

# A REMARKABLE CLADONIACEAE FLORA AT SUBANDEAN REGION IN CHÁMEZA (CASANARE, COLOMBIA)

## Flora de Cladoniaceae muy especial en la región subandina en Chámeza (Casanare, Colombia)

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### ABSTRACT

A remarkable Cladoniaceae flora was discovered in the subandean region of Chámeza, (Casanare, Colombia) at 1200 meters above sea level. Four species of the genus *Cladonia* (Cladoniaceae, Lichenized Fungi) are new records for Colombia: *Cladonia macilentoides*, *C. scabriuscula*, *C. sipmanii* and *C. subdelicatula*. This shows the importance of increasing diversity studies at mid elevations where suitable habitats for species of *Cladonia* occur.

**Key words.** *Cladonia*, subandean forest, plant richness, lichenized fungi.

### RESUMEN

En la región subandina de Chámeza (Casanare, Colombia), alrededor de 1200 m de altitud, se encontró una flora de Cladoniaceae muy especial. El hallazgo de *Cladonia macilentoides*, *C. scabriuscula*, *C. sipmanii* y *C. subdelicatula* constituye nuevos registros para Colombia y señala la conveniencia de intensificar los muestreos en estas elevaciones intermedias donde hay hábitats adecuados para especies del género.

**Palabras clave.** *Cladonia*, región subandina, diversidad vegetal, hongos liquenizados.

### INTRODUCTION

The cosmopolitan family Cladoniaceae (lichenized fungi) is one of the most collected lichen groups because its members are

conspicuous and they can be found in many different ecosystems. Nevertheless the taxonomy and distribution of this family are not well studied in most parts of the world, including Colombia.

The first specialized publication on Cladoniaceae in Colombia (Sipman & Cleef 1978) treats morphology, chemistry, and ecological and spatial distribution of 6 species of the family Cladoniaceae. Afterwards a Flora Neotropica Monograph (Ahti 2000) revised and summarized all knowledge on the family for the Neotropics, including Colombia. Patterns of species richness of the Cladoniaceae in the Neotropics were analysed by Edier Soto Medina (2013). In the same year Ahti & Sipman (2013) in a Cladoniaceae volume for the Flora of the Guianas made clear that the diversity of Cladoniaceae has been underestimated.

This study aims to contribute to the knowledge of the Colombian lichen biota, considering that Colombia has a high percentage of endemism and that lichens are an important component of many ecosystems.

## METHODOLOGY

### Sampling

The material used in this work was collected on two farms in Chámeza-Casanare on various different substrates (rock, soil and wood), on 24-31 January 2012, at elevations of about 1400 m, 1450 m and 1500 m, in grazing areas and secondary forest. The specimens were air-dried and subsequently placed in the freezer at -25° C for 24 hours in order to kill any noxious insects. Then the specimens were transferred to herbarium packets and provided with labels containing all collection data.

### Determination of the material

Subsequently the specimens were analyzed in the laboratory using stereomicroscope and transmission microscope. For the identification the literature available in the library and the collections of Neotropical Cladoniaceae in the herbarium of B were consulted. The main publications used were Ahti (2000), Ahti & Sipman (2013) and Sipman & Ahti (2013).

### Technique of thin layer chromatography (TLC)

The chemistry of the samples reported below was analysed by the TLC method, using solvents A, B and C (Orange et. al. 2001). As standard a mixture of the control substances atranorin, norstictic and fumarprotocetraric acid was used. They were obtained from the lichens *Cladonia symphylicarpa* (Flörke) Fr. and *Cladonia rangiferina* (L.) Weber ex F.H. Wigg.

## RESULTS

The following species were recognized: *Cladia aggregata* (Sw.) Nyl., *Cladonia confusa* R. Sant., *C. didyma* (Fée) Vain., *C. furfuraceoides* Ahti & Sipman, *C. macilentoides* Ahti & Fleig, *C. miniata* G. Mey., *C. peltastica* (Nyl.) Müll. Arg., *C. pyxidata* Ahti, *C. ramulosa* (With.) J.R. Laundon, *C. rappii* A. Evans, *C. scabriuscula* (Delise) Leight., *C. sipmanii* Ahti, *C. squamosa* Hoffm., *C. subdelicatula* Vain. ex Asahina, *C. subradiata* (Vain.) Sandst. and *C. subsquamosa* Kremp.

