

***Pseudocyphellaria dasyphyllidia* – a new phyllidiate species from Chile (Lobariaceae, lichenised Ascomycota)**

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Abstract – *Pseudocyphellaria dasyphyllidia* growing on rocks and trees in rather dry habitats in Chile is described as new to science. It is characterised by a cyanobacterial photobiont, narrow, lacinate and imbricate lobes with hirsute margins, and simple to coralloid, densely hirsute phyllidia that are both marginal and laminal. It is most closely related to the non-phyllidiate species *P. hirsuta* and *P. guillemini*.

lichens / *Pseudocyphellaria* / phyllidia / species pair

Résumé – La nouvelle espèce, *Pseudocyphellaria dasyphyllidia*, est décrite. Elle se développe sur les rochers et les arbres dans des habitats secs du Chili ; et se caractérise par son photobionte appartenant aux cyanophytes, des lobes du thalle étroits, laciniés et imbriqués, à marges hirsutes, simples ou coralliformes, la présence de nombreuses phyllidies hirsutes marginales ou laminales. *P. dasyphyllidia* est en relation étroite avec les espèces non-phyllidiées *P. hirsuta* et *P. guillemini*.

INTRODUCTION

The lichen genus *Pseudocyphellaria* Vain. is one of the most speciose genera in southern South America. Galloway (1986) first revised 14 non-glabrous species from southern South America, and subsequently he revised the genus in southern South America, accepting a total of 53 species (Galloway, 1992). *Pseudocyphellaria hirsuta* (Mont.) Malme, a common hirsute, cyanobacterial monophyllous species, was considered a variable species in terms of lobe morphology, surface hairiness and of pigment deposition in the pseudocyphellae (Galloway, 1986). This variation in lobe morphology and hairiness was indicated already by Montagne (1835) in a note at the end of the description of *Sticta hir-*

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suta: "Thallus (...) submonophyllus late lobatus, lobi antice rotundati sublobulati, marginibus magis minusve repando-crenatis". An extreme example with '±pseudo-isidiate-coralloid' lobe margins was seen by Galloway (1986) and considered an ecological modification of a primarily corticolous species to growth in an exposed, saxicolous habitat.

A closer study of the variation within *P. hirsuta* as defined by Galloway (1986; 1992) was undertaken. Resulting from this, a new species is described below to accommodate the suite of isidiate-phyllidiate specimens, which are distinct from *P. hirsuta* s. str. in various features.

MATERIAL AND METHODS

Field studies and collecting trips in Chile were performed by the authors on several occasions throughout the distribution range of species of *Pseudocyphellaria*. Most specimens are deposited in TROM and UV. In addition, some of the herbarium specimens from S and G seen by the second author during his work with the revision of the genus (Galloway, 1986; 1992) were re-examined, for example the syntype of *S. hirsuta*.

Thin-layer chromatography (TLC) was performed according to standardised procedures (Culberson 1972; White & James 1985). Photographs were taken in a stereo microscope.

RESULTS

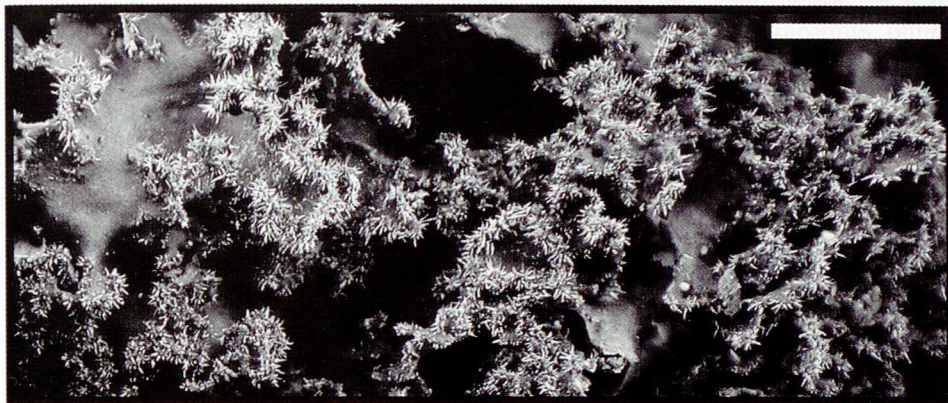
Pseudocyphellaria dasyphyllidia Bjerke, sp. nov. Fig. 1

Quoad thallum, fabricam internam apotheciorum et contentum chemicum ad Pseudocyphellariam hirsutam accedit, sed ab ea differt essentialiter lobis lacinatoribus minusque hirsutis, phyllidiis hirtis et numerosis et marginalibus et lateralibus, quae longitudinem 0.2-1.0 mm habent.

