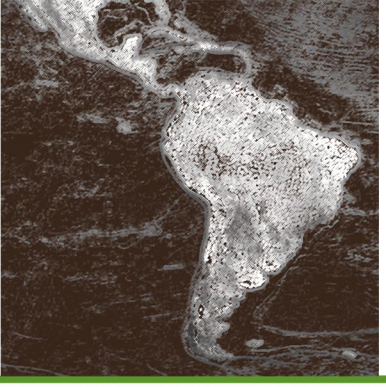

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Lichens on the Maritime Antarctica

(A small field guide for some common species)

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Abstract - A rapid guide for some common lichens in Maritime Antarctica is presented, with color pictures, a simplified key, and brief comments to facilitate the recognition of the genera and species treated.

Resumen – Se presenta una guía rápida para algunos líquenes comunes presentes en la Antártida marítima, con fotos a color, una clave simplificada y comentarios breves para facilitar el reconocimiento de los géneros y las especies tratadas.

Palabras clave • Key words — *Ascomycota*, South Shetland Islands, Antarctic Peninsula.

Introduction

Antarctic lichens are fantastic organisms! Or, more properly saying, amazing ecosystem interactions between fungi and algae (or cyanobacteria). Their diversity and abundance (biomass) are unsurpassed compared to Antarctic communities of terrestrial plants. Even with about 500 known species, year after year new taxa and geographical novelties are discovered (e.g. OSYCZKA & OLECH 2011, Øvstedal & LEWIS SMITH 2009, ØVSTEDAL & GREMMEN 2010, WIRTZ *et al.* 2008). Antarctic lichens have been used in studies of environmental monitoring, chemical accumulation, photosynthesis, and global warming (see for example SANCHO & PINTADO 2004). Nevertheless, many people are not aware of these lichens and, more often than not, *what* are these lichens.

Based on field experience in the Maritime Antarctic, especially on South Shetland Island and the Antarctic Peninsula, the need to bring into focus this important group of organisms became evident. Therefore, the main goal of this paper was to illustrate 32 common species or genera of lichens which the occasional Antarctic visitor is likely to see in the field, and to provide a simple key to identify them. More detailed tools, such as an extensive key, a glossary, more detailed methodology etc. were not included. The curious reader should search for these in some of the excellent books available, like REDÓN (1985), ØVSTEDAL & LEWIS SMITH (2001) and OLECH (2004). A good idea is to combine the use of these three references, since while the keys and scope of REDÓN (1985) are mainly focused on the Maritime Antarctica; the nomenclature used is quite outdated. Olech (2004) provides a detailed flora of King George Island, and finally ØVSTEDAL & LEWIS SMITH (2001) is the most comprehensive and reliable flora available.

Much general information about lichens can be found on the internet, and for a first

impression the text of SPIELMANN & MARCELLI (2006, in Portuguese) could be indicated. Once will realize that lichens live at a smaller, different world scale, and one should first start to familiarize with “small things” to appreciate them properly.

This is our first attempt to popularize Antarctic lichens. We hope it will not be the last, and so your critics are very welcome for future editions.

Methodology

Since our goal was to show the lichens *in the field*, all pictures were taken that way: in nature. The identifications were based mainly on REDÓN (1985), ØVSTEDAL & LEWIS SMITH (2001) and OLECH (2004). More detailed determinations required the utilization of several specialized papers, which can be found in the literature cited in the above books. Collection and morphological analysis in the laboratory was done following standard techniques in Lichenology, and the chemical studies, *spot tests*, microcrystallization and chromatography was done following ORANGE *et al*. (2010) and HUNECK & YOSHIMURA (1996).

The taxonomic and ecological information is based on our field and laboratory experiences. However, much more data can be found in the suggested books. Especially recommended are the glossaries of technical terms, to familiarize oneself with the lichenological nomenclature.

All photographs were taken by A.A. Spielmann.

Simplified key to some common lichens in Maritime Antarctica

1a. Thallus filamentous, fruticose or small fruticose 2

2a. Thallus filamentous, black, appearing “pubic hairs” ..... *Pseudephebe pubescens*

2b. Thallus not filamentous 3

3a. Thallus small fruticose, usually less than 3 cm high (if thallus forming grayish tuffs, with phyllocladia and cephalodia, see *Stereocaulon* below) 3

4b. Thallus grey or brownish grey ..... *Lecania brialmontii*

4a. Thallus yellow or orange 5

5a. Thallus usually orange, K+ purple ..... *Caloplaca regalis*

5b. Thallus yellow, K– ..... *Candelaria murrayi*

3b. Thallus fruticose, usually more than 3 cm high 6

6a. Thallus black, burden-like, occasionally brownish at the base of branches or in eroded areas ..... *Himantormia lugubris*

6b. Thallus greenish gray, brownish, or variegating yellow and black 7

7a. Thallus branches strongly flattened, frequently eroded .....
..... *Ramalina terebrata*
7b. Thallus branches cylindrical 8
8a. Branches with a tough, cartilaginous central axis ..... *Usnea*
8b. Branches without cartilaginous central axis, usually more soft 9
9a. Thallus with phyllocladia and cephalodia ..... *Stereocaulon*
9b. Thallus without phyllocladia or cephalodia 10
10a. Branch surface with numerous, tiny spines .....
..... *Cetraria aculeata*
10b. Branches without spines ..... *Sphaerophorus globosus*
1b. Thallus foliose, squamulose, crustose or dimorphic 11
11a. Thallus dimorphic (with squamules and podetia) ..... *Cladonia*
11b. Thallus foliose, squamulose or crustose 12
12b. Thallus foliose 13
13a. Thallus orange, K+ purple ..... *Xanthoria elegans*
13b. Thallus black, brownish or greenish grey, K+ yellow or K– 14
14a. Thallus homoiomerous (without distinct internal layers) 15
15a. Thallus surface with numerous protuberances (perithecia), photobiont *Prasiola*, strongly ornithocoprophilous .....
..... *Mastodia tesselata*
15b. Thallus with apothecia (not always present), photobiont *Nostoc*, ornithocoprophobous ..... *Leptogium*
14b. Thallus heteromerous (internal layers distinct) 16
16a. Thallus umbilicate (attached to the substrate by a central holdfast) ..... *Umbilicaria*
16b. Thallus not umbilicate 17
17a. Undersurface of the thallus with veins ..... *Peltigera*
17b. Undersurface of the thallus without veins 18
18a. Thallus grey, without pseudocyphellae .....
..... *Physcia caesia*

