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Standard Paper

Marchantiana pyramus, M. ramulicola and *Austroplaca thisbe* (*Teloschistaceae*, lichenized *Ascomycota*) – three new twig lichens from southern Patagonia

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Abstract

Three twig-growing lichen species belonging to the family *Teloschistaceae* from southern Patagonia are described as new to science: *Marchantiana pyramus* sp. nov., with minute apothecia, orange due to dominant content of emodin, *M. ramulicola* sp. nov., with minute olive apothecia with dominant parietin and *Austroplaca thisbe* sp. nov., with clear yellow apothecia also with dominant parietin. *Marchantiana subpyracea*, *M. epibrya* and *M. queenslandica* are new combinations for species which, so far, are known only from New Zealand and Australia. *Blastenia circumpolaris* is shown to be very common in Patagonia and *Marchantiana asserigena* is documented for the first time from the Southern Hemisphere, viz. the Falkland Islands. The genus *Marchantiana* is analyzed here using three genes and is shown to be closely related to *Yoshimuria*; although appearing as paraphyletic, a monophyletic origin cannot be ruled out. Morphology, ecology and distribution support a monophyletic treatment and *Marchantiana* is therefore treated as such.

Keywords: biogeography; *Blastenia*; Chile; Falkland Islands; molecular taxonomy; Tierra del Fuego; *Yoshimuria*

(Accepted 12 April 2023)

Introduction

Southern Patagonia including Tierra del Fuego is the southernmost region bearing trees and shrubs on Earth, and epiphytic lichens growing here are thus at the southern limit of their distribution. Only Antarctica, with no epiphytes, is further south, and the distance to similar climates and vegetation in New Zealand is more than 7000 km. The *Teloschistaceae* of southern Patagonia have been critically studied during the past decades (Lumbsch *et al.* 2011; Søchting & Sancho 2012; Søchting *et al.* 2014, 2016, 2021). Recently, an extensive catalogue of lichen species known from Navarino Island in Tierra del Fuego was published (Etayo *et al.* 2021), but *Teloschistaceae* on twigs were only superficially treated at the time. It might be expected that the biogeographical history of the southern continents could result in a high degree of endemism among twig lichens, therefore we decided to focus particularly on *Teloschistaceae* on twigs and thin branches of trees and shrubs. Results from the whole Southern Hemisphere show very little overlap between the twig species composition in Tasmania/New Zealand and Patagonia. Therefore this paper focuses on Patagonian species, and the New Zealand species will be dealt with in a forthcoming paper.

Twigs and thin branches often host a diverse and characteristic lichen community (Degelius 1964, 1978; Ott *et al.* 2000), but in the industrialized and agricultural world twig lichens often suffer from being exposed to low air quality (Larsen *et al.* 2009). In southern Patagonia, including Tierra del Fuego, and in the Falkland Islands, the air is, however, generally clean and lichens thrive on both living and dead twigs. For this study, twigs were intensively collected by the first author during recent decades. The two very common species *Austroplaca thisbe* sp. nov. and *Marchantiana pyramus* sp. nov. are proposed as new to science, together with the less frequent *M. ramulicola* sp. nov. Molecular analyses were carried out to disclose the generic structure of the genus *Marchantiana* and its relationship with the neighbouring genus *Yoshimuria*, but a more comprehensive study of the genus will be published in a forthcoming paper based on species from Australia and New Zealand. The field studies also revealed new distribution data for *Blastenia circumpolaris* Søchting *et al.* and *Marchantiana asserigena* (J. Lahm) Søchting & Arup.

Material and Methods

Material

Twigs with lichens were collected in southern Patagonia, mainly in Tierra del Fuego but also on the Falkland Islands. Phorophytes were mostly *Berberis*, *Chiliotrichum*, *Nothofagus*, *Ribes* and the parasitic *Misodendrum* on *Nothofagus*. Cited specimens collected by U. Søchting and M. Z. Søgaard were deposited in C.

Morphology and anatomy

Macroscopic descriptions are based on observations made with an Olympus SZH dissecting microscope with an Olympus OM-D

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camera. Sections were made by hand or with a Reichert-Jung Cryostat 2800 Frigocut E microtome and studied with a Leitz Orthoplan microscope. All measurements were made on material mounted in water. Spores were measured outside the asci and measurements are given as the mean ($\bar{x}$) and standard deviation (SD) of '*n*' measurements, with minimum and maximum measurements in parentheses.

