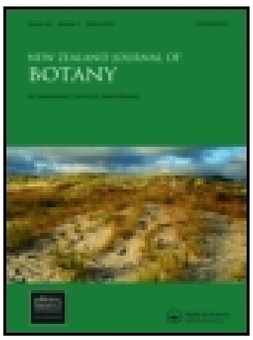

New Zealand Journal of Botany

ISSN: 0028-825X (Print) 1175-8643 (Online) Journal homepage: http://www.tandfonline.com/loi/tnzb20

New records of Antarctic lichens

A Passo, JM Rodriguez & J Chiapella

To cite this article: A Passo, JM Rodriguez & J Chiapella (2015): New records of Antarctic lichens, New Zealand Journal of Botany, DOI: 10.1080/0028825X.2015.1057185

To link to this article: http://dx.doi.org/10.1080/0028825X.2015.1057185

Published online: 29 Nov 2015.

New Zealand Journal of Botany, 2015
http://dx.doi.org/10.1080/0028825X.2015.1057185

Taylor & Francis
Taylor & Francis Group

SHORT COMMUNICATION

New records of Antarctic lichens

A Passo[a]*, JM Rodriguez[b,c] and J Chiapella[d]

[a]*Instituto de Investigaciones en Biodiversidad y Medio Ambiente, INIBIOMA-CONICET - Universidad Nacional del Comahue, Bariloche, Argentina;* [b]*Centro de Ecología y Recursos Naturales Renovables, CERNAR, Universidad Nacional de Córdoba, Córdoba, Argentina;* [c]*IIByT, CONICET- Universidad Nacional de Córdoba, Córdoba, Argentina;* [d]*Instituto Multidisciplinario de Biología Vegetal, IMBIV-CONICET- Universidad Nacional de Córdoba, Córdoba, Argentina*

(*Received 3 April 2015; accepted 27 May 2015*)

Recent collections from King George Island, Deception Island and the Antarctic Peninsula provide evidence of the presence of previously unrecorded lichen taxa in the Antarctic flora. *Parmelia sulcata*, previously cited for South Georgia, and *Usnea neuropogonoides* are recorded for the first time from maritime Antarctica. The distributions of *Psoroma buchananii* and *U. acromelana* are extended to the Antarctic Peninsula and to Deception Island, respectively. The taxonomic position of an abnormal form of *U. aurantiaco-atra* is discussed.

Keywords: Antarctic Peninsula; distribution; lichenised fungi; South Shetlands Island; taxonomy

Introduction

The vast Antarctic territory includes all lands south of latitude 60° (Heap 1994). It is divided into two major biogeographical zones: continental Antarctica, comprising the Antarctic continent itself and all islands immersed in the ice shelf, excluding the west coast of the Antarctic Peninsula; and maritime Antarctica, which includes the west coast of the peninsula, the South Shetlands, the South Sandwich Islands and the South Orkney Islands (Lewis Smith 1984). Terrestrial ecosystems are restricted to the 4% of lands that are ice-free during the summer months. The severe weather conditions make Antarctica one of the harshest environments on Earth for the development of higher plants (Green et al. 2007). In fact, Antarctic terrestrial ecosystems have the particularity of being dominated almost exclusively by lichens and mosses. Only two species of vascular plants can be found, *Deschampsia antarctica* Desv. and *Colobanthus quitensis* (Kunth) Bartl., and these only in maritime Antarctica. The relatively high humidity and milder temperatures found in maritime Antarctica, together with the absence of competition from higher plants, create the perfect place for stress-tolerant organisms such as lichens (Sancho & Pintado 2011). The lichen diversity of the Antarctic territory was estimated at c. 350 species (Olech 2001), but this number is rapidly increasing (Øvstedal & Lewis Smith 2009) due to additions being continuously published. The total number for the Antarctic and South Georgia is now estimated to be at least 500 (Øvstedal & Lewis Smith 2011; Øvstedal & Schaefer 2013).

However, this assemblage of lichen species could be undergoing modifications. The Antarctic continent is experiencing a steady increase in human activities that could result in the risk of introduction of non-native species; global climate change may additionally trigger the expansion of the distribution range of taxa of nearby regions (i.e. southern South America, New Zealand, Australia).

