins is recorded for the first time in South America. The specimens were found growing on soil, in an open area at 1695 m alt., in Southern Brazil. We present a distribution map, figures, and comments.
Keywords: Atlantic Forest, biodiversity, fungi, high altitude fields, lichen

RESUMO - (Distribuição disjunta de *Cladonia dimorphoclada* Robbins (Ascomycota: Cladoniaceae): primeiro registro para a América do Sul). Conhecida previamente apenas para América do Norte e Central , o fungo liquenizado *Cladonia dimorphoclada* Robbins é registrada pela primeira vez para a América do Sul. Os espécimes foram encontrados crescendo sobre solo, em áreas abertas, a 1695 m de altitude no Sul brasileiro. Nós apresentamos um mapa de distribuição, figuras e comentários.
Palavras-chave: Biodiversidade, campos de altitude, Floresta Atlântica, fungo, líquen

Introduction

Cladonia P. Browne is one of the most frequently collected lichenized fungi, even by non-lichenologists, and thus reports about the genus have been abundant in recent literature for systematic studies (*e.g.* Pino-Bodas *et al.* 2010, 2011, 2012, Gumboski *et al.* 2013, Ahti & Sipman 2013, Yánez-Ayabaca *et al.* 2013), and new distribution records of various species (*e.g.* Burgaz & Ahti 2009, Ahti & Stenroos 2012, Burgaz & Pino-Bodas 2012, Flakus *et al*. 2012, Charnei & Eliasaro 2013, Yánez-Ayabaca *et al.* 2013).

Approximately 115 species of *Cladonia* are known from Brazil (*e.g.* Vainio 1887, 1894, Ahti *et al.* 1993, Fleig *et al.* 1995, Ahti & Marcelli 1995, Ahti 2000, Stenroos *et al.* 2002, Gumboski & Eliasaro 2011, Gumboski *et al.* 2013) and distributed in various environments. However, the lichenized mycota in many Brazilian regions remain poorly studied, in terms of inventories and ecology.

Previously, *Cladonia dimorphoclada* was only known from the Eastern United States (*e.g.* Ahti 1973, Flenniken 1999, Hansen & Freeman 2003, Thomson 2003, Harris 2004), and also rarely found in southern Mexico, and western Cuba (Ahti 2000). In this paper, we report the occurrence of *C. dimorphoclada* for the first time in South America, more precisely from the Southern region of Brazil.

Material and methods

Specimens were examined using standard techniques, stereomicroscope, and light microscope. Sections of the thallus and apothecia were mounted in water. Chemical analyses were done according to Huneck & Yoshimura (1996) and Orange *et al*. (2001). The distribution map (figure 1) was produced in QGIS Software 2.0.1, according to a tutorial developed by Calegari *et al.* (2016).

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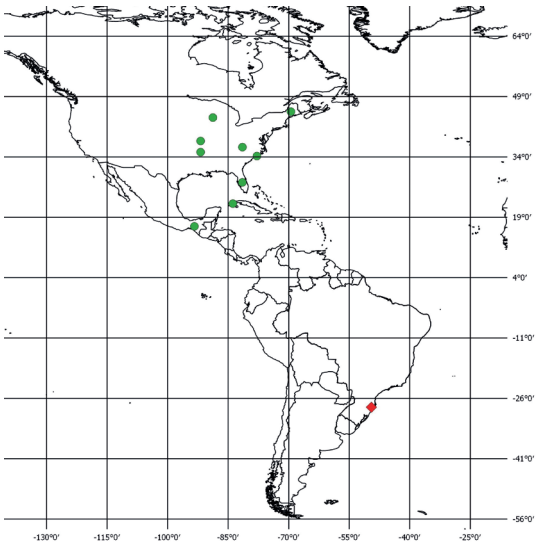

Figure 1. Distribution map of *Cladonia dimorphoclada*. Green circles: previous records. Red star: new record.