Secondary chemistry

Secondary metabolites were identified and quantified using HPLC according to Søchting (1997); thallus and apothecia were analyzed separately. The relative composition of the secondary compounds was calculated based on absorbance at 270 nm, according to Søchting (1997). All yellow, orange or reddish-pigmented parts are K+ purple.

Molecular analyses

PCR amplification was carried out on DNA extracts or using direct PCR following Arup *et al.* (2015). Amplifications were made of the internal transcribed spacer regions (nrITS) and the large subunit (nrLSU) of the nuclear ribosomal RNA genes, and the small subunit of the mitochondrial ribosomal RNA gene (mtSSU). Primers for amplification were ITS1F (Gardes & Bruns 1993), ITS4 (White *et al.* 1990), AL1R (Döring *et al.* 2000), LR5 or LR6 (Vilgalys & Hester 1990), mrSSU1 (Zoller *et al.* 1999) and mrSSU7 (Zhou & Stanosz 2001). The PCR parameters included an initial hold at 94 °C for 5 min, then denaturation at 94 °C for 1 min, annealing at 50 or 54 °C (mtSSU) or 53–56 °C (nrITS and nrLSU) for 1 min, decreasing 1 °C per cycle for the first six of the 39 cycles (touchdown), and an extension at 72 °C for 3 min.

Sequence alignment

Two different alignments were prepared, one for a combined analysis of the genes nrITS, nrLSU and mtSSU and one alignment of only nrITS sequences. The combined analysis included 72 sequences from most genera of the subfamily *Caloplacoideae* and the ITS alignment included 29 sequences of the genus *Marchantiana*. *Xanthoria parietina* (L.) Th. Fr. from subfamily *Xanthorioideae* was used as outgroup for the first analysis and *Xanthopeltis rupicola* R. Sant. for the ITS analysis. The sequencing was carried out by Macrogen Inc. (the Netherlands), using the same primers as for the PCR. The two resulting strands were assembled using CLC Main Workbench 4.1.2™ or Geneious v. 11.1.5. Subsequent alignments were performed in Geneious v. 11.1.15 using the MAFFT option (auto) and adjusted manually. Unalignable ends, introns in all the aligned genes and ambiguously aligned parts were excluded from the alignment. Sequences have been submitted to GenBank as indicated in Table 1. The alignments of the three different genes were first analyzed separately to check for incongruence between genes. A conflict between the datasets was assumed to be significant if two different relationships were both supported with posterior probabilities ≥ 0.95.

Phylogenetic analysis

Phylogenetic relationships were inferred using maximum likelihood (ML) as implemented in IQ-TREE (Nguyen *et al.* 2015) and Bayesian tree inference was carried out using Markov chain Monte Carlo (MCMC) as implemented in MrBayes v. 3.2 (Ronquist *et al.* 2012). In the combined analysis, the three included genes were treated as separate partitions. A suitable likelihood model for each of the genes was selected, using BIC as implemented in the software jModelTest v. 2.1.4 (Guindon & Gascuel 2003; Darriba *et al.* 2012), evaluating only the 24 models available in MrBayes (Ronquist *et al.* 2012). For the concatenated dataset, the SYM + I + G model was found to be optimal for the nrITS dataset and GTR + I + G for both the nrLSU and the mtSSU datasets. For the pure nrITS dataset, the evolutionary model SYM + G was found to be optimal. The parameters used in the analyses followed those of Arup *et al.* (2013), except for the branch length prior that was set to an exponential with mean 1/10. No molecular clock was assumed. Three parallel runs with 20 000 000 generations starting with a random tree and employing six simultaneous chains were executed, five of which were incrementally heated with a temperature of 0.10. Analyses were diagnosed every 1000 generations in the last 50% of the tree sample and automatically halted when convergence was reached. Convergence was defined as a standard deviation of splits (of frequency 0.1) between runs below 0.01. Every 2000th tree was sampled. A majority-rule consensus tree was constructed from the post-burn-in tree samples. The consensus trees were visualized using FigTree v. 1.4.4 and redrawn in Adobe Illustrator. The maximum likelihood analyses used the same evolutionary models as those used in the Bayesian analyses. Branch support values were computed via 1000 non-parametric bootstrap replicates.