*Corresponding author. Email: alfredo.passo@crub.uncoma.edu.ar

Establishing a better knowledge of the taxa native to Antarctica, as well as of changes in their distributions, will fulfil a twofold objective: a deepening of our understanding of the evolution of the Antarctic flora, and establishment of suitable environmental protection policies. The aim of this article is to provide evidence of previously unrecorded lichen taxa and new localities of species in maritime Antarctica. Herein, *Parmelia sulcata* and *Usnea neuropogonoides* are recorded for the first time from maritime Antarctica. In addition, the distribution ranges of two other lichen species, *Psoroma buchananii* and *Usnea acromelana*, are extended to the Antarctic Peninsula and Deception Island. Finally, an abnormal form of *Usnea aurantiacoatra* is documented and its taxonomic position discussed.

Materials and methods

The present research was based on collections made during the Antarctic Argentinean survey of February and March 2014. Three localities were visited: Potter Peninsula near Carlini station (ex Jubany), on King George Island (Isla 25 de Mayo), South Shetland Islands; Whalers Bay on Deception Island, in the same archipelago; and Cierva Cove, near Primavera station, on the Danco Coast, west Antarctic Peninsula. The collections are kept in the herbaria of Universidad Nacional del Comahue (BCRU) and Universidad Nacional de Córdoba (CORD).

Study area

King George Island, the largest in the South Shetland archipelago, is located between 61°50′ and 62°15′S and 57°30′ to 59°01′W (Fig. 1A,B). The island lies c. 770 km southeast of Cape Horn, from which it is separated by Drake Passage, and c. 160 km north of Trinity Peninsula, the northernmost part of the Antarctic Peninsula.

Deception Island is the caldera of an active volcano and is located at 62°58′37″S, 60°39′00″W (Fig. 1A). The island is approximately circular with a diameter of about 12 km. Whalers Bay is an abandoned whaling station, first established by Norwegians, but then re-occupied by the British Royal Navy until 1969 when it was abandoned due the eruption of the volcano (Fig. 1C).

The Danco Coast (64°42′S, 62°0′W) is that portion of the west coast of the Antarctic Peninsula between Cape Sterneck and Cape Renard (Fig. 1A, D).

Species studies

Morphological and anatomical studies were performed following standardised methods. Secondary compounds were identified by thin layer chromatography (TLC), following standardised protocols (Culberson & Kristinsson 1970; Elix 2014). For a detailed list of the characters used in *Usnea* species description see Rodriguez et al. (2011).

Taxonomy

Parmelia sulcata Taylor (1836), Flora Hibernica, Dublin: 145, 1836.

Lectotypus. Ireland, Co. Kerry: Dunkerron, Kerry, *Taylor* (FH-Taylor, non vidi).

Description

Thallus foliose, lobulated, orbicular to more or less irregularly spreading, up to 10 cm diam. (Fig. 2A), closely to loosely attached to substratum, saxicolous in Antarctic territory; lobes linear-laciniate to more or less rounded in older specimens, sub-dichotomously branched, 2–3.5 mm wide; margins entire, sinuous; upper surface whitish to pale greenish-grey, not pruinose in Antarctic specimens, maculate at lobe tips, slightly wrinkled-foveolate, pseudocyphellae coarse, elongate and reticulate, originating from maculae and soon becoming sorediate (Fig. 2B); soredia derived from pseudocyphellae, in lines as a coarse reticulum, or becoming confluent at thallus centre; lower surface black, densely rhizinate; rhizines black, simple to squarose; apothecia and pycnidia not seen. *Chemistry*: cortex K+ yellow, medulla K+ yellow to red, C-, KC+ red, Pd+ orange; salazinic acid, consalazinic and atranorin.

