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Contribution to the knowledge of the genus *Cladonia* in Macaronesia

Israel Pérez-Vargas, Cristina González-Montelongo, Consuelo Hernández-Padrón y Pedro Luis Pérez de Paz[1]

Abstract: Pérez-Vargas, I.; González-Montelongo, C; Hernández-Padrón, C. & Pérez de Paz, P. L. 2015. Contribution to the knowledge of the genus *Cladonia* in Macaronesia. *Bot. Complut.* 39: 31-35.

Sixteen species of the genus *Cladonia* are reported from Macaronesia from the Canary Islands. Three species are new to canarian flora and, two of them new to Macaronesia. The chemical variation of the taxa is reported. A phytogeographic distribution of the taxa with data on their habitat and ecology are presented.

Key words: lichen, Canary Islands, biogeography, taxonomy.

Resumen: Pérez-Vargas, I.; González-Montelongo, C; Hernández-Padrón, C. & Pérez de Paz, P. L. 2015. Contribution to the knowledge of the genus *Cladonia* in Macaronesia. *Bot. Complut*. 39: 31-35.

Se citan 16 especies del género *Cladonia* de la Región Macaronésica de las Islas Canarias. Tres especies son nuevas citas para el archipiélago canario y de ellas dos lo son para la Macaronesia. Se comenta la variación química de los taxones así como su distribución geográfica y datos de su hábitat y ecología.

Palabras clave: liquen, Islas Canarias, biogeografía, taxonomía.

INTRODUCTION

The genus *Cladonia* includes more than 450 species worldwide (Litterski & Ahti 2004, Pino-Bodas *et al*. 2013b). In the last years, the phylogenetic position, status and delimitation of the family *Cladoniaceae* and the genus *Cladonia* have been extensive debated in many works (Stenroos & DePriest 1998, Wedin *et al.* 2000, Ahti & DePriest 2001, Stenroos *et al*. 2002a,b). Stenroos *et al*. (2002a) proposed a new classification of the genus in three subdivisions. Within these subdivisions four supergroups and further, seven groups and two subgroups were distinguished. In the Canary Islands the four supergroups (*Cladonia*, *Perviae*, *Cocciferae* and *Crustaceae*) are represented (Hernández Padrón & Pérez-Vargas 2010).

Knowledge of species distribution is an integrative tool between systematic and ecology and therefore indispensable for the evaluation of biodiversity; distribution data of species is also essential for estimation of their extinction risk and classification into threat categories (Litterski & Otte 2002). The genus *Cladonia* is still insufficiently known in the Canary Islands. There are some data published of this group in dispersed works, most of them without indication of author and locality, and compiled by Hafellner (1995, 1999, 2002, 2005) in his Macaronesian checklist. The only detailed of this genus in the Canaries were due to Etayo & Burgaz (1997) and Sicilia *et al*. (2009). The aim of this investigation was extend the previous lichenological knowledge of the genus *Cladonia* in this area.

MATERIALS AND METHODS

The morphology of the lichen specimens was examined using a Leica ZOOM 2000 stereomicroscope. Section for anatomical examination were cut by hand and mounted and observed in water. Chemical constituents were identified by thin-layer chromatography (TLC) using standardized procedure and using solvents A, B and C (Elix & Ernst-Russell 1993, Orange *et al*. 2001). The material studied is deposited in TFC– Lich and

[1] Dpto. Botánica, Ecología y Fisiología Vegetal, Sección de Farmacia, Fac. de Ciencias de la Salud. Universidad de La Laguna, 38201 Tenerife, Canary Islands, Spain. ispeva@ull.es, chely.hernandez@ull.es, pperez@ull.es
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some duplicates are in MACB. The species were determined by their morphological and chemical characters.

RESULTS AND DISCUSSION

Cladonia cervicornis (Ach.) Flot. subsp. ***cervicornis***
Jahrb. schles. Ges. vaterl. Kultur 27: 31, 1849.