Results

We generated 28 new nrITS sequences, three new nrLSU sequences and five new mtSSU sequences for this study. The alignment for the first analysis consisted of 73 terminals of 2082 aligned nucleotide sites, of which 543 were parsimony-informative. The nrITS partition consisted of 502 sites (260 informative), the nrLSU partition of 768 sites (137 informative) and the mtSSU partition of 812 sites (146 informative). The Bayesian analysis halted after 1 280 000 generations and a 50% majority-rule tree with posterior probabilities is shown in Fig. 1. The second analysis of only nrITS data consisted of 30 terminals of 533 sites, of which 121 were parsimony-informative. This analysis halted after 2 060 000 generations and the 50% majority-rule tree with posterior probabilities is shown above the branches in Fig. 2. The maximum likelihood and Bayesian analyses yielded very similar trees and so only the Bayesian trees are shown. Bootstrap values are shown under the branches in the same figure.

The analysis of the combined three-gene alignment (Fig. 1) recovers all genera recognized in the subfamily *Caloplacoideae* by Arup *et al.* (2013). The tree also includes many of the genera as supported monophyletic clades proposed in subsequent papers concerning the subfamily: *Lacrima, Obscuroplaca, Oceanoplaca* and *Sucioplaca* (Bungartz *et al.* 2020, 2021), *Marchantiana* and *Yoshimuria* (Kondratyuk *et al.* 2014), *Jasonhuria, Loekoesia* and *Olegblumia* (Kondratyuk *et al.* 2015), *Fauriea* (Kondratyuk *et al.* (2016), *Gintarasiella* (Kondratyuk *et al.* (2017), *Upretia* (Kondratyuk *et al.* 2018) and *Lendemeriella* (Kondratyuk *et al.* 2020). It also recovers *Pyrenodesmia* as monophyletic sister to the recently resurrected genus *Kuettlingeria* and the newly described *Sanguineodiscus* (Vondrák *et al.* 2020).

Yoshimuria appears as monophyletic and is supported in the tree as sister to another strongly supported clade that includes

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Table 1. Sequences from species of *Teloschistaceae*, newly produced (in bold) or downloaded from GenBank used in the analyses.