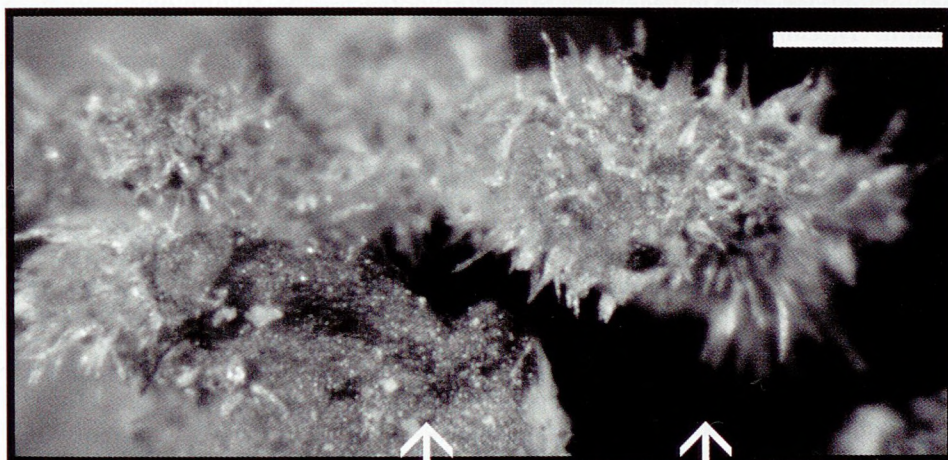
Holotype: CHILE, IX Región de la Araucana, Provincia de Cautín, Parque Nacional Conguillío, 100 m WSW of Cabañas La Baita, 910 m a.s.l. 38°43'43" S - 71°37'36" W. In part shade on fresh scoria between trees of *Nothofagus dombeyi*, associated with *Pseudocyphellaria crocata* (L.) Vain., *P. intricata* (Delise) Vain., *Placopsis fuscidula* I. M. Lamb, *P. perrugosa* (Nyl.) Nyl., *Stereocaulon vesuvianum* Pers., *S. verruciferum* Nyl., *Coelopogon epiphorellus* (Nyl.) Brusse & Kärnefelt and *Racomitrium* sp., 29 November 2001, J. W. Bjerke 1421/01 & D. J. Galloway, TROM, isotypes in SGO, S.

Thallus saxicolous, terricolous or rarely corticolous, 170-300 µm thick, orbicular to irregularly spreading, 3-15 cm diam., rather closely attached centrally, margins free, slightly ascendant. *Lobes* linear-lacinate to slightly rounded, imbricate, 0.3-1.0 cm wide, not monophyllous, *margins* irregularly notched, crenate, rather thin, sparsely to densely phyllidiate, especially in older lobes, occasionally sublobulate at non-phyllidiate lobes, hirsute. *Upper surface* dark bluish-grey centrally, orange-brown at margins when moist, dark brown to greyish

a



b



glabrous
upper surface

hirsute
phyllidium

Fig. 1. *Pseudocyphellaria dasyphyllidia*. Type specimen. a. Upper surface with hirsute phyllidia along margins. b. Detail of phyllidium Scale: a = 1.5 cm, b = 0.4 mm.