Representative specimens. Antarctic Peninsula, Danco Coast, Punta Cierva, 64°09′18,5″S, 60°57′

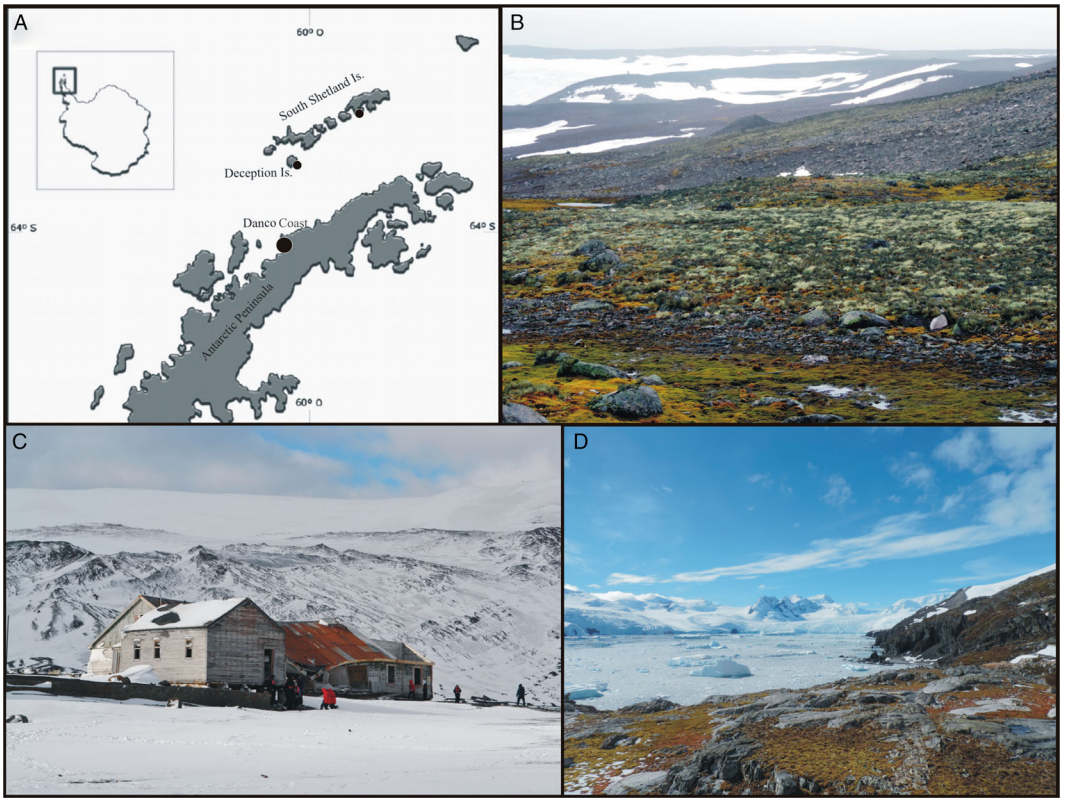

Figure 1 Localities visited during the 2014 Argentinean Antarctic Expedition. **A,** Map of the Antarctic Peninsula and South Shetland Islands. Black dots indicate locations of the three stations visited; **B,** typical landscape of King George Island, showing a mature *Usnea*-dominated community; **C,** abandoned whaling buildings at Deception Island; **D,** landscape of Danco Coast, near Primavera station.

09,1″W, on rock, 11 Feb 2014, *Passo–Rodriguez s.n.* (BCRU 5369); 64°09′40,1″S, 60°57′09,1″W, on rock, 12 Feb 2014, *Rodriguez–Passo 2856* (CORD).

Ecology and distribution. *Parmelia sulcata* is a widespread species, known from New Zealand, Australia, Asia, Europe, Africa and North America (Stenroos 1991). In southern South America it is relatively common, found in Argentina, including the Falkland Islands (Islas Malvinas), and Chile (Stenroos 1991; Calvelo 1994). Lindsay (1973) reported the species for the sub-Antarctic island, South Georgia, but considered it an introduced species, as it was growing on the hulks of a sunken ship. The species was never found again, either in sub-Antarctic islands or in the Antarctic region (Øvstedal & Lewis Smith 2001). This is the first record of the species from maritime Antarctica. It was found over rocks together with *P. saxatilis*, *Usnea antarctica* Du Rietz and *Umbillicaria antarctica* Frey & I.M. Lamb, near the sea in the vicinity of the Argentine base Primavera on the Danco Coast, west Antarctic Peninsula.