Species	Country, collector, collector no., herbarium	nrITS	nrLSU	mtSSU
Blastenia ammiospila	Austria, *Søchting* 9345, C (ITS, SSU); Norway, *Søchting* 10092, C (LSU)	KC179413	KC179161	KC179491
B. catalinae	Sweden, *Arup* L06075, LD	FJ866792	KT291532	KT291477
B. crenularia	Iceland, *Søchting* 7523, C	KC179415	KC179162	KC179492
Bryoplaca jungermanniae	Greenland, *Søchting* 10451, C	KC179420	MT952895	MT95295
B. sinapisperma	Norway, *Arup* L08184, LD (ITS, SSU); Norway, *Arup* L08184, LD (LSU)	KC179421	MT952896	KC179495
B. tetraspora	Antarctica, *Søchting* 7979, C (ITS); Greenland, *Søchting* 10480, C (LSU, SSU)	KC179422	MT952897	KC179496
Caloplaca cerina	Svalbard, *Elvebakk* 03:109, TROM	KC179425	KC179168	KC179499
C. chlorina	Denmark, *Søchting* 7321, C	KC179426	KC179169	KC179500
C. turkuensis	Sweden, *Frödén* 1909, LD	KC179432	MT952899	KC179501
Eilifdahlia dahlii	Australia, *Kärnefelt* 20043101, LD	KJ021318	KJ021253	KJ021279
E. wirthii	Australia, *Wirth* et al. 05.10.2011, STU	KJ021320	KJH021255	KJ021281
Fauriea chujaensis	South Korea, KoLRI 023698	KX793095	KX793098	KX793101
F. orientochinensis	China, 2011, *Wang*, KoLRI 013959	KX793096	KX793099	KX793102
Franwilsia bastowii	Australia, *Kärnefelt* 994301, LD	KJ021324	KJ021257	KJ021284
F. kilcundaensis	Australia, *Kärnefelt* 20047101, LD	KJ021327	KJ021260	KJ021287
Gintarasiella aggregata	Australia, *Kantvilas* 476/12, HO	KY614392	KY614450	
Gyalolechia aurea	*Arup* L97493, LD	KC179434		KC179530
G. aurea	Austria, 1993, *Poelt* & *Grube*, GZU		KC179196	
G. flavorubescens	Estonia, *Søchting* 10127, C	KC179439	KC179197	KC179531
G. flavovirescens	Russia, *Søchting* 8648, C	AF353966	KC179198	KC179532
G. fulgens	Spain, *Søchting* 7306, C (ITS); Sweden, *Arup* L06206, LD (LSU);	KC179440	KC179199	
G. fulgens	Sweden, *Søchting* 10586, C (SSU)			KC179533
Huneckia pollinii	USA, Kansas, *Morse* 14464, LD	KJ021336	KJ021265	KJ021296
H. wrightii	Galapagos, *Aptroot* 63246, CDS (ITS); *Miranda* 962, CDS (LSU, SSU)	MT967388	MT952903	MT952929
Jasonhuria bogilana	South Korea, KoLRI 120454	KT220196	KT220205	KT220214
Kuettlingeria albolutescens	Sweden, *Arup* L09030, LD	KC179423	MT952998	KC179502
K. atroflava	Sweden, *Arup* L06010, LD	KC179424	KC179171	KC179504
K. erythrocarpa	Italy, *Arup* L07109, LD	KC179427	KC179173	KC179506
K. teicholyta	Denmark, *Søchting* 11195, C (ITS, LSU); Denmark, *Søchting* 9772, C (SSU)	KC179431	KC179176	KC179510
Lacrima epiphora	Panama, *van den Boom* 43698, hb. van den Boom	MT967392	MT952904	MT952930
L. galapagoensis	Galapagos, *Bungartz* 4091, CDS (ITS); *Ertz* 22855, CDS (LSU, SSU)	MT967297	MT952905	MT952931
Lendemeriella reptans	USA, *Lendemer* 48186, NY	MH104934	MH100766	MH100796
Leproplaca chrysodeta	Sweden, *Arup* L07107, LD (ITS, LSU); Sweden, *Arup* L13261, LD (SSU)	KC179448	KC179206	MT952933
L. xantholyta	Austria, *Arup* L97278, LD (ITS); Spain, *Søchting* 9675, C (LSU, SSU)	KC179451	KC179208	KC179542
Loekoesia austrocoreana	South Korea, KoLRI 120523	KT220020	KT220210	KT220219
L. yuchiorum	USA, *Lendemer* 22026, LD	**OQ678329**	**OQ678282**	**OQ678286**
Marchantiana asserigena	Scotland, *Arup* L10184, LD	MT967307	MT952907	MT952934
M. epibrya 1	New Zealand, *Søchting* 11956, C	**OQ678330**		
M. epibrya 2	Tasmania, *Kantvilas* 95/12, C	**OQ678331**	**OQ678283**	**OQ678287**
M. epibrya 3	New Zealand, *Søchting* 11957, C	**OQ678332**		
M. michelagoensis 1	New Zealand, *Søchting* 11987, C	**OQ678333**		
M. michelagoensis 2	Australia, *Elix* 37402, LD	**OQ678334**		**OQ678288**
M. occidentalis 1	Australia, *Elix* 32479, CANB	**OQ678335**		

(*Continued*)

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Table 1. (*Continued*)