18b. Thallus usually brownish, with pseudocyphellae .. .. *Parmelia saxatilis*

12b. Thallus squamulose or crustose 19

19a. Thallus squamulose 20

20a. Thallus beige or ochre, apothecia with ochre or pink discs .... *Ochrolechia frigida*

20b. Thallus brownish, apothecia with brown discs .... *Psoroma cinnamomeum*

19b. Thallus crustose 21

21a. Thallus brownish, asci polyspored (one hundred ascospores or more per ascus) ..... *Acarospora macrocyclos*

21b. Thallus whitish, orange, ochre or yellow, asci with up to eight ascospores 22

22a. Thallus orange or yellow, K+ purple ..... *Caloplaca*

22b. Thallus whitish, ochre or yellow, K+ yellow or K– 23

23a. Thallus whitish, placodioid with marginal lobules, with central cephalodia ..... *Placopsis antarctica*

23b. Thallus ochre or yellow, without cephalodia 24

24a. Thallus sulphur yellow, usually with a conspicuous black margin and black apothecia ..... *Rhizocarpon geographicum*

24b. Thallus yellow or ochre or apparently absent (only yellow apothecia visible), without black margin and apothecia not black 25

25a. Thallus almost entirely composed by yellowish, well-developed coalescent apothecia ..... *Rhizoplaca aspidophora*

25b. Thallus crustose, well developed, yellow or ochre, apothecia when present with red or ochre discs 26

26a. Thallus yellow, apothecial discs red, strongly ornithocoprophilous .... *Haematomma erythromma*

26b. Thallus ochre, apothecial discs beige or ochre, usually found on inland hills and away from bird colonies ..... *Ochrolechia parella*

Brief comments on the illustrated lichens

Acarospora macrocyclos Vainio
(Fig. 1)
Acarospora can be recognized through the microscope, because its asci contain more than 100 ascospores. Macroscopically, the thallus is crustose, and the apothecia are lecanorine (with thalline margin). Usually the thallus is brown, although species with yellow thalli are also present in Antarctica. *Acarospora macrocyclos* is ornithocoprophilous, being common in penguin colonies and bird nesting areas, were the occurrence of guano is frequent.

Caloplaca spp.
(Figs. 2 and 4)
Caloplaca species can be recognized by the usually orange thallus (anthraquinones), which reacts K+ purple red, and the polarilocular ascospores (i.e. with a central canal connecting the lumina). Several species are ornithocoprophilous, although they can be found sometimes far away from bird colonies, including on some interesting habitats like over whale bones (Fig. 4).

Caloplaca regalis (Vainio) Zahlbr.
(Fig. 3)
Quite conspicuous by its colour and fruticose habit, rare in a group of lichens that is usually crustose. Can be found easily near bird colonies.

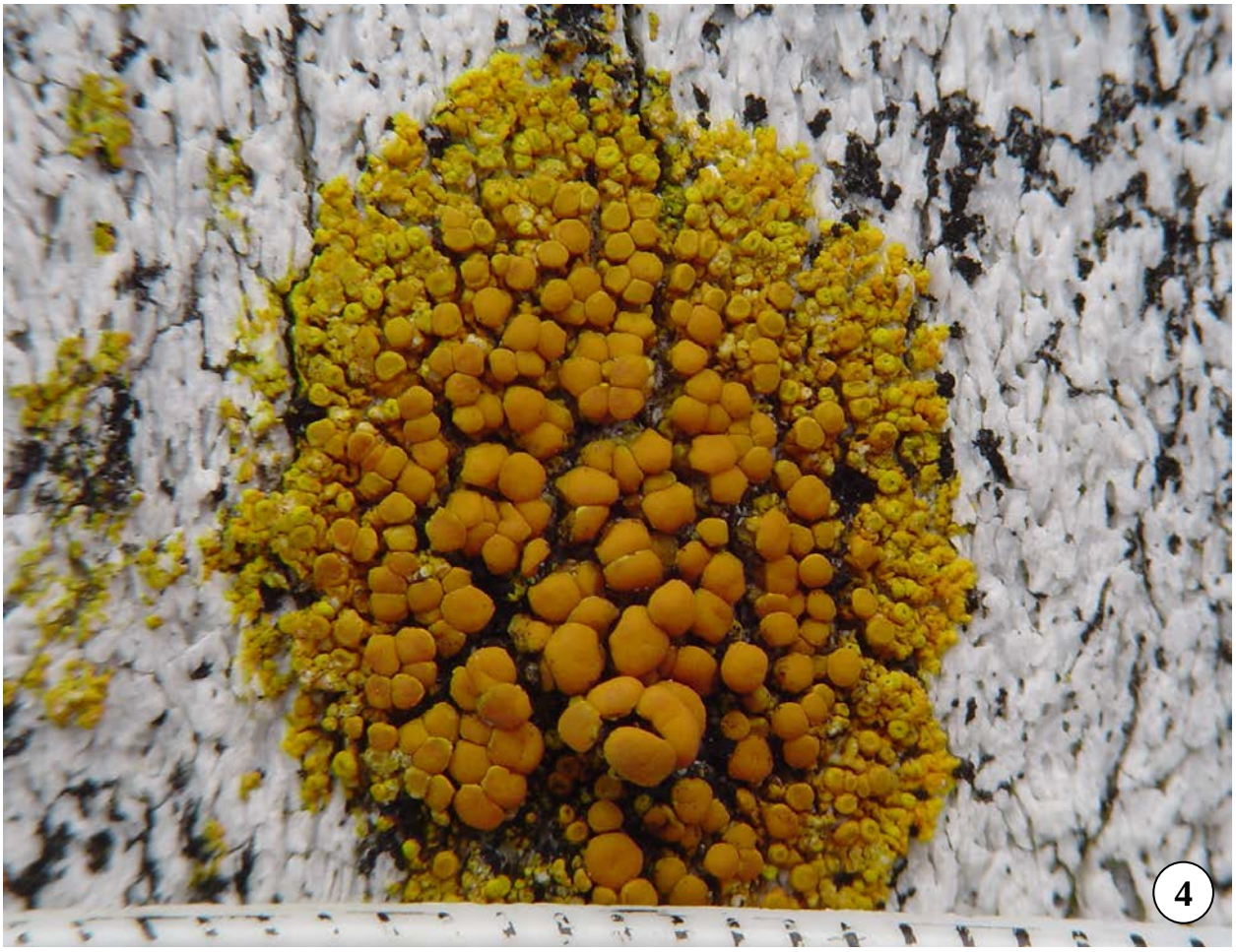
Candelaria murrayi Poelt
(Figs. 2 and 5)
This lichen could be confused with *Caloplaca*, but it is separated by the yellow colour (*Caloplaca* tends to be more orange), the K- reaction and the polysporous asci (normally more than 20 ascospores per ascus). The species is endemic to Antarctica.