brown when dry, undulate to slightly wrinkled, hirsute only at margins and outermost part of lobes and phyllidia, \pm glabrous laminally, occasionally with small, isolated hirsute patches, occasionally scabrid-areolate, thin, rather papery, brittle when dry, emaculate, without pseudocyphellae and soredia. *Hairs* rather long at margins, shorter or lacking centrally, silky, white. *Phyllidia* marginal and occasionally laminal, especially along cracks, densely hirsute, flattened, dorsiventral, 0.2-1.0 mm long, constricted at base, crenate, simple to dichotomous to coralloid, occasionally terete, dactyliform and isidia-like, easily detached leaving a white scar. *Medulla* white. *Lower surface* undulate, pale buff to brownish, tomentose, \pm glabrous centrally and around pseudocyphellae, *tomentum* whitish to pale buff, brownish towards centre, velvety, cortex smooth. *Pseudocyphellae*

yellow, small, flat to slightly verruciform, rather inconspicuous to occasionally strongly eroded and confluent, 0.1-2.5 mm diam., scattered to slightly clustered, round, ellipsoid when confluent, linear and discontinuous at margins, decorticate area flat or slightly raised. *Apothecia* occasional to common, sometimes absent, marginal or submarginal, pedicellate, often rather cupuliform, 0.5-7.0 mm diam., margins normally hirsute, involute and obscuring disc at first, pseudocyphellate, occasionally phyllidiate, *disc* concave, dark red-brown to brown-black, matt, epruinose. *Exciple* densely hairy, rarely with scattered hairs only, often with conspicuous pseudocyphellae, occasionally with decorticate, white patches (< 1 mm). *Pycnidia* laminal, red-brown when moist, dark brown when dry, slightly raised, 0.15 mm diam. or less, rare to scattered.

Anatomy: *Upper cortex* 28-40 μm thick, orange-brown to dark brown with a paler zone near photobiont layer, cells \pm isodiametric, 5-7 μm diam., *hairs* in fascicles, 35-200(-250) μm long. *Photobiont layer* 35-65 μm thick, cyanobiont *Nostoc*. *Medulla* 55-100 μm thick. *Lower cortex* 20-38 μm thick, pale straw-coloured to pale-brown, cells 5-8 μm diam., *tomental hairs* in fascicles, septate, 6-10 μm thick and to 400 μm long, normally shorter than 260 μm . *Apothecia:* *exciple* containing photobiont, layers as in vegetative thallus. *Hypothecium* 35-50 μm thick, yellowish brown. *Thecium* 60-90 μm tall, colourless to pale straw-coloured, *epithecium* 7-13 μm thick, red-brown. *Asci* 55-75 \times 15-20 μm at maturity. *Ascospores* 1-3-septate, hyaline to brown at maturity, broadly fusiform; 20-26 \times 6-9 μm .

Chemistry: Calycin, pulvinic acid and pulvinic dilactone. The latter compound is often in too small concentrations to be detected by TLC.

Etymology: The epithet is constructed by two words, both of Greek origin: 'dasys', which means 'hairy' or 'hirsute', and 'phyllidium' which is a term derived from 'phyllum' and introduced by Acharius to accommodate the dorsiventral outgrowths in lichens smaller than lobules.

Distinguishing features: *Pseudocyphellaria dasyphyllidia* is characterised by a white medulla, a cyanobacterial photobiont, narrow, laciniate and imbricate lobes with hirsute margins (Fig. 1), and simple to coralloid, densely hirsute phyllidia that are both marginal and laminal. It has marginal to submarginal apothecia with a tomentose exciple, prominent yellow pseudocyphellae and occasionally furnished with phyllidia along margins. It is distinguished from *P. hirsuta* s. str. in having true phyllidia, narrower, more laciniate lobes that are not monophyllous, and somewhat smaller apothecia, asci and ascospores. The large apothecia (diam. > 1 cm) with flat discs often seen in *P. hirsuta* are not found in *P. dasyphyllidia*. Sublobulate specimens of *P. hirsuta* are close to *P. dasyphyllidia*, but the lobules are not constricted at base and do not easily break off as do true phyllidia. The lobules of *P. hirsuta* often appear to be the primary stage in the production of marginal apothecia, and therefore do not have a role as vegetative propagules. Similar lobules are occasionally found in *P. dasyphyllidia*. Although *P. hirsuta* shows some variation in upper surface hairiness (Galloway, 1986), it is rarely as glabrous as *P. dasyphyllidia*, which is most common with hairs only within a 0.1-0.5 cm broad marginal zone of the lobes, and on phyllidia. The spores of *P. hirsuta* are 25-36 \times 5.5-8.5 μm (Galloway, 1986). The spores of *P. dasyphyllidia* are more similar to those of *P. guillemini* (Mont.) D. Galloway, which are 20-25 \times 6.5-7.5 μm (Galloway, 1986). It is distinguished from *P. guillemini* in having phyllidia and laciniate, crenate margins and in lacking pseudocyphellae on the upper surface, and from the New Zealand species *P. margaretae* D. Galloway that lacks both apothecia and vegetative propagules and has thick lobes that are subdichotomously to complexly divided. Yellow pseudocyphellae on the lower surface of young, minute, laminal phyllidia in *P. dasyphyllidia* are sometimes