Species	Country, collector, collector no., herbarium	nrITS	nrLSU	mtSSU
M. occidentalis 2	Australia, *Kärnefelt* 20042502, LD	MT964708		KJ021304
M. pyramus 1	Chile, *Søchting* 11312, C	**OQ678336**		
M. pyramus 2	Chile, *Søgaard* 58, C	**OQ678337**		
M. pyramus 3	Chile, *Søgaard* 28, C	**OQ678338**		
M. pyramus 4	Chile, *Søgaard* 27B, C	**OQ678339**		
M. pyramus 5	Chile, *Søchting* 12241, C	**OQ678340**		
M. pyramus 6	Chile, *Søchting* 11363, C	**OQ678341**		
M. pyramus 7	Falkland Islands, *Upson* HSG 091109-25, C	**OQ678342**		
M. pyramus 8	Falkland Islands, *Søchting* 12654, C	**OQ678343**		
M. pyramus 9	Falkland Islands, *Fryday* 11279, C	**OQ678344**		
M. pyramus 10	Chile, *Søchting* 12667, C	**OQ678345**		
M. pyramus 11	Chile, *Søchting* 10178, C	**OQ678346**		
M. queenslandica	Australia, *Kalb* 27764, CANB	MT967409	MT952908	
M. ramulicola 1	Chile, *Søchting* 11353, C	**OQ678347**		
M. ramulicola 2	Chile, *Søchting* 11377, C	**OQ678348**		
M. ramulicola 3	Chile, *Søchting* 11367, C	**OQ678349**		
M. ramulicola 4	Chile, *Søchting* 12308, C	**OQ678350**		**OQ678289**
M. subpyracea 1	New Zealand, *Frödén* 1317, LD	**OQ678351**	**OQ678284**	**OQ678290**
M. subpyracea 2	New Zealand, *Søchting* 12013, C	**OQ678352**		
M. subpyracea 3	New Zealand, *Søchting* 11958, C	**OQ678353**		
M. subpyracea 4	New Zealand, *Søchting* 11959, C	**OQ678354**		
Marchantiana sp. 1	New Zealand, *Søchting* 11961, C	**OQ678355**		
Marchantiana sp. 2	New Zealand, *De Lange* CH 2322, AK	**OQ678356**		
Obscuroplaca camptidia	USA, *Morse* 14420, LD	MT967431	MT952918	MT952942
O. ochrolechioides	Australia, *Kalb* & *Rogers* 18982, CANB	MT967432	MT952919	
O. tortuca	Galapagos, *Aptroot* 65189, CDS	MT967433		MT952943
Oceanoplaca caesiosorediata	Cape Verde, *van den Boom* 36346, LD	MT967412	MT952911	MT952936
O. catillarioides	Cape Verde, *van den Boom* 36365, LD	MT967410	MT952909	MT952935
O. isidiosa	Galapagos, *Adsersen*, LAM8-1, C	MT967416	MT952913	MT952938
Olegblumia demissa	Italy, *Arup* L97911, LD	AF353960	KC179172	KC179505
Pyrenodesmia alociza	Sweden, *Arup* L10185, LD	MT967436	MT952920	MT952944
P. chalybaea	Austria, *Søchting* 9351, C	KC179454	MT952921	KC179571
P. variabilis	Austria, *Arup* s. n., LD (ITS); Sweden, *Arup* L03134, LD (LSU, SSU)	AF353963	KC179234	KC179572
Rufoplaca scotoplaca	Sweden, *Arup* L10032, LD	KC179457	KC179235	KC179573
R. tristiuscula	Norway, *Arup* L08171, LD	KC179460	KC179237	KC179575
Rufoplaca sp.	California, *Arup* L09201, LD	KC179458	KC179236	KC179574
Sanguinodiscus aractinus	Czech Republic, *Vondrák* 6702, PRA	MH104919		MH100773
S. haematites	Ukraine, *Vondrák* 7278, PRA	MH104928	MH100789	MH100756
Seirophora blumii	Iran, *Haji Moniri* Al_4, KW	KT456219	KT456234	KT456249
S. californica	Mexico, *Gaya* 03.04.10-9 & *Lutzoni*, DUKE	KT291470	KT291564	KT291521
S. lacunosa	Kazakhstan, *Moberg* & *Nordin* K18:04, LD	KC179465	KC179243	KC179582
S. scorigena	Lanzarote, *Snogerup, S.* & *B.* 17201, LD	KC179466	KC179244	KC179583
Upretia amarkantakana	India, 2010 LWG: 10-013313/B	MG652764		MG652767

(*Continued*)

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Table 1. (*Continued*)

Species	Country, collector, collector no., herbarium	nrITS	nrLSU	mtSSU
U. squamulosa	China, *Lisong Wang* et al. 17-56088, KUN (ITS); China, *Lisong Wang* et al. 16-50174, KUN (LSU)	MH497054	MH497052	
Usnochroma carphinea	France, *Roux* 1998, C	KC179468	KC179259	KC179598
U. scoriophila	Tenerife, 1995, *Gomez-Bloea*, C	KC179469	KC179260	KC179599
Variospora aurantia	Spain, 1998, *Llimona*, C (ITS, SSU); Italy, 2006, *Lange*, C (LSU)	KC179470	KC179261	KC179600
V. dolomiticola	Spain, *Thell* SP0514, LD	KC179471	KC179262	KC179601
V. thallincola	Sweden, *Søchting* 7481, C (ITS); Sweden, *Gaya* et al. s. n., BCN (LSU)	KC179475	JQ301563	
V. thallincola	UK, Wales, *Arup* L92148, LD (SSU)			KC179604
V. velana	Italy, *Arup* L07194, LD (ITS); Italy, *Arup* L07123, LD (LSU, SSU)	KC179476	KC179265	KC179605
Xanthopeltis rupicola	Chile, *Frödén* 1654, LD	KC179146	KC179286	KC179626
Xanthoria parietina	Denmark, 2002, *Søchting*, C (ITS, SSU); Denmark, *Søchting* 7157, C (LSU)	KC179411	KC179289	KC179629
Yoshimuria galbina	South Korea, *Arup* L15370, LD (ITS); *Arup* 15500, LD (LSU, SSU)	MT967482	MT952923	MT952946
Y. spodoplaca	South Korea, *Wang* & *Ryu* 110364, KoLRI (ITS, SSU); *Arup* L15575, LD (LSU)	KJ021249	MT952924	KJ023194