Cetraria aculeata (Schreb.) Fr.
(Fig. 6)
The thallus is fruticose, with branches covered by spines. Bipolar distribution, i.e. it is also found in the Arctic region.

Cladonia spp.
(Figs. 8-9)
The species of *Cladonia* commonly present two thallus elements: one squamulose and the other erect-fruticose. This is called a *dimorphic* thallus. The features of the fruticose part (podetia), combined with the chemical substances produced by the lichen, are very important characters for their specific identification.

Cladonia borealis Stenroos
(Fig. 7)
Distinguished by the pale yellow-green colour (usnic acid) and podetia with broad scyphi (small cups), *Cladonia borealis* is one of the commonest species in Maritime Antarctica. The lucky observer can find, growing in the scyphi, beautiful red apothecia!

Figures 1-2: 1 – *Acarospora macrocyclos*, with brown thallus and lecanorine apothecia, growing over rock (Hope Bay, Antarctic Peninsula); **2** – A tiny pebble covered with *Caloplaca* (orange crusts) and *Candelaria* (yellow foliose thalli) (Hope Bay, Antarctic Peninsula).



Figures 3-4: 3 – *Caloplaca regalis*, a fruticose member of this genus (Deception Island); **4** – *Caloplaca* sp., over a whale bone (Hennequin Point, King George Island). The scale is in milimeters.

Figures 5-6: 5 – *Candelaria murrayi*, a yellow foliose lichen (Hope Bay, Antarctic Peninsula); **6** – *Cetraria aculeata*, note the small spines indicated by the arrows (Keller Peninsula, King George Island).

Figures 7-9: 7 – A small "forest" of *Cladonia borealis*, showing the podetia with broad scyphi, and *Usnea antarctica*. Use the water drop as scale (Keller Peninsula, King George Island); **8-9** – *Cladonia* spp., with distinct podetia types (King George Island).

Haematomma erythromma (Nyl.) Zahlbr.
(Figs. 10-11)
Very common in bird nest or feeding areas, usually forming yellowish crusts. When produced, the apothecia are distinctly red with a thalline margin (lecanorine).

Himantormia lugubris (Hue) I.M. Lamb
(Fig. 12)
An Antarctic endemic, which can be recognized as fruticose lichen with a "burnt" appearance. It is commonly associated with *Usnea aurantiaco-atra*.

Lecania brialmontii (Vainio) Zahlbr.
(Fig. 13)
This fruticose lichen usually forms small, aggregated tufts near bird colonies. Under the microscope it can be distinguished by the elongate, triseptate ascospores.

Leptogium menziesii Mont.
(Fig. 14)
The lead, blackish colour of this foliose lichen is because the presence of a cyanobacterium (*Nostoc*) as photobiont. The species is frequent distant from bird colonies (ornithocoprophobous).

Mastodia tessellata (Hook. f. & Harvey) Hook. f. & Harvey
(Figs. 15-17)
The greenish *Prasiola crispa*, a terrestrial alga, is the photobiont of this lichen. It can also be found in the free living state (Fig. 15) and is very common in the penguin rookeries. When lichenized, the thalli become blackish and are covered by numerous perithecia, ascomata where the spores are ejected through a small hole.

Ochrolechia parella (L.) A. Massal.
(Fig. 18)
The genus *Ochrolechia* presents ochre thalli, lecanorine apothecia and unicellular, large ascospores (30-100 µm). *Ochrolechia parella* grows over rocks, while *O. frigida* is found over mosses.

Ochrolechia frigida (Sw.) Lynge
(Fig. 19)
Aside from the muscicolous habit, this species present small spiny appendices on the thallus. In the region covered it is more common than *O. parella*, although with smaller thalli and not always with apothecia.

Parmelia saxatilis (L.) Ach.
(Fig. 20)
Foliose lichen with the undersurface black and with rhizines. On the upper surface isidia and pseudocyphellae are common. The medulla produces salazinic acid (K+ yellow becoming red). One time thought as cosmopolitan species, this concept is being contested mainly by molecular studies.