La Palma: curso del bco. de la Laja Azul, 1200 m, *Hernández & Pérez,* November 1999, TFC Lich: 7040; El Riachuelo, 1250 m, *Hernández & Pérez*, November, 2001, TFC Lich: 7033.

Chemistry.— Fumarprotocetraric acid.

Habitat and distribution.— On mossy soil. Subcosmopolitan.

Observations.— It was reported from Macaronesia (Azores, Madeira and the Canary Islands) by Tavares (1952). It is a widespread species in the Macaronesian Region, however, it is not common in the Canaries. Outside, it is known from Europe and North America.

Cladonia cyathomorpha Stirt. *ex* Walt. Watson
J. Bot. 73: 156, 1935.

La Palma: La Cumbrecita, 1280 m, *Hernández & Pérez*, November 1999, TFC Lich: 2690.

Chemistry.— Fumarprotocetraric acid.

Habitat and distribution.— On mossy soil. West Europe, S America (Tierra del Fuego).

Observations.— Only reported from the Macaronesian Region by James (2009) and from the Canary Islands by Burgaz & Ahti (2009), but without any indication of island or locality.

Cladonia fimbriata (L.) Fr.
Lichenogr. Eur. Ref.: 222, 1831

La Palma: Cabecera del bco Bombas de Agua, 2190 m, *Hernández & Pérez*, May 1999, TFC Lich: 7115; Unión bco Roque-Hoyo Verde, 1500 m, *Hernández & Pérez*, July 2000, TFC Lich: 7049.

Chemistry.— Fumarprotocetraric acid and occasionally zeorin.

Habitat and distribution.— On mossy soil. Cosmopolitan.

Cladonia firma (Nyl.) Nyl.
Bot. Z., 1861: 352, 1861

La Palma: bco. de Las Verduras de Alfonso, 900 m, *Sánchez & Sicilia*, April 2000, TFC Lich: 7044.

Chemistry.— Fumarprotocetraric acid and atranorin.

Habitat and distribution.— On soil. Most frequent in the Mediterranean Region but extends to the Eurosiberian and Macaronesian Region. It is also reported from North America, however, the taxonomic status of the North American samples is somewhat uncertain (Ahti & Hammer 2002). It is a common species growing on soil on exposed open areas usually mixed with mosses in the Canarian laurel forest.

Cladonia floerkeana (Fr.) Flörke
De Cladon.: 99, 1828.

Tenerife: Anaga, Cueva del Guanche, February 2014, on *Erica arborea*, *González-Montelongo & Pérez-Vargas*, TFC Lich: 14196g.

Chemistry.— Barbatic and squamatic acids.

Habitat and distribution.— On *Erica arborea* between mosses. It is not easy to specify its distribution because is easily confused with *C. macilenta* Hoffm. (Burgaz & Ahti, 2009).

Observations.— Previously reported from Macaronesia from the Azores (Tavares 1952). New to Canary Islands.

Cladonia foliacea (Huds.) Willd.
Fl. Berol.: 363, 1787.

La Palma: El Riachuelo, 1200 m, *Hernández & Pérez*, November 1999, TFC Lich: 2892; El Riachuelo-La Cumbrecita, 1250 m, *Hernández & Pérez*, November 2001, TFC Lich: 3896.

Chemistry.— Fumarprotocetraric and usnic acid.

Habitat and distribution.— On mossy soil. Widespread in the Mediterranean Region although reaches the Eurosiberian Region, too.

Observations.— The variation and delimitation of this species towards *C. convoluta* (Lam.) Anders were discussed by Burgaz *et al*. (1993). Nevertheless, recent molecular studies would seem to indicate that are conspecific (Pino-Bodas *et al.* 2010). *Cladonia angustiloba* Ahti & Aptroot is a similar species that occurs in similar habitats and it is characterised by the yellow color of the squamules and the very narrow basal squamules, much narrower than in *C. foliacea* (Ahti & Aptroot 2009).

Cladonia hammeri s.l.