Four species were recognized which had not been published from Colombia before (Ahti 2000, Sipman et al. 2008; unpublished checklist). Descriptions and notes are presented here.

### *Cladonia macilentoides* Ahti & Fleig

Fig. 1.

Fleig et al., *Napaea* 11: 14. 1995. Type. Brazil. Rio Grande do Sul: Mun. Cambara do Sul, Parque Nacional dos Aparados da Serra, Itaimbezinho, nr. administration building, 900 m, 1989, Fleig 3601 (holotype, ICN 71921; isotype, H).

**Description (after Ahti 2000):** Primary thallus persistent, consisting of crenulate esorediate squamules, 1-2 mm wide. Podetia 0.5-2 cm tall, 0.1-0.2 mm thick towards

the base, 0.05 mm thick toward the tips, very slender, greenish or whitish gray, with basal parts sometimes partly blackening; unbranched to usually somewhat branched by dichotomy, ascyphose; tips often bifurcate, narrow. Surface mostly decorticate, with soredioid granules present. Podetial wall 80-120  $\mu\text{m}$ ; cortex 20-30  $\mu\text{m}$ ; medulla 0-20  $\mu\text{m}$ ; stereome 80-100  $\mu\text{m}$ . Conidiomata on primary squamules (not seen). Apothecia rare, red (not seen).

Chemistry. P + yellow, K + yellow; thamnolic acid.

**Remarks:** *Cladonia macilentoides* is difficult to recognize when hymenial discs are absent. Then it resembles most the young podetia of *C. didyma* (Fée) Vain. by the acuminate, mostly unbranched, largely decorticated podetia. They differ by the presence of fine soredia, usually rather scarce and best found near the tips or the base, and the stereome is thinner, not turning translucent and brownish. Similar species with decorticate, acuminate podetia and thamnolic acid chemistry occur in section Perviae, like *C. chondrotypa* Vain., *C. granulosa* (Vain.) Ahti, *C. palmicola* Ahti & Fleig and *C. subdelicatula* Vain. ex Asahina. They lack the yellow-orange spots at the base of the basal squamules, and the surface of the podetia is less denudated or with different disposition of the propagules.

**Selected specimen:** Chámeza-Casanare. Vda. Centro Sur, Finca el paraíso. 5°11'45"N 72°53'27"W. Vargas Mendoza L. and Herrera Vargas J. 795a (Fig. 1).

*Cladonia scabriuscula* (Delise) Nyl.

Fig. 2.

Compt. Rend. Hebd. Seances Acad. Sci. 83: 88. 1876; *Cenomyce scabriuscula* Delise in Duby, Bot. Gall. 623. 1830. Type: France (lectotype, PC-Delise, designated by Ahti 2000: 172).

**Description (after Ahti 2000):** Primary thallus evanescent, consisting of small squamules 2 x 3 mm. Podetia 1-3 cm tall, 1-3 mm thick, brownish to grayish, with white patches, not melanotic at base, slightly to moderately branched; branching type anisotomic dichotomy; axils open to closed; tips subulate, ascyphose. Surface of podetia areolate corticate, with cortex smooth, thin, scaling off to form podetial squamules, often finally becoming largely decorticate, usually moderately to richly squamulose (squamules to 2 x 2-3 mm); distal parts incompletely corticate, scabrose, micro-squamulose to granulose. Podetial wall 140-215  $\mu\text{m}$ ; cortex 15-20  $\mu\text{m}$ ; medulla 20-35  $\mu\text{m}$ ; stereome 170-180  $\mu\text{m}$ , translucent to opaque, very hard, distinctly delimited from medulla; surface of central canal slightly uneven. Conidiomata common, at tips of podetia. Apothecia brown (not seen).