Taxonomic notes. Five *Parmelia* species were cited for Antarctica by Øvstedal & Lewis Smith (2001, 2009). Among these records they cited *P. cunninghamii* Cromb. for the Danco Coast growing on rock, relatively near Punta Cierva where *P. sulcata* was found. However, the two species are easily separated by the presence of marginal whitish

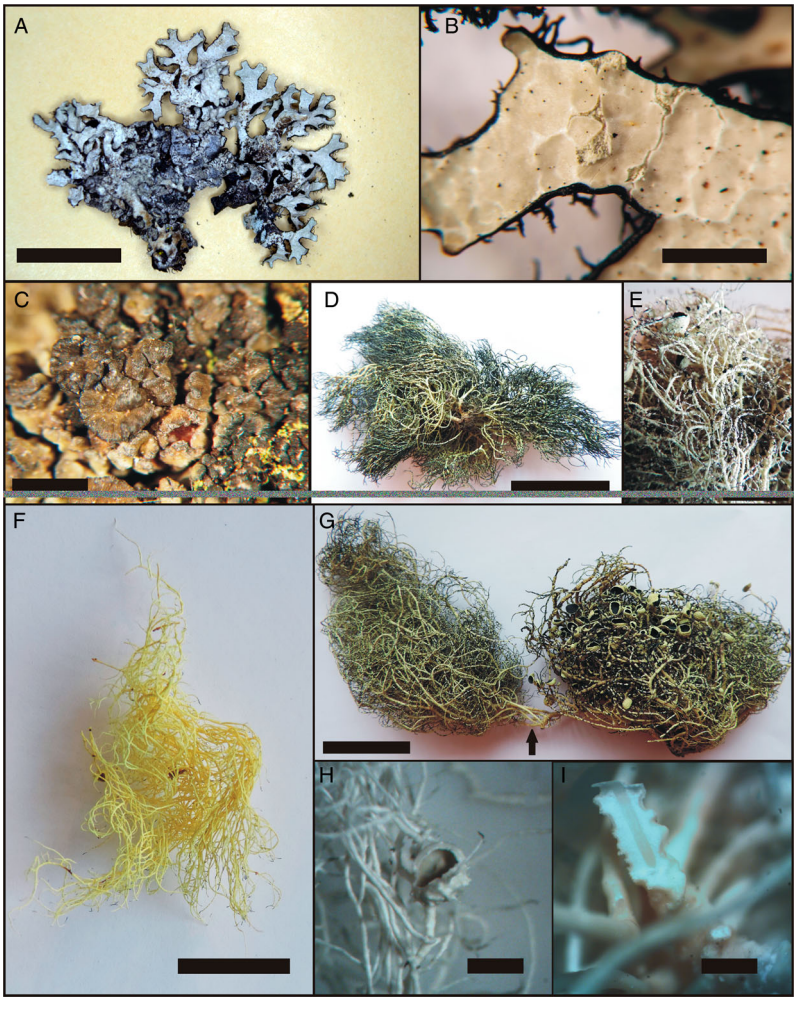

Figure 2 Growth habit and detail of species. **A,** Thallus of *Parmelia saxatilis*; **B,** soredia originating from maculae; **C,** thallus of *Psoroma buchananii*; **D,** thallus of *Usnea acromelana*; **E,** fertile specimen of prostrate *Usnea* aff. *aurantiaco-atra*; **F,** prostrate form of *Usnea* aff. *aurantiaco-atra* originating from basal branch of a typical shrubby form (arrow); **G,** thallus of *Usnea neuropogonoides*; **H,** apothecia of *Usnea neuropogonoides* with a yellowish disc; **I,** cortex, medulla and axis of *Usnea neuropogonoides*. Scale bars: A, F, G = 2.5 cm; B = 2 mm; C and I = 1 mm; D = 2 cm; E = 1 cm; H = 2.5 mm.

glomerular soredia, rounded lobes, and lobaric acid as accessory to salazinic and atranorin in *P. cunninghamii*, while *P. sulcata* has laminar soredia originating in pseudocyphellae, laciniate lobes and an absence of lobaric acid (Stenroos 1991; Calvelo 1994). Additional collections of both species from Patagonia were analysed, confirming the identity of *P. sulcata*.