the type of the genus *Marchantiana*, but this position lacks support. A third, fully supported clade, included here in *Marchantiana*, holds a sister position to these two genera. These three clades seem closely related to one another with strong or rather strong support (PP = 0.984 and BS = 82).

In the combined analyses, *Gintarasiella aggregata* (Kantvilas & S. Y. Kondr.) S. Y. Kondr. & Hur, type of that genus, is found within the genus *Variospora* with full support. However, this position is based only on part of an nrITS sequence (5.8S and partial ITS2) and nrLSU data, and should therefore be considered preliminary with confirmation required using more data.

The analysis of the dataset containing only nrITS sequences (Fig. 2) shows the internal relationship of the two newly proposed species, *M. ramulicola* and *M. pyramus*, and related species of the clade. The new species and *M. epibrya* are monophyletic and well supported, whereas *M. subpyracea* appears as monophyletic except for one sequence at the base of the clade which is not supported as part of the clade.

Discussion

In accordance with Wilk *et al.* (2021), the genus *Marchantiana* is shown here to belong to the subfamily *Caloplacoideae*. In the combined analysis, the two paraphyletic clades of *Marchantiana* form a supported clade together with *Yoshimuria*. From a purely genetic perspective it would be possible to either unite all three genera into one or treat them as three independent genera. The two clades, treated here as *Marchantiana*, show great similarities in morphology, ecology and distribution. They are mainly small species with small apothecia and a thin or inconspicuous thallus, all but one (*M. epibrya*) grow on bark, often twigs, and they are mainly distributed in the Southern Hemisphere (Patagonia, Australia and New Zealand), with only *M. asserigena* seeming to have migrated to Europe in the Northern Hemisphere (Søchting & Arup 2018). The species of the genus *Yoshimuria* on the other hand occur in South-East Asia, are saxicolous, and have a well-developed thallus with rather large apothecia. Thus, it seems logical to recognize two genera rather than three or one. This hypothesis can be assessed using the AU test as implemented in IQ-TREE (Shimodaira 2002), where the null hypothesis is that a tree where the two branches of *Marchantiana* form one monophyletic clade with *Yoshimuria* outside of it is significantly worse ($P < 0.05$) than the tree presented in Fig. 1. Such a test, forcing *Marchantiana* to be monophyletic, returned a *P*-value of 0.5, which means that a tree with *Marchantiana* as monophyletic cannot be rejected. This makes sense since the branch including *Marchantiana* in a strict sense and *Yoshimuria* is not supported. We therefore recognize *Marchantiana* in the wider sense and describe the new species within this genus.

Taxonomy

Austroplaca thisbe Søchting & Arup sp. nov.

MycoBank No.: MB 848021

Similar to *Austroplaca sibirica* (H. Magn.) Søchting & Arup but molecularly distinct and growing on twigs instead of detritus. Thallus crustose, inconspicuous; apothecia zeorine to biatorine, yellow; ascospores polardiblastic, 13.5 × 7.5 µm, septum 5 µm; on twigs in Patagonia.

Type: Chile, XII Región de Magellanes y de la Antártica Chilena, Beagle Channel, Seno Pia IV, 54.710°S, 69.696°W, 5 m, on dead twigs of *Misodendrum* on *Nothofagus antarctica*, 15 December 2009, *U. Søchting* 11317 (C—holotype; LD—isotype).

(Fig. 3)

Thallus crustose, inconspicuous.