La Palma: sendero Cumbrecita-Mirador de los Roques, 1300 m, *Pérez-Vargas*, April 2004, TFC Lich: 5565, 7028, 7029.

Chemistry.— Fumarprotocetraric acid.

Habitat and distribution.— Soil. W North America and Iberian Peninsula.

Observations.— This taxon was described from Sonoran Desert Region, North America (Ahti & Hammer 2002). It is very probably overlooked, include in *C. pyxidata s.l.* This is the second report from the Macaronesian Region, previously recorded from La Gomera (Sicilia *et al*. 2009). The identity of the European samples is uncertain and we accept this species in the broad sense, because they differ genetically from the American samples (Pino-Bodas *et al*. 2013).

Cladonia humilis (With.) J. R. Laundon
Lichenologist 16, 3: 220, 1984.

La Palma: trayecto Los Brecitos-Tenerra, 1000 m, *Hernández, Pérez & Pérez-Vargas*, February 2002, TFC Lich: 3969; trayecto Valencia-Bejenado, 1200 m, *Hernández, Pérez & Pérez-Vargas*, February 2002, TFC Lich: 4113; alrededores de Los Brecitos, 1075 m, *Hernández & Pérez*, May 1999, TFC Lich: 7054; Unión bco Roque-Hoyo Verde, 1500 m, *Hernández & Pérez*, July 2000, TFC Lich: 7050.

Chemistry.— Fumarprotocetraric acid and atranorin.

Habitat and distribution.— On mossy soil. Cosmopolitan.

Observations.— Reported to the Macaronesian Region from Azores by Tavares (1952). In the Canary Islands only known from Tenerife (Gil González *et al*. 1990) and La Gomera (Sicilia *et al*. 2009). New to La Palma Island.

Cladonia macrophylla (Schaer.) Stenh.
Lich Suec. Exs., ed. 2: 186, 1865.

La Palma: bco. del Limonero, 1050 m, *Muñoz & Rebolé*, March 2001, TFC Lich: 5948.

Chemistry.— Psoromic acid and atranorin.

Habitat.— Soil.

Observations.— It is an artic-alpine species of the northern hemisphere, widely distributed throughout the artic and boreal zone, not known from the Mediterranean region. The southernmost localities are in the Rocky Mountains, Appalachians, China and Portugal (Litterski & Ahti 2004). New to Macaronesian archipelagos.

Cladonia prolifica Ahti & S. Hammer
Mycotaxon 37: 342, 1990.

La Palma: El Riachuelo-La Cumbrecita, 1250 m, *Hernández & Pérez*, November 2001, TFC Lich: 7035, 7116; proximidades de la Casa de Tenerra, 1050 m, *Hernández, Pérez & Pérez-Vargas*, TFC Lich: 3976.

Chemistry.— Fumarprotocetraric acid.

Habitat and distribution.— Soil. North America and W Europe.

Observations.— This species resembles *C. phyllophora* Hoffm. very much, but the base is not melanotic and it has no subarachnoid surface structures (Hammer & Ahti 1990, Burgaz & Ahti 2009). It would represent another disjunction between North America and Macaronesia and West Mediterranean region (Kärnefelt 1980). Only reported from the Macaronesian region from La Gomera by Sicilia *et al*. (2009). New to La Palma Island.

Cladonia pseudopityrea Vain.
Acta Soc. Fauna Flora fenn. 4: 452, 1887.

La Palma: unión Bco Roque-Hoyo Verde, 1500 m, *Hernández & Pérez*, July 2000, TFC Lich: 7051; Lomo de Tacote, 1059 m, *Muñoz & Rebolé*, January 2001, TFC Lich: 5631.

Chemistry.— Fumarprotocetraric and confumarprotocetraric acids.

Habitat and distribution.— Soil. Mediterranean Region, rarely reaches the Eurosiberian Region.

Observations.— It is a rare and overlooked species very confused with *C. ramulosa* (With.) J. R. Laundon (Ahti & Puntillo 1995, Burgaz & Ahti 2009). New to Macaronesian Region.