similar to the pseudocyphellae on the upper surface of *P. guillemini*, but the pseudocyphellae of the latter species are not associated with phyllidia-like outgrowths.

Pseudocyphellaria dasyphyllidia shows minor morphological and anatomical variation. The shape and length of phyllidia is variable, and show intrathalline variation. The best-developed phyllidia are coralloid apparently with one phyllidium growing out from another, but they start as simple, dorsiventral outgrowths that soon become constricted at base. It is normally hirsute only at margins and on phyllidia, but a few specimens are \pm hirsute towards centre. The length of hairs both at upper and lower surfaces is variable, and exceeding the lengths measurements for *P. hirsuta* given by Galloway (1986). The variation in deposition of pulvinic acid derivatives in pseudocyphellae observed in *P. hirsuta* (Galloway, 1986) is not seen in *P. dasyphyllidia*. All examined specimens have yellow pseudocyphellae.

Habitat ecology and distribution: *Pseudocyphellaria dasyphyllidia* is known from two main distribution areas in Chile (Fig. 2). The major area of occurrence is between latitudes 35°30' and 38°30' S, where it grows on volcanic rocks or on trunks of fallen or standing trees in open, relatively dry forests, mostly at altitudes between 900 and 1400 m a.s.l. Phorophytes are *Nothofagus dombeyi*, *N. obliqua*, *N. glauca*, *N. antarctica* and probably *Araucaria araucana*. In these habitats it associates with other drought-tolerant lichens such as *Pseudocyphellaria coriifolia* (Müll. Arg.) Malme, *Physconia* spp., *Physcia* spp., *Hypotrachyna sinuosa* (Sm.) Hale and *Protousnea* spp. On rocks it associates with *Pseudocyphellaria crocata*, *P. intricata* and other saxicolous species (see type specimen above). Further south, in antiboreal deciduous forests between 50 and 250 m a.s.l., it is a predominantly saxicolous species, growing amongst mosses and other saxicolous lichens such as *P. crocata*, *Parmelia saxatilis* (L.) Ach., *Neuropogon* spp. and *Xanthoparmelia* spp. It has also been found on fallen trunks of *Nothofagus pumilio*, and associates with many of the same species as further to the north. A poor specimen (*G. Follmann* s.n.) collected from rocks in Parque Nacional Fray Jorge, a relict sclerophyllous forest at latitude 30° S, kept alive by constant sea fog (Redon *et al.*, 1975), has a few, minute phyllidia-like outgrowths and is placed with some caution in *P. dasyphyllidia*. More material should be seen to confirm its occurrence at this locality. It is probably present in Argentina, but none of the examined specimens was Argentinean.

Pseudocyphellaria dasyphyllidia thrives in drier and more sun-exposed habitats than *P. hirsuta* and *P. guillemini*, and is absent from the humid, lush forests at low altitudes where the two latter species are common. However, *P. hirsuta* also occasionally occurs on rocks in rather dry and sunny habitats, e.g. in Parque Nacional La Campana at latitude 33° S (own observations).