Apothecia regular, vivid yellow, zeorine to biatorine, dispersed to mostly aggregated, sessile, never immersed or erumpent, constricted at base, 0.2–0.5 mm diam.; *disc* flat, with fine epipsamma, vivid yellow; thalline margin where present excluded, discontinuous, thin; *proper margin* distinct, *c.* 50 µm thick, concolorous or slightly brighter than disc, initially prominent, when older ±level with disc; *thalline exciple* cortex poorly differentiated; *true exciple* fan-shaped, laterally up to *c.* 50 µm; *hypothecium* very thin; *hymenium* 50–70 µm; *paraphyses* simple to apically branched, *c.* 1.5 µm thick, terminal cells moniliform, up to 3 µm thick. *Asci* clavate, with 8 spores. *Ascospores* ellipsoid,

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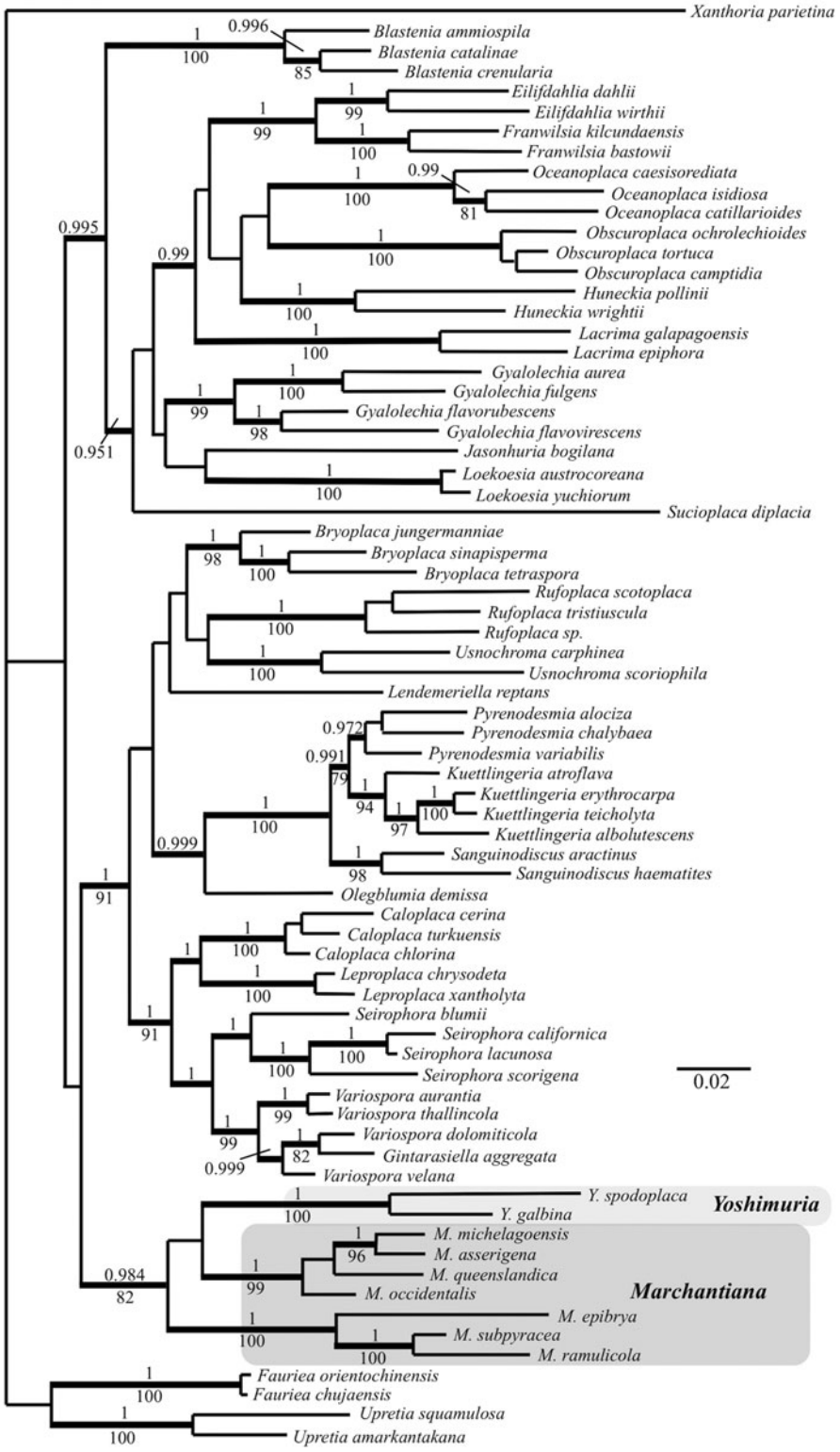