Peltigera didactyla (With.) J.R. Laundon
(Fig. 21)
The veins on the undersurface are the differential feature of the genus *Peltigera*. On the upper surface, this species produces soredia, concentrated in more or less rounded, eroding soralia.

Physcia caesia (Hoffm.) Fürnr.
(Fig. 22)
With the foliose thallus, usually in the form of rosettes, *Physcia caesia* is bluish gray and has maculae on the upper surface; and the soralia are capitate. Ornithocoprophilous.

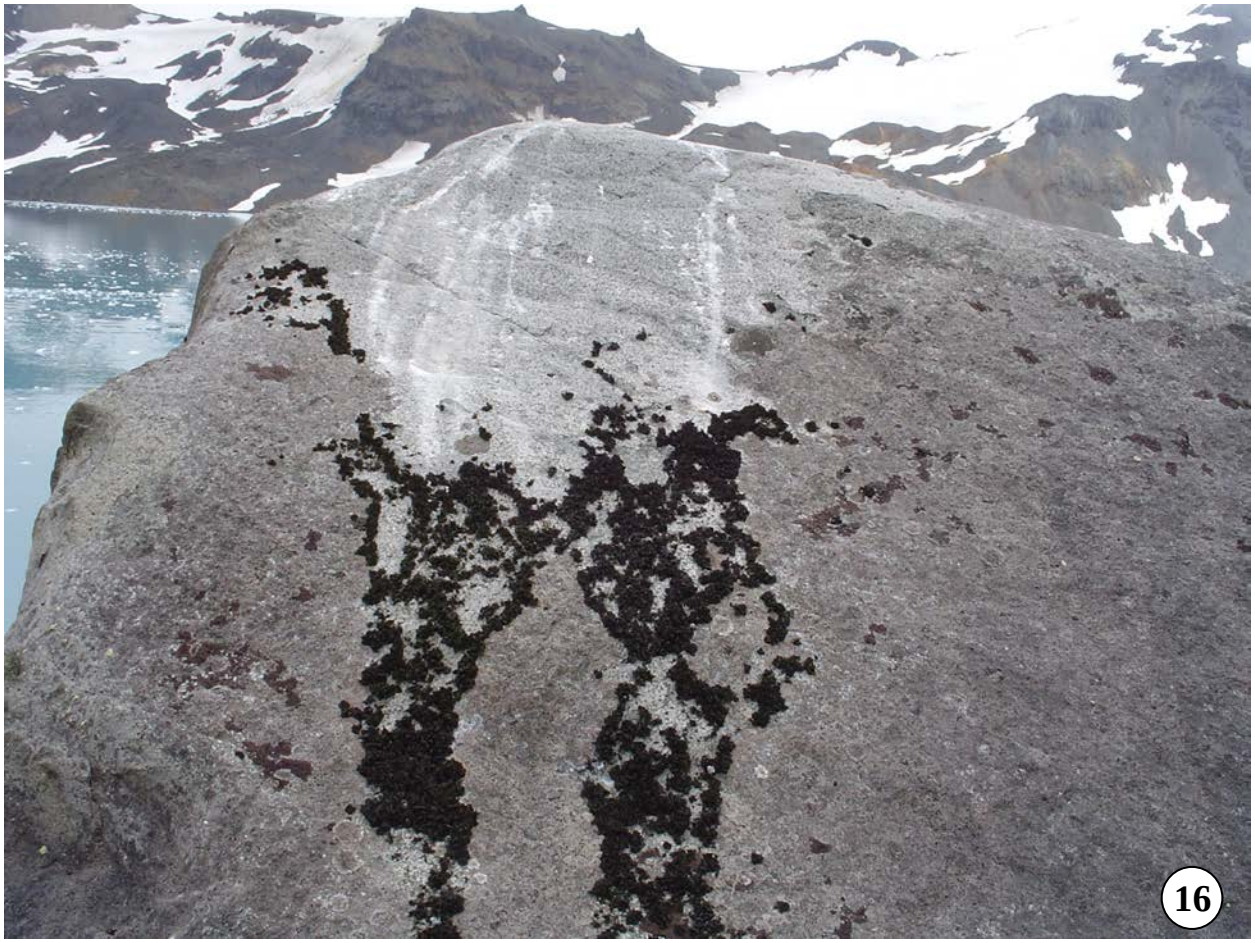
Placopsis antarctica D.J. Galloway, Lewis-Sm. & Quilhot
(Fig. 23)
Three kingdoms of organisms make up the thalli of this lichen: the *Fungi* (*Placopsis*), *Viridiplantae* (the photobiont *Trebouxia*) and *Eubacteria* (*Nostoc*), the latter restricted to special structures, the cephalodia, in the center of the thalli. *Placopsis antarctica* is ornithocoprophilous, and has been for a long time confused with *P. contortuplicata* I.M. Lamb.

Pseudephebe pubescens (L.) M. Choisy
(Fig. 24)
Black or blackish fruticose and usually abundantly branched thalli. Grows over rocks or mosses, and is an example of lichen with a bipolar distribution.