Chemistry. P + red, K -; fumarprotocetraric and protocetraric (trace) acids.

**Remarks:** *Cladonia scabriuscula* is very closely related to *Cladonia furcata* (Huds.) Schrad., which lacks granulose tips, is less squamulose, and is generally more robust.

**Selected specimen:** Chámeza-Casanare. Vda. Mundo Viejo, finca El Triunfo. 5°11'45"N 72°54'04"W. Herrera Vargas J. and Vargas Mendoza L. 92 (Fig. 2).

*Cladonia sipmanii* Ahti

Fig. 3.

Flora Neotropica Monograph 78: 304. 2000. Type. Guyana. Demerara-Mahaica Region: Km 7 on Linden Hwy., by Housener Farm, 10 m, 1996, Ahti 52929 (holotype, BRG; isotypes, B, BM, DUKE, H, MERF, NY, SP, UPS, US).

**Description (after Ahti 2000):** Primary thallus evanescent. Podetia slender to fairly robust, 5-7 cm tall, 0.5-1 mm thick, pale glaucous-

white, with necrotic base darkening at surface, often cyanescent in part, moderately branched; branching type anisotomic dichotomy or trichotomy, with distinct main axes and short side branchlets; axils perforated but usually closed near the young tips and frequently also lower down, to 0.1-3 mm broad, funnels small but sometimes widely gaping in lower part of aged podetia; tips erect or slightly divaricate, furcate. Surface of podetia smooth, continuous in upper parts, areolate in lower parts; often slightly squamulose. Podetial wall 240-275  $\mu\text{m}$ ; cortex 25  $\mu\text{m}$ ; medulla 75-100  $\mu\text{m}$ ; stereome 125-150  $\mu\text{m}$ , sharply delimited; central canal grooved. Conidiomata at tips of podetia, containing red slime (not seen). Apothecia brown (not seen). Chemistry. P + yellow, K + yellow; thamnolic acid.

**Remarks:** *Cladonia hians* Ahti is similar by its thamnolic acid chemistry and open axils, and differs because most of its upper axils are open and it produces numerous regular scyphoid funnels in well-illuminated habitats, though in shade the funnels are narrow and less regularly developed. The original Guyanan material of *C. sipmanii* is more robust than the Colombian specimen, which looks juvenile, with strongly branched, slender podetia without conidiomata or apothecia.

**Selected specimen:** Chámeza-Casanare. Vda. Mundo viejo, finca El Triunfo. 5°11'45"N 72°54'04"W. Herrera Vargas J. and Vargas Mendoza L. 92 (Fig. 3).

*Cladonia subdelicatula* (Vain.) Sandst.

Fig. 4.

Vain. ex Asahina, J. Jap. Bot. 38: 1. 1963. Type. Brazil. Rio Grande do Sul: Mun. Venâncio Aires, Faxinal Tamanco, 1909, Jürgens 5735 (135) (holotype, TUR-V 15098a; isotypes, FH, US).

**Description:** Primary thallus evanescent, consisting of very narrow squamules to 0.1-0.5 mm long. Podetia to 1-4.5 cm x 0.05-0.1 mm, of determinate growth, pale glaucous-white, pale brown at base, slightly sinuous, dichotomously branching at irregular intervals of about 1.2-1.0 mm., the branchlets usually at sharp angles, ca. 20°, occasionally with secondary branchlets or anastomoses with adjacent podetia, with closed axils, gradually attenuated from the base, often with forked tips. Surface mostly decorticate, whitish and rather smooth, with scattered ca. 50-100  $\mu\text{m}$  wide corticated warts containing algae, which bear corticated granules ca. 50  $\mu\text{m}$  diam. transgrading into small, easily detached, finely lacinate squamules ca. 0.1-0.5 mm long with recurved tips, without soredia. Podetial wall 100  $\mu\text{m}$ ; cortex ca. 10  $\mu\text{m}$ ; stereome ca. 700  $\mu\text{m}$ , compact around the central canal, densely fissured on the outside; surface of the central canal papillose. Conidiomata on squamules or at tips of podetia (not seen). Hymenial discs brown (not observed).