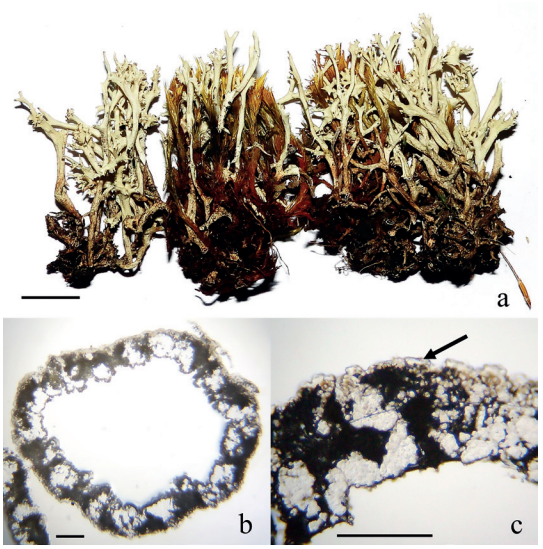

Figure 2. *Cladonia dimorphoclada* found in Southern Brazil. a. Podetia (JOI). b. Anatomical section of a podetial showing the stereome intermixed with medulla. c. Detail of an anatomical section showing the rudimentary cortex (black arrow). Scale bar: a = 1 cm; b,c = 200 µm.

Results and Discussion

Cladonia dimorphoclada Robbins *in* Sandstede, Cladon. Exs. 1882. 1929.
Figure 2

Description. Primary thallus not seen. Podetia 1.0-5.0 cm tall, 0.4-2.0 mm thick, pale yellowish green, somewhat branched, branching type irregular, anisotomic dichotomy and trichotomy, often with many short outgrowths; axils closed; apices slightly acute, rather slender, erect; not melanotic at base; surface slightly shiny, dull at the base, pruinose near tips, smooth to slightly rough, areolate but not cracked. Podetial wall 130-250 µm thick, cortex rudimentary, 7-12(-25) µm thick, medulla intermixed with irregular bundles of stereome, medulla 110-240 µm thick, bundles of stereome 65-100 µm in diam., inner surface rough to slightly arachnoid. Conidiomata not seen. Hymenial disks apical, immature.

Chemistry. Spot tests: K-, C-, KC- or KC+ yellow, P-, UV-. TLC and NMR: Usnic acid only.

Distribution and ecology: according to Ahti (2000), in the United States *Cladonia dimorphoclada* occurs mainly on sandy soils, in Mexico on sandstone rocks, and in Cuba on the coastal white sand. In Brazil, specimens were found growing on top of a rocky outcrop in an open field (figure 3).

Cladonia dimorphoclada can be differentiated from other Brazilian *Cladoniae* by the few branched thalli with closed axils, the presence of a rudimentary cortex and stereome intermixed with medulla, and the production of usnic acid as the only secondary compound.

Figure 3. Habitat where *Cladonia dimorphoclada* was found in Southern Brazil, Municipality of Urubici, São Joaquim National Park.

Species with similar morphology and chemistry are *Cladonia substellata* Vain., *C. spinea* Ahti, *C. uncialis* (L.) Weber *ex* F.H. Wigg. and *C. vareschi* Ahti. However, *C. substellata* has moderately to very branched podetia with pale gray necrotic base (Vainio 1887, Ahti 2000); *C. spinea* form densely branched cushions and present six chemotypes where only usnic acid is constant (Ahti 2000); *C. uncialis* has a richly branched podetia with a well-developed cortex (Ahti 2000, Burgaz & Ahti 2009); and *C. vareschi* has moderately branched podetia with a slender cortex and well-delimited stereome (Ahti 1986, 2000).

Cladonia apodocarpa Robbins and *C. robbinsii* A. Evans also present disjunct distribution between North America and temperate South America (Ahti 2000), somewhat like *C. dimorphoclada*. *Cladonia apodocarpa* was recorded in North America (*e.g.* Evans 1947, Harris 2004) and Uruguay (Ahti 2000), and *C. robbinsii* was recorded in North America (*e.g.* Flenniken 1999, Thomson 2003, Harris 2004) and South America, in Chile (Galloway & Quilhot 1998, Ahti 2000), Uruguay and Southern Brazil (Fleig *et al.* 1995, Ahti 2000).

Material examined: BRAZIL. Santa Catarina: Municipality of Urubici, Parque Nacional de São Joaquim, Campo de Santa Bárbara, in exposed site, rocky outcrop, near an old cemetery, 1695 m alt., 1-II-2012, leg. *A.A. Spielmann & L.S. Canêz 9978* (CGMS, JOI).

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