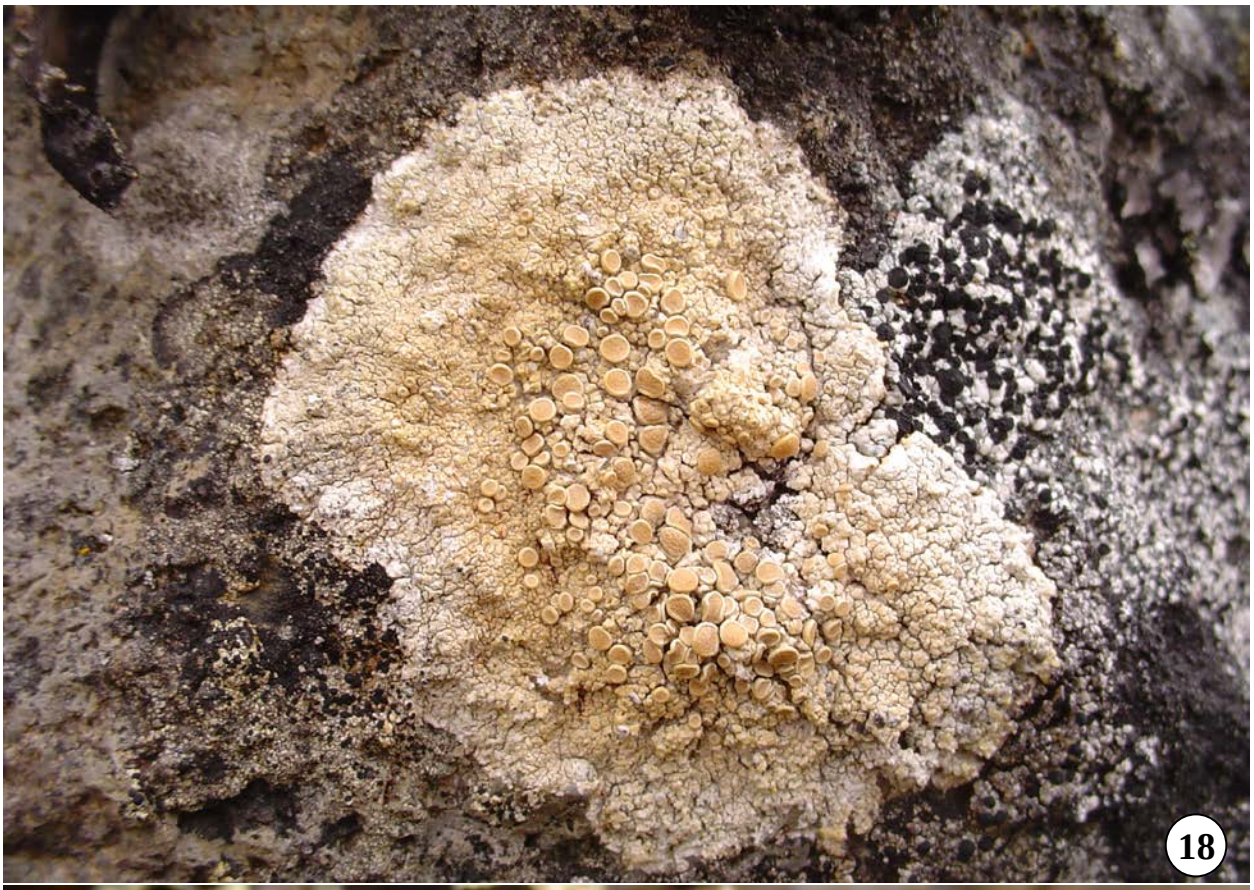
Figures 10-11: 10 – A rock covered by yellow *Haematomma erythromma*, together with *Usnea* and other crusts (Byers Peninsula, Livingston Island); **11** – Detail of the red apothecia of *H. erythromma*, note the scale in millimeters (Hennequin Point, King George Island).

Figures 12-13: 12 – *Himantormia lugubris*, an Antarctic endemic (Potter Peninsula, King George Island); **13** – The grayish *Lecania brialmontii*, growing with a yellow *Caloplaca* in a strongly ornitocoprophilous area (Hope Bay, Antarctic Peninsula).

Figures 14-15: 14 – *Leptogium menziesii*, a gelatinous, foliose lichen with cyanobacteria (*Nostoc*) as photobiont (Potter Peninsula, King George Island); **15** – *Mastodia tessellata* (blackish) growing with *Prasiola crispa* (green algae) not yet lichenized (Potter Peninsula, King George Island).



Figures 16-17: 16 – *Mastodia tesselata* showing the strong preference by guano (Stenhouse Point, King George Island); **17** – Details of the perithecia (black dots) of *M. tesselata* (Hennequin Point, King George Island).



Figures 18-19: 18 – *Ochrolechia parella*, with its crustose thallus growing over rock (Byers Peninsula, Livingston Island); **19** – *Ochrolechia frigida*, over mosses, and showing apothecia and typical spines, indicated by the arrows (Byers Peninsula, Livingston Island).

Figures 20-21: 20 – *Parmelia saxatilis*, foliose thallus growing over rock, mosses and *Deschampsia* (Hennequin Point, King George Island); **21** – *Peltigera didactyla*, a typically muscicolous, sorediate lichen (Deception Island).

Figures 22-23: 22 – *Physcia caesia*, a foliose lichen with *Trebouxia* as photobiont (Keller Peninsula, King George Island); **23** – *Placopsis antarctica*, the central brownish part of the thallus is the cephalodium, while the arrows indicate the open pustules (Byers Peninsula, Livingston Island).

Figures 24-25: 24 – *Pseudephebe pubescens*, growing over rock (Potter Peninsula, King George Island); **25** – *Psoroma cinnamomeum*, note the brownish, lecanorine apothecia (Hennequin Point, King George Island).

Psoroma cinnamomeum Malme
(Fig. 25)
Several species of *Psoroma* were reported from Antarctica. The lecanorine apothecia with carved margins and the rugose ascospores help to recognize the genus. *Psoroma cinnamomeum* has reddish-brown apothecial discs.

Ramalina terebrata Hook. f. & Taylor
(Figs. 26-27)
This fruticose, pale yellow-green lichen (usnic acid) has the branches flattened and devoid of a central axis (present in *Usnea*), with pseudocyphellae that eventually become hollow. Usually found near bird colonies.

Rhizocarpon geographicum (L.) DC.
(Fig. 28)
One of the most common *Rhizocarpon* species in the Antarctica. The sulphur yellow thallus (rhizocarpic acid), the well-developed black margin (prothallus) and the brown, muriform ascospores are important features to recognize it.