Specimens examined: CHILE: IV Region: Prov. de Limari: Parque Nacional Fray Jorge, 1963, G. Follmann s.n. (UV 0503). VII Region: Prov. de Cauquenes: Constitución, Pellines, 1970, J. Redon s.n. (UV); Constitución, Pellines, 27 September 1970, W. Quilhot s.n. (UV). VIII Region: Prov. de Ñuble: Chillán, Cajón de Diguillín, 7 May 1984, W. Quilhot 0936 (UV); Prov. de Concepción: Caleta Puda, September 1970, J. Redon 02263 (UV 0836). IX Region: Prov. de Malleco: Reserva Nacional Malalcahuello, September 1968, J. Redon (?) 01279 (UV 0509); Reserva Nacional Malalcahuello, 23 November 1980, W. Quilhot 0837 (UV); Los Jeuyes, March 1973, W. Quilhot 0832 (UV); Lonquimay, September 1968, J. Redon (?) 01279 (UV 1039); Parque Nacional Nahuelbuta, May 1970, J. Redon 002260, 0222 (UV); Parque Nacional Nahuelbuta, 29 May 1973, W. Quilhot 0501 (UV). Prov. de Cautín: Parque Nacional Conguillío, El Hoyón,

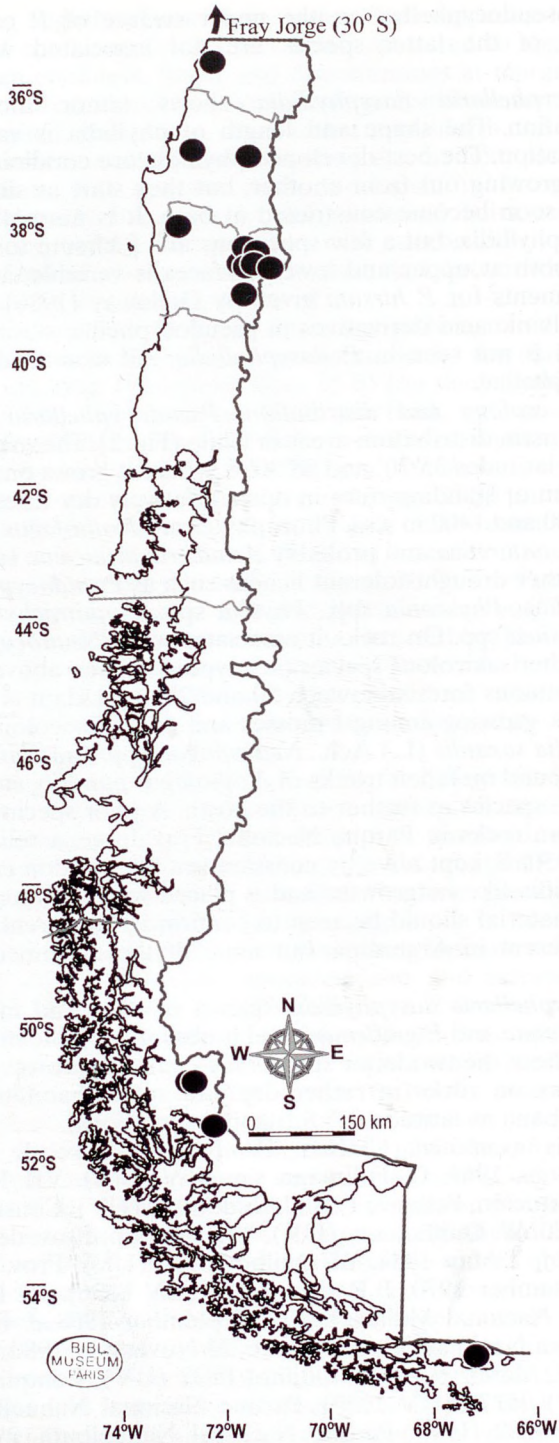


Fig. 2. Known distribution of *Pseudocypbellaria dasyphyllidia* in Chile.

14 December 1983, W. Quilhot 0978 (UV); Parque Nacional Conguillío, Los Paraguas, November 1992, W. Quilhot 0977 (UV); Parque Nacional Conguillío, 5–10 km N of the Visitor's centre, 20 December 1995, A. Elvebakk 95:384 (TROM); Lago Icalma, February 1971, J. Redon (?) 002704 (UV 0968); Icalma, 28 November 2001, J. W. Bjerke 1399/01 (TROM); 10 km NE of Curarrehue, 18 January 1998, A. Elvebakk s.n. (TROM). X Región: Prov. de Valdivia: Valdivia, 1877, s. coll. (G 10042/9). XII Region: Prov. de Última Esperanza: Parque Nacional Torres del Paine, 1.5 km W of Refugio Pehoe, 8 March 1998, J. W. Bjerke 108/98 & A. Elvebakk 98:290 (TROM); Parque Nacional Torres del Paine, SE of Lago Grey, 11 March 1998, J. W. Bjerke 150/98 (TROM); Puerto Natales, Cerro Dorotea, 1940, R. Santesson 8238 (S); N of Puerto Natales, Cueva Chica, 17 March 1992, A. Elvebakk s.n. (TROM). Prov. de la Antártica Chilena: Isla Navarino, Puerto Toro, 1975, J. Redon s.n. (UV).