Psoroma buchananii (C. Knight) Nyl., *Lich. Nov. Zealand.:* 55 (1888).

=Thysanothecium buchananii C. Knight, Trans. Proceed. New Zealand Instit., 13: 386 (1881).

Lectotypus. New Zealand, Otago, Mt. Aspiring Range, *J. Buchanan* (H-NYL 30797). *isolectotype* at WELT *n.v.*

Description

Thallus squamulosus, muscicolous or terricolous, 1.5–3 cm diam., growing irregularly on the substratum, in compact patches; prothallus absent; squamules 1–4 mm diam., granular, closely attached to substratum or incised, rosette forming to subascendant (Fig. 2C); upper surface smooth to slightly rough, matt to partially shiny, olive green to brown-reddish or purplish, with darker areas; lower surface growing directly on the substratum; cephalodia squamulose to cerebroid, dark brown to grey, occasionally pruinose; pycnidia semiglobose, black; apothecia circular, up to 4 mm diam., somewhat convex, margin crenate to granular, prominent; disc dark brown to reddish; hymenium I+ blue, asci with internal amyloid ring structure; ascospores globose to subglobose, 10.5–17 × 10.5–13 µm, perispore notably warted. *Chemistry*: medulla K-, C-, Pd-, no substances detected by TLC.

Representative specimens. Antarctic Peninsula, Danco Coast, Punta Cierva, 64°09′27,1″S, 60°56′51,1″W, on soil among mosses, 10 Feb 2014, *Passo–Rodriguez s.n.* (BCRU 5371). South Shetland Islands, King George Island, Potter Peninsula, 62°14′30,5″S, 58°39′42,8″W, on soil, 16 Feb 2014. *Passo–Rodriguez s.n.* (BCRU 5373), 62°14′25,5″S, 58°40′30,7″W, 13 Feb 2014, *Passo–Rodriguez s.n.* (BCRU 5372). Admiralty Bay area, 29 Dec 1979, *R. Ochyra 5011/79* (H). Admiralty Bay, Damay Point, on basalt rock in penguin rookery, 27 Jan 1980, *R. Ochyra s.n.* (H).

Ecology and distribution. *Psoroma buchananii* is an austral species, found in New Zealand, the Antarctic territories (South Orkney, the South Shetland and James Ross Islands) and southern South America (Øvstedal & Lewis Smith 2001; Galloway 2007; Passo 2010). The distribution of this species is here extended to the Antarctic Peninsula.

Taxonomic notes. *Psoroma buchananii* is characterised by its incised, more or less rosette-forming squamules, by its olive-green colour, with reddish or purplish tinges (Fig. 2C), and by its subglobose spores with big rounded warted epispores, which distinguish the species from the usually co-existing *P. hypnorum* (Vahl) Gray and *P. cinnamomeum* Malme.

Usnea acromelana

Stirton in Trans. Proc. N.Z. Inst. 30: 388 (1898).

Description

For a detailed description see Øvstedal & Lewis Smith (2001). *Usnea acromelana* is readily identified by the absence of tubercles and papillae, anisotomic branching, its variegated black to violet pigment and the soralia circular, plane to concave with pigmented isidiomorphs (Fig. 2D). Additionally, this species can be identified by its very thin and compact medulla (less than 10%), and thick axis. The chemistry is very stable in this species with norstictic and salazinic acid in the medulla.

In this work, *Usnea acromelana* was collected from fence posts in the abandoned buildings of the whaling stations at Whalers Bay (Fig. 1C). This is the first record from Deception Island in the maritime Antarctic.

Representative specimens. South Shetland Islands, Deception Island, Bahía de los Balleneros, on fence post, 09 Feb 2014, *Rodriguez–Passo 2852* (CORD).