Chemistry. P + yellow, K + yellow; thamnolic acid.

**Remarks:** *Cladonia polystomata* Ahti & Sipman is probably the most similar species by its largely ecorticate podetial walls with scattered squamules and thamnolic acid chemistry, and differs by the conspicuous, wide open axils forming wide funnels and more persistent, larger podetial squamules.

*Cladonia subdelicatula* is a poorly-known species reported mainly from SE Brazil, but occasionally also from the northern Amazon basin and Africa (Ahti 2000, Ahti & Sipman 2013). No authentic material was available for comparison and therefore the identification is provisional.

**Selected specimen:** Chámeza-Casanare. Vda. Centro Sur, Finca el paraíso. 5°11'45"N 72°53'27"W. Vargas Mendoza L. and Herrera Vargas J. 58 (Fig. 4).



**Figure 1.** *Cladonia macilentoides*.



**Figure 2.** *Cladonia scabriuscula*.





**Figure 3.** *Cladonia sipmanii*.



**Figure 4.** *Cladonia subdelicatula*.

## DISCUSSION

The lichen family Cladoniaceae is in Colombia by far the best represented in the páramos, from where 39 species were reported by Sipman *et al.* (2000). Certainly the harsh climate at high elevations, unfavorable for luxuriant phanerogam vegetation, increases the chances for poor competitors like soil lichens. Another speciose Cladoniaceae flora was found at low elevation on the sandstone table lands around Araracuara, where the extremely poor sandstone rocks prevent a luxuriant phanerogam vegetation. Sipman (1997) reported 17 species, almost all different from those occurring in the páramos. The landscape at intermediate elevations is usually forest-covered, at least in virgin condition, and leaves few opportunities for Cladoniaceae. However, the lichens reported here from Chámeza-Casanare show that suitable habitats for Cladoniaceae may occur also at intermediate elevations.

**Table 1.** List of Cladoniaceae species found in Chámeza-Casanare, with elevation and presence or absence in Araracuara and the páramos.

| species                        | elevation | Araracuara | páramos |
|--------------------------------|-----------|------------|---------|
| <i>Cladia aggregata</i>        | 1400 m    | X          | X       |
| <i>Cladonia confusa</i>        | 1400 m    |            | X       |
| <i>Cladonia didyma</i>         | 1400 m    | X          | X       |
| <i>Cladonia furfuraceoides</i> | 1400 m    |            |         |
| <i>Cladonia macilentoides</i>  | 1450 m    |            |         |
| <i>Cladonia miniata</i>        | 1500 m    |            |         |
| <i>Cladonia peltastica</i>     | 1400 m    | X          |         |
| <i>Cladonia pyxidata</i>       | 1400 m    |            | X       |
| <i>Cladonia ramulosa</i>       | 1400 m    |            |         |
| <i>Cladonia rappii</i>         | 1400 m    |            | X       |
| <i>Cladonia scabriuscula</i>   | 1400 m    |            |         |
| <i>Cladonia sipmanii</i>       | 1400 m    |            |         |
| <i>Cladonia squamosa</i>       | 1400 m    |            |         |
| <i>Cladonia subdelicatula</i>  | 1400 m    |            |         |
| <i>Cladonia subradiata</i>     | 1400 m    | X          | X       |
| <i>Cladonia subsquamosa</i>    | 1400 m    |            | X       |

As table 1 shows, 8 out of the 16 species of Cladoniaceae observed in Chámeza-Casanare are not known from the páramos or the sandstone area of Araracuara. This indicates that a considerable number of the species found at intermediate elevations do not show up in the páramos or the lowlands, and appear restricted to intermediate elevations. This indicates that the rare natural habitats suitable for Cladoniaceae in such elevations are of particular interest for the exploration of the Cladoniaceae flora of Colombia.

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