Rhizoplaca aspidophora (Vainio) Redón
(Fig. 29)
In this species the beige or yellowish apothecia are so large that they can hide the thallus. Strongly ornithocoprophilous and endemic to Antarctica. *Rhizoplaca melanophthalma* (Ram.) Leuckert & Poelt, a very closely related species, usually develops some greenish color and is less ornithocoprophilous.

Sphaerophorus globosus (Huds.) Vain.
(Fig. 30)
Thallus fruticose, orange or brownish, strongly branched, growing in tufts. Usually muscicolous. The branches become bluish when exposed to the UV light.

Stereocaulon spp.
(Fig. 31)
The *Stereocaulon* species usually have fruticose thalli with grayish, raisin-like cephalodia (with cyanobacteria inside). The main branches (pseudopodetia) are solid, while the species of *Cladonia* usually present hollow branches (podetia).

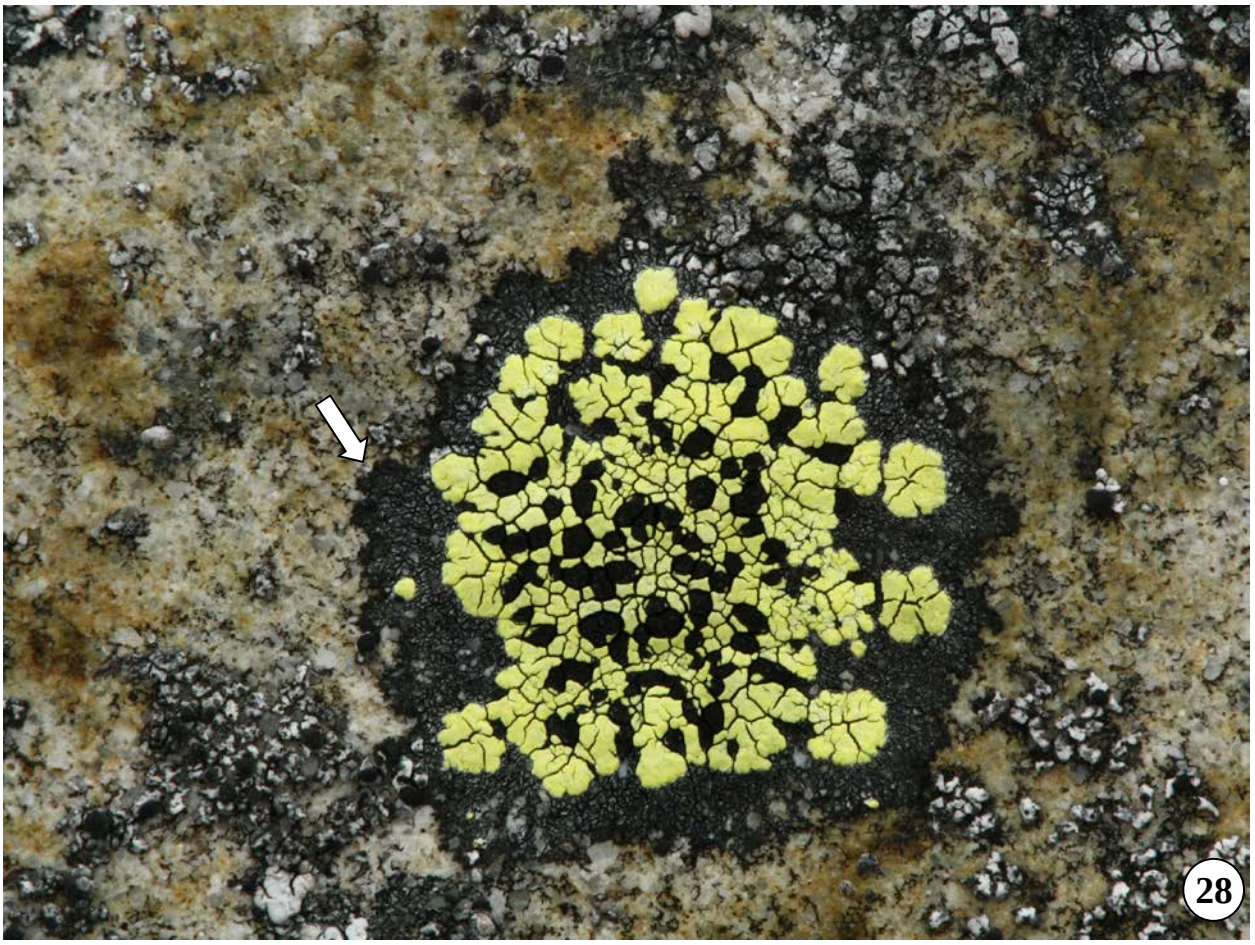
Stereocaulon alpinum Laurer
(Fig. 32)
In this species the pseudopodetia are covered by a thick tomentum, and chemically it reveals lobaric acid (UV+ bluish).

Umbilicaria antarctica Frey & I.M. Lamb
(Fig. 33)
The species of *Umbilicaria* are attached to the substrate by a central holdfast (umbilicus). The photobionts are green algae. Several species grow in Antarctica, *Umbilicaria antarctica* being endemic. It is probably one of the larger species, some thalli with more than 30 cm in diameter.

Usnea antarctica Du Rietz
(Figs. 34-35)
Many people think that there is only one *Usnea* in Antarctica, but actually about ten species were already recorded. *Usnea antarctica* can be recognized by the production of soredia and the papillate branches. Apothecia are quite rare, but can be found in some specimens.

Usnea aurantiaco-atra (Jacq.) Bory
(Fig. 36)
This species does not produce soredia, and usually (although not always) is found with dozens of apothecia with black discs.