Usnea aurantiaco-atra

(Jacq.) Bory in Mém. Soc. Linn. Paris 4:596 (1826).

Lectotypus. [Chile] Magellan Straits, 1767, *Commerson, comm. D. Jussieu* (PC).

Description

Thallus scrambling-prostrate, with or without distinctive holdfast, up to 23 cm long, anisotomic-dichotomous branching; trunk absent or present, up to 5 mm, black pigmented; branches cylindrical to irregular; secondary branches not narrowed at point of attachment; segments cylindrical and ridged in transversal section; fibrils scarce, short (1.5–2.5 mm), irregularly distributed on whole thallus; black to violet pigmentation in base, terminal branches

and fibrils and sometimes in whole thallus variegated; furrows and foveoles absent; soralia and isidiomorphs absent; papillae absent, tubercles always present, conspicuous; apothecia only seen in one specimen (Fig. 2E), serial, disc black, up to 7 mm diam., without fibrils; pycnidia and conidia not seen; cortex glossy, thin: 4.4–7.0–8.8–10.4–13.1% (n = 8); medulla compact, white, thin: 4.6–9.8–13.2–18.4–22.3% (n = 8); axis thick: 42.1–53.9–56.1–68.0–82.0% (n = 8). *Chemistry*: Chemical race 1: usnic acid, chemical race 2: salazinic, norstictic, usnic acids.

Representative specimens. South Shetland Islands, King George Island, Potter Peninsula, 62°14′16.8″ S, 58°40′01.7″W, 3 m, on rocks, 17 Feb 2014, *Rodriguez–Passo 2525* (CORD). 62°14′39,2″S, 58°40′11,8″W, 20 Feb 2014, *Rodriguez–Passo 2526* (CORD). 62°14′42,0″S, 58°39′21,1″W, 20 Feb 2014, *Rodriguez–Passo 2853* (CORD). 62°14′21,9″S, 58°39′13,9″W, 20 Feb 2014, *Rodriguez–Passo 2854* (CORD). 62°14′28,9″S, 58°39′43,9″W, 20 Feb 2014, *Rodriguez–Passo 2855* (CORD).

Taxonomic notes. Walker (1985) mentioned this abnormal form of *Usnea aurantiaco-atra* from prostrate and sterile specimens from Antarctica and the Falkland (Malvinas) Islands. In intensive fieldwork in King George Island we found typical *U. aurantiaco-atra* as described in Walker (1985), Øvstedal & Lewis Smith (2001) and Olech (2004). Also, we found pendant and prostrate specimens in soil communities. The scarce pigmentation, the habit and the absence of apothecia easily separate these specimens, in appearance, from the typical erect–shrubby *U. aurantiaco-atra*. A robust character to separate species in *Usnea* is the relationship between the width of the cortex, medulla and axis (CMA; Clerc 1998). In our measurements, the pendulous specimens of *U. aurantiaco-atra* have a thinner axis in comparison with the shrubby ones. However, this character alone is not enough to separate species in *Usnea.* Indeed, we found one specimen where the two forms are exhibited, a typical erect–shrubby fertile form, and a pendant sterile form derived from a basal branch (Fig. 2F). In this specimen, the shrubby branches showed different CMA values from the pendant branches on the same thallus. *Usnea austrocampestris* Øvstedal (Fryday & Øvstedal 2012) is similar to these prostrate specimens of *U. aurantiaco-atra.* Further field observations as well as molecular studies will be necessary to assess the synonym between these two taxa.

Usnea neuropogonoides

Motyka, Lich. Gen. Usn. Stud. Monogr. 1: 73 (1936).

Holotypus. Argentina: terr. Santa Cruz, Rio Fósiles, c. 1000 m, in rupibus. May 1905, *P. Dusén.* (UPS). TLC: no medullary substances, usnic acid.