DISCUSSION

Some species of southern South American *Pseudocyphellaria* that normally lack vegetative propagules are occasionally found with scattered phyllidia or phyllidia-like lobules, e.g. *P. berberina* (G. Forster) D. Galloway & P. James, *P. coerulescens* (Mont.) Magnusson and *P. obvoluta* (Ach.) Malme (Galloway, 1992). The development of phyllidia in these species was considered by Galloway (1992) as an adaptation to a particular habitat ecology, and not given any taxonomic rank, although an infraspecific rank of the phyllidiate specimens of *P. coerulescens* was considered (ibid., p. 80). In the genus *Nephroma* Ach., similar examples of non-phyllidiate taxa with phyllidiate, isidiate or lobulate counterparts are found. In some cases, the phyllidia development arises as a result of environmental stress, and a continuum from non-phyllidiate, richly fertile specimens to phyllidiate-lobulate specimens with few or no apothecia can be demonstrated (White & James, 1988). In these cases, there appears to be little justification for treating foliole development at more than varietal level, as in *N. antarcticum* (Jacq.) Nyl. var. *lobuligerum* Müll. Arg., *N. cellulosum* (Ach.) Ach. var. *isidioferum* J. S. Murray and *N. plumbeum* (Mont.) Mont. var. *isidiatum* (J. S. Murray) F. J. White & P. James (White & James, 1988). However, other pairs of taxa in the genus are recognised as distinct species. For instance, there are no intermediate forms between the fertile species *N. areolatum* P. James & F. J. White and the isidiate species *N. sulcatum* P. James & F. J. White, whereas the isidiate species *N. isidiosum* (Nyl.) Gyeln. possesses many features in common with the fertile species *N. helveticum* Ach., but in addition to the presence of isidia, other minor morphological differences exist (James & White, 1987; White & James, 1988).

The taxonomic rank of isidiate-phyllidiate types in the genus *Peltigera* Willd. has been a matter of discussion for a long time, as reviewed by Vitikainen (1994). *Peltigera praetextata* (Flörke ex Sommerf.) Zopf, which differs from *P. canina* (L.) Willd. by the presence of phyllidia and the structure of rhizines and veins, is now widely recognised at species level, but it was previously recognised as varieties or forms of both *P. canina* and *P. rufescens* (Weiss) Humb. (Vitikainen, 1994). The isidiate species *P. lepidophora* (Vain.) Bitter and *P. evansiana* Gyeln.

are also raised to species level, after having been treated at infraspecific levels previously (Vitikainen, 1994).

In *Pseudocyphellaria*, there are several examples of species pairs, in which the presence-absence of propagules are the major distinguishing feature. Most of these species pairs are sorediate and non-sorediate counterparts (see Galloway, 1988; 1992). However, phyllidiate and non-phyllidiate counterparts exist as well. *Pseudocyphellaria fimbriata* D. Galloway & P. James is distinguished from *P. coriacea* (J. D. Hook & Taylor) D. Galloway & P. James primarily by the marginal and laminal phyllidia (Galloway, 1988). Another such example of species pair is *P. fimbriatoides* D. Galloway & P. James and *P. cinnamomea* (A. Rich.) Vain. (Galloway, 1988).

The new taxon described in the present paper is recognised at species level in accordance with the taxonomic comprehension outlined in the many examples given above. Since there is no continuum from *P. dasyphyllidia* to *P. hirsuta* s. str., and since the presence of phyllidia is accompanied by other minor morphological differences, the species rank appears to be well justified. Actually, the sizes of asci and ascospores in *P. dasyphyllidia* indicate a closer relationship to *P. guillemini* than to *P. hirsuta*, but morphologically it is most similar to *P. hirsuta*.

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