Cladonia pulvinella s.l.

La Palma: proximidades de las Casa de Tenerra, 1050 m, *Hernández & Pérez,* November 2001, TFC Lich: 3977; Cumbrecita-Mirador de Los Roques, 1300 m, *Pérez-Vargas,* December 2006, TFC Lich: 7057.

Chemistry.— Fumarprotocetraric acid and atranorin.

Habitat and distribution.— Soil, very common. North America, Southern Europe.

Observations.— This species was described from North America (Hammer 1991). It is known from southern Europe, but this species and its allies need comprehensive taxonomic studies in this area (Burgaz *et al*. 1999). The identity of the European samples is quite uncertain and we accept this species in the broad sense, because they differ genetically from the American samples (Pino-Bodas *et al*. 2013).

Cladonia pyxidata (L.) Hoffm.
Deutschl. Flora 2: 121, 1796.

La Palma: El Riachuelo-La Cumbrecita, 1250 m, *Hernández & Pérez*, November 2001, TFC Lich: 7034.

Chemistry.— Fumarprotocetraric acid.

Habitat and distribution. Soil. Cosmopolitan.

Observations.— Very polymorphic. The taxonomy of this group is still not clear, specially, with respect to *C. chlorophaea* (Flörke ex Sommerf.) Spreng. and related taxa. A phylogenetic study has shown that *C. pyxidata* and *C. pocillum* are genetically indistinguishable (Kotelko & Piercey-Normore 2010). The name was often used in a very wide sense in the past, old records need to be checked in our area.

Cladonia ramulosa (With.) J. R. Laundon
Lichenologist 16(3): 225, 1984.

La Palma: proximidades de la Casa de Tenerra, 1050, *Hernández, Pérez & Pérez-Vargas*, TFC Lich: 7030.

Chemistry.— Fumarprotocetraric acid.

Habitat and distribution.— On *Pinus* trunks. Subcosmopolitan.

Observations.— It is a very polymorphic taxon, often confused with other *Cladonia* species in the past. Only known from Macaronesia from two localities in the Canaries from La Palma (Etayo & Burgaz 1997) and Tenerife (Tavares 1952 as *C. pytirea* (Flk.) Fr.)

Cladonia rangiformis Hoffm.
Deutschl. Flora 2: 114, 1796.

La Palma: cauce del bco. Las Traves, 1100 m, *Hernández & Pérez*, April 2000, TFC Lich: 7056; El Riachuelo-La Cumbrecita, 1250 m, *Hernández & Pérez*, TFC Lich: 3919, 3923; Cumbrecita-Mirador de Los Roques, 1300 m, *Pérez-Vargas*, December 2006, TFC Lich: 7059.

Chemistry.— Atranorin and frequently rangiformic acids.

Habitat and distribution.— On mossy soil. Eurasian region reaches to all Macaronesian Archipelagoes.

Observations.— Although the presence of attached squamules at the podetia are rather rare (James 2009) in our material is very frequent. *Cladonia rangiformis* Hoffm. var. *gracillima* which forms round tufts of very delicate, brittle podetia is reported too from Macaronesia (Berger & Aptroot 2002), but we did not found any samples of this variety among our specimens.

Cladonia subturgida Samp.
Ann. Acad. Polytechn. Porto 13: 106, 1918.

La Palma: trayecto Valencia-Bejenado, 1200 m, *Hernández, Pérez & Pérez-Vargas*, February 2002, TFC Lich: 4093; P.N. Caldera de Taburiente, 2150 m, *Rebolé*, August 1999, TFC Lich: 7047.

Chemistry.— Atranorin and protolichesterinic acid.

Habitat and distribution.— On soil. Iberian Peninsula, Canary Islands.

Observations.— Recently synonimized with *C. iberica* Burgaz & Ahti (Pino-Bodas *et al*. 2012). Only reported from the Macaronesian region from La Gomera (Canary Islands) as *C. iberica* by Etayo & Burgaz (1997). New to La Palma Island.

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