Description

Thallus scrambling-prostrate, without distinctive holdfast, up to 10 cm long (Fig. 2G), anisotomic-dichotomous branching; multiple points of attachment to the substrate; branches cylindrical to irregular; secondary branches not narrowed at point of attachment; segments cylindrical and ridged to terete in transverse section; fibrils absent to scarce, short, up to 1.5 mm, irregularly distributed on whole thallus; terminal branches and fibrils usually with black tips, furrows and foveoles present; soralia and isidiomorphs absent; papillae absent, tubercles scarce; apothecia sometimes present, scarce, lateral up to 3 mm diam., strongly concave, disc yellowish to slightly reddish (Fig. 2H), without fibrils or fibrils scarce on the margin and on the underside; spores simple and hyaline, (5.4)–8.1–(9.6) × (4.8)–5.9–(6.2) (n = 11) µm; pycnidia and conidia not seen; cortex glossy, thick: 10.0–10.7–12.2–13.7–14.3% (n = 8); medulla dense, white, moderately thick (Fig. 2I), 9.8–14.6–19.3–24.1–23.7% (n = 8); axis moderately thin, 29.3–37.2–36.9–45.1–51.8% (n = 8). *Chemistry*: usnic acid.

Representative specimens. South Shetland Islands, King George Island, Potter Peninsula, 62°14′39,2″S, 58°40′11,8″W, on rocks, 17 Feb 2014, *Rodriguez–Passo 2527* (CORD). 62°14′21,9″S, 58°39′13,9″W, on rocks, 17 Feb 2014, *Rodriguez–Passo 2850* (CORD). 62°14′42,0″S, 58°39′21,1″W, on rocks, 17 Feb 2014, *Rodriguez–Passo 2851* (CORD).

Ecology and distribution. *Usnea neuropogonoides* is a rare species and has been recorded only from Patagonia (Motyka 1936; Walker 1985). This is the first mention of this species from Antarctica. It was found on King George Island growing in the soil in mature lichen communities.

Taxonomic notes. *Usnea neuropogonoides* is characterised by its prostrate habit, the absence of soralia and isidia, a dense medulla and the absence of medullar secondary metabolites. The scarce black or violet pigmentation and the yellowish apothecia separate *U. neuropogonides* from the typical neuropogonoid species. Hence this is the first record of *Usnea* subgenus *Usnea* from Antarctica. However, recent phylogenetic evidence finds an absence of support for groups within the genus *Usnea* (Wirtz et al. 2006). According to Wirtz et al. (2008) and Lumbsch & Wirtz (2011), the neuropogonoid *Usnea* or *Neuropogon* group is characterised by the presence of a patchy or variegated dark pigment in cortex and apothecial discs. However, these characters are ambiguous for defining groups inside the genus (Seymour et al. 2007).

Acknowledgements

We thank the staff of the Carlini (Jubany) station and the Dirección Nacional del Antártico (DNA) for providing logistics support during fieldwork. AP and JC are supported by the Consejo Nacional de Investigaciones Científicas y Técnicas (CONICET) from Argentina. We also thank Dr Jackelyn Kembro and Dr Neil Bell for reading the manuscript and improving the English.

Associate Editor: Dr Eric McKenzie.

Disclosure statement

No potential conflict of interest was reported by the authors.

Funding

This work was funded by Project PICTO 2010–0095 (ANPCyT-DNA) to JC.

References

Calvelo S 1994. *Parmeliaceae* s. lat. (ascomycetes liquenizados) foliosos de los bosques andino-patagónicos y de Tierra del Fuego: estudios taxonómico-florísticos. Unpublished PhD thesis. Buenos Aires, Argentina, Universidad de Buenos Aires. 265 p.

Clerc P 1998. Species concepts in the genus *Usnea* (lichenized ascomycetes). Lichenologist 30: 321–340.

Culberson CF, Kristinsson H-D 1970. A standardized method for the identification of lichen products. Journal of Chromatography A 46: 85–93.

Elix J 2014. A catalogue of standardized chromatographic data and biosynthetic relationships for lichen substances. 3rd edition. Canberra, Author. 322 p.

Fryday AM, Øvstedal DO 2012. New species, combinations and records of lichenized fungi from Falklands Islands (Islas Malvinas). The Lichenologist 44: 483–500.

Galloway DJ 2007. Flora of New Zealand: lichens. Vols 1–2. 2nd edition. Lincoln, Manaaki Whenua Press. 2262 p.