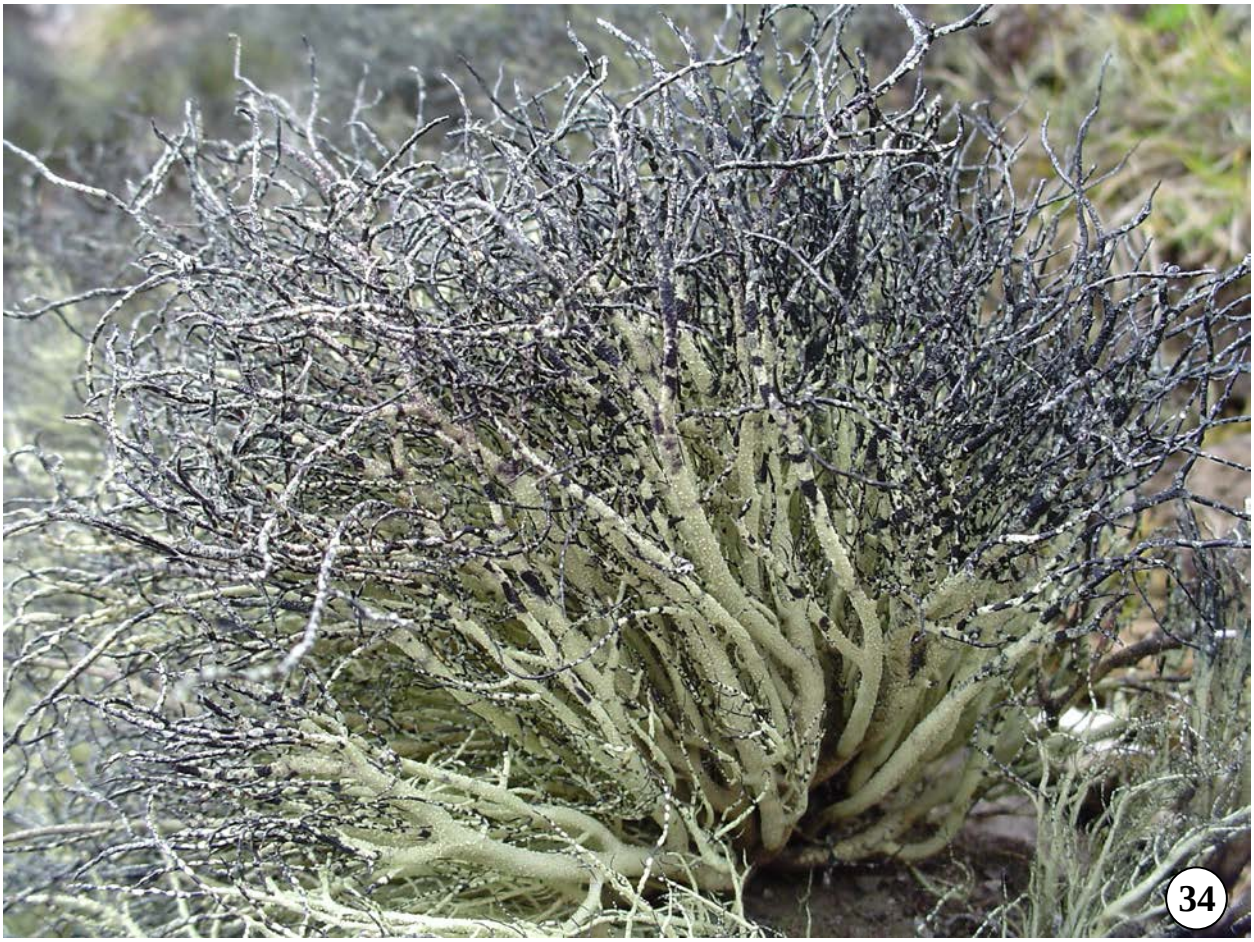
Figures 26-27: 26 – *Ramalina terebrata*, fruticose yellowish lichen usually associated with bird colonies (King George Island); **27** – *Ramalina terebrata*, showing the ulcerated, dorsiventral branches (Hennequin Point, King George Island).



Figures 28-29: 28 – *Rhizocarpon geographicum*, sulphur yellow areoles with black apothecia, and surrounded by a prothallus (arrow) (Hope Bay, Antarctic Peninsula); **29** – *Rhizoplaca aspidophora*, with strongly coalescing apothecia (arrows) (Hope Bay, Antarctic Peninsula).

Figures 30-31: 30 – *Sphaerophorus globosus*, strongly branched (Hennequin Point, King George Island); **31** – *Stereocaulon* sp., in cushion-like formations (King George Island).

Figures 32-33: 32 – *Stereocaulon alpinum*, note the pseudopodetia covered by phyllocladia (Hennequin Point, King George Island); **33** – *Umbilicaria antarctica*, an Antarctic endemic foliose, umbilicate lichen (Potter Peninsula, King George Island).



Figures 34-35: 34 – *Usnea antarctica*, showing the black pigmentation on the tips of branches (Hennequin Point, King George Island); **35** – *Usnea antarctica*, the arrows indicating the soralia (Hope Bay, Antarctic Peninsula).

Figures 36-37: 36 – *Usnea aurantiaco-atra*, full of apothecia (Hennequin Point, King George Island); **37** – *Usnea trachycarpa*, with the pale brown apothecia indicated by the arrows (Keller Peninsula, King George Island).

Usnea trachycarpa (Stirton) Müll. Arg.
(Fig. 37)
Recognized by the brownish or pinkish apothecial discs and the apothecial margin being ornamented with numerous rays.

Usnea perpusilla (I.M. Lamb) F.J. Walker
(Fig. 38)
This taxon is part of a complex of species that was recently found in Antarctica. The apothecia are black and flatted, with foveolae on the undersurface. The central axis of the branches are thin, and the specimens are usually smaller that *Usnea aurantiaco-atra*, which can be confused in the field.

Xanthoria elegans (L.) Th. Fr.
(Fig. 39)
With the strongly attached foliose and orange thallus, *Xanthoria elegans* is one of the most beautiful species in Antarctica, usually found near bird colonies.

Acknowledgments

This small guide would not be possible without the help and incentive of many people and institutions, to which we are sincerely thankful: Brazilian CNPq (Process 574018/2008-7), FAPERJ (Process E-26/170.023/20080), Fundect (T.O. 0158/09), MCT, MMA, FAPRJ, CIRM and Marinha do Brasil (NaPOc Ary Rongel and NPO Almirante Maximiniano); Brazilian Antarctic Station Comandante Ferraz; the Criossolos project and all his members, specially Dr. Carlos Ernesto Gonçalves Reynaud Schaefer and Dr. Márcio Rocha Francelino; the Clube Alpino Paulista (São Paulo). The lichenologists Dr. Dag. Olav Øvstedal and Dr. Maria Agata Olech, kindly confirmed some of our identifications. Dr. Neli Kika Honda confirmed some chemical determinations. Dr. Luciana Canêz and Dr. Patrícia Jungbluth checked the text. And my friend, the Bryologist Dr. Juçara Bordin helped in the collection.

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Figures 38-39: 38 – *Usnea perpusilla*, a species that closely resembles *U. aurantiaco-atra* (Keller Peninsula, King George Island); **39** – *Xanthoria elegans*, common near bird colonies (Hennequin Point, King George Island).

Figure 40 – A special acknowledgment to these nitrogen providers, very appreciated by many Antarctic lichen communities (Keller Peninsula, King George Island).

INSTRUCCIONES PARA AUTORES

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- Autores del trabajo: TAHOMA* 13 puntos, centrado.
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Entradas de taxones:

Graphis Adans.

ADANSON, Familles des Plantes **2:** 11 (1763). – Tipo: *Graphis scripta* (L.) Ach.
Sinónimos heterotípicos:
Opegrapha Humb., Flora Fribergensis Specimen Plantarum Quasdam Cryptogamicas Praesertim Sub-terraneas Exhibitum: 57 (1793); nom. illeg. – Tipo: *Opegrapha vulgaris* Humb.; nom. illeg. = *Graphis scripta* (L.) Ach.
Scaphis Eschw., Systema Lichenum: 14 (1824). – Tipo: *Scaphis anfractuosa* Eschw. ≡ *Graphis anfractuosa* (Eschw.) Eschw.

(Fig. 2A–F, 5J–L)

Descripción — Talo grisáceo a marrón amarillento pálido ...

Discusión — Especies de Acanthothecis se reconocen ...

Distribución y Ecología — Acanthothecis es un género ...

Citación de especímenes:

Especímenes examinados — COSTA RICA. **PUNTARENAS:** Parque Nacional Corcovado, 83° 15' O, 10° 12' N, 100 m, Mayo 2005, Chaves 3113 (INB). — COLOMBIA. ...

La secuencia de países debe seguir el orden geográfico, de norte a sur y de oeste a este (Norteamérica, Centroamérica, Caribe, Sudamérica). En caso de dudas, consultar la página web de la serie Flora Neotrópica [http://www.nybg.org/botany/ofn/fn-gdap1.htm] para una lista exacta de secuencia de países. Las divisiones políticas como estados, provincias y departamentos, deben aparecer en orden alfabético para cada país.

Claves taxonómicas:

Usar numeración consecutiva, separando las parejas de alternativas con las letras a/b en minúscula. Tabulación: 1 cm en la margen izquierda y sangría de 1 cm; 16 cm en la margen derecha utilizando puntos [.....], dejando un espacio a la izquierda y a la derecha de cada línea de puntos como se muestra a continuación:

15a Ascosporas pequeñas, menos de 20 µm de largo 16
15b Ascosporas medianas a grandes, más de 20 µm de largo 18

Figuras, fotografías e ilustraciones:

Las figuras, fotografías e ilustraciones deben ser preparadas en formato TIFF o JPG de alta calidad, con un tamaño final de máximo 22 cm × 16 cm, en resolución de 300 dpi. Se alienta el envío de figuras en color. En el caso de figuras compuestas, usar líneas blancas finas para separar cada imagen y letras mayúsculas en las imágenes para su identificación (**A**, **B**, **C**,...). Se sugiere usar ARIAL BLACK de 20 puntos para las letras indicativas.

Tablas:

Las tablas deben ser citadas en el texto.

Tabla 1 — Separación tradicional de géneros en la familia Graphidaceae (según MÜLLER ARGOVIENSIS 1880, 1882, 1887a, b, 1894a; ZAHLBRUCKNER 1907, 1923, 1926).

Organización apotecios	**Ascosporas hialinas transversal**	**Ascosporas hialinas muriformes**	**Ascosporas marrón grisáceas transversal**	**Ascosporas marrón grisáceas muriformes**
Lirelas solitarias Lirelas estromáticas	Graphis Glyphis	Graphina Medusulina	Phaeographis Sarcographa	Phaeographina Sarcographina

Referencias:

ADAWADKAR, B. & MAKHIJA, U. (2006) New species and new records of Graphis from India: transseptate species with completely carbonized exciples and norstictic acid. Mycotaxon **96:** 51–60. **[Articulo]**

ZAHLBRUCKNER, A. (1907) Lichenes. In: ENGLER, A. & PRANTL, K. (eds.) Die natürlichen Pflanzenfamilien I. Teil. 1. Abteilung: 49–249. Borntraeger, Leipzig. **[Capitulo en libro]**

ZAHLBRUCKNER, A. (1923–24) Catalogus Lichenum Universalis 2. Borntraeger, Leipzig. **[Libro]**

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