Green TGA, Schroeter B, Sancho LG 2007. Plant life in Antarctica. In: Pugnaire FI ed. Handbook of functional plant ecology. New York, Marcel Dekker Inc. Pp. 389–434.

Heap J 1994. The Antarctic Treaty System: introduction. In: Cohen H ed. Handbook of the Antarctic Treaty System, part I, general measures, Washington, DC, US Department of State. Pp. 9–19.

Lewis Smith RI 1984. Terrestrial plant biology of the subantarctic and Antarctic. In: Laws RM ed. Antarctic ecology 1. London, Academic Press. Pp. 61–162.

Lindsay DC 1973. Notes on Antarctic lichens: VII. The genera *Cetraria* Hoffm., *Hypogymnia* (Nyl.) Nyl., *Menegazzia* Massal., *Parmelia* Ach. and *Platismatia* Culb. et Culb. British Antarctic Survey Bulletin 36: 105–114.

Lumbsch HT, Wirtz N 2011. Phylogenetic relationships of the neuropogonoid core group in the genus *Usnea* (Ascomycota, Parmeliaceae). The Lichenologist 43: 553–559.

Motyka J 1936. Lichenum generis *Usnea* studium monographicum. Pars systematica, volumen primum. Lwów: Leopoli. 304 p.

Olech M 2001. Annotated checklist of Antarctic lichens and lichenicolous fungi. Kraków, Institute of Botany of the Jagiellonian University. 145 p.

Olech M 2004. Lichens of King George Island, Antarctica. Kraków, Institute of Botany of the Jagiellonian University. 392 p.

Øvstedal DO, Lewis Smith RI 2001. Lichens of Antarctica and South Georgia: a guide to their identification and ecology. Cambridge, Cambridge University Press. 441 p.

Øvstedal DO, Lewis Smith RI 2009. Further additions to the lichen flora of Antarctica and South Georgia. Nova Hedwigia 88: 157–168.

Øvstedal DO, Lewis Smith RI 2011. Four additional lichens from the Antarctic and South Georgia,

including a new *Leciophysma* species. Folia Cryptog. Estonica 48: 65–68.

Øvstedal DO, Schaefer CEGR 2013. A new species from Heritage Range, Ellsworth mountains, Antarctica. Hoehnea 40: 361–364.

Passo A 2010. Psoroma y géneros relacionados (Pannariaceae, Ascomycota Liquenizados) de Sudamé-rica austral: estudio taxonómico. Unpublished PhD thesis. Córdoba, Argentina, Universidad de Córdoba. 238 p.

Rodriguez JM, Estrabou C, Truong C, Clerc P 2011. The saxicolous species of the genus *Usnea* subgenus *Usnea* (Parmeliaceae) in Argentina and Uruguay. The Bryologist 114: 504–525.

Sancho LG, Pintado A 2011. Ecología vegetal en la Antártida. Ecosistemas 20: 42–53.

Seymour FA, Crittenden PD, Wirtz N, Øvstedal DO, Dyer PS, Lumbsch HT 2007. Phylogenetic and morphological analysis of Antarctic lichen-forming *Usnea* species in the group *Neuropogon*. Antarctic Science 19: 71–82.

Stenroos S 1991. The lichen genera *Punctelia* and *Parmelia* in Tierra del Fuego. Annales Botanici Fennici 28: 241–245.

Walker FJ 1985. The lichen genus *Usnea* subgenus *Neuropogon.* Bulletin of the British Museum Natural History (Botany) 13: 1–130.

Wirtz N, Printzen C, Lumbsch HT 2008. The delimitation of Antarctic and bipolar species of neuropogonoid *Usnea* (Ascomycota, Lecanorales): a cohesion approach of species recognition for the *Usnea perpusilla* complex. Mycological Research 112: 472–484.

Wirtz N, Printzen C, Sancho LG, Lumbsch HT 2006. The phylogeny and classification of *Neuropogon* and *Usnea* (Parmeliaceae, Ascomycota) revisited. Taxon 55: 367–376.