Figure 1. Majority-rule consensus tree based on a Bayesian MCMC analysis of a combined dataset of the nrITS, nrLSU and mtSSU genes showing the position of *Marchantiana* s. lat. Branches with posterior probabilities ≥ 0.95 are shown in bold. Posterior probabilities ≥ 0.95 are shown above the branches and bootstrap values ≥ 75 are shown below the branches.

polardiblastic, (11.5)13.3 ± 1.2(14.5) × (6)7.6 ± 0.7(8) µm, length/width ratio 1.8 ± 0.1, septum (4)4.9 ± 0.4(5.5) µm, length/septum ratio 2.7 ± 0.3 (n = 8).

Chemistry. Chemosyndrome A of Søchting (1997): 6–10% teloschistin, 0–5% fallacinal, 0–4% parietinic acid and 85–90% parietin (n = 3).

Etymology. *Austroplaca thisbe* is named after Thisbe, the love of Pyramus in Ovid's classic play '*Metamorphoses*'. It very often grows together with *Marchantiana pyramus* (Fig. 3).

Ecology and distribution. In *Nothofagus* forest, grassland and alpine heathland on living or dead twigs and occasionally rough bark. Phorophytes include *Berberis*, *Nothofagus* and its parasite

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Figure 2. Majority-rule consensus tree based on a Bayesian MCMC analysis of ITS data of *Marchantiana*. Branches with posterior probabilities ≥ 0.95 are shown in bold. Posterior probabilities ≥ 0.95 are shown above the branches and bootstrap values ≥ 75 are shown below the branches. New species are marked with *.

Misodendrum. It is often associated with *Marchantiana pyramus* (see above). So far reported only from Chile but is expected to also occur in Argentina.

Notes. *Austroplaca thisbe* was included as sequence *Austroplaca* 9 in Arup *et al.* (2013). The species is molecularly well delimited and located at the base of the genus *Austroplaca*, where it is sister species to *Austroplaca sibirica*. They are morphologically very similar but are well separated by their ITS sequences and their different habitats and distribution; *A. thisbe* grows on bark and *A. sibirica* grows on dead plant material, bones, lignum and dead *Peltigera* sp. (Søchting & Arup 2021).

Figure 3. *Austroplaca thisbe* (*U. Søchting* 11272,2b), with one apothecium of *Marchantiana pyramus* (marked with arrow). Scale = 0.5 mm. In colour online.

Austroplaca thisbe may be mistaken for an *Athallia* but so far no molecular analysis has confirmed the presence of epiphytic *Athallia* species in Patagonia, even though it was suggested by Etayo *et al.* (2021).

Additional specimens examined. **Chile:** *XI Región Aisén*: *c.* 5 km along the road from Coyhaique to Coyhaique Alto, on dead twigs of *Berberis* sp. in open, exposed pastureland, 2001, *P. Frödén* 1550 (LD). *XII Región de Magellanes y de la Antártica Chilena*: Cueva de Miledon, 51.5611°S, 72.6160°W, 145 m, dead *Berberis* twigs, 2018, *U. Søchting* 12684; Morro Chico, 100 km N of Punta Arenas, basaltic rock of old volcano in steppe, 52.0575°S, 71.4212° W, 195 m, dead twigs of *Berberis*, 2015, *U. Søchting* 12366, 12674; 45 km SW of Punta Arenas, Reserva National Laguna Parrillar, 53.4070°S, 71.2616°W, 300 m, base of *Nothofagus* sp. by lake shore, rough bark, 2005, *U. Søchting* 10144; Province Última Esparanza, Parque Nacíonal Torres del Paine, 51.0494°S, 72.9367° W, 169 m, bush (*Berberis* cf.), 2008, *M. Z. Søgaard* 35, 39; Parque Nacíonal Torres del Paine, tracks from Lago Grey, 51.1222°S, 073.1242°W, twigs, 2008, *M. Z. Søgaard* 46; Parque Nacional Torres del Paine, Mirador Lago Nordenskjold, halfway between Laguna Larga and Laguna Mellizas, 51.05°S, 72.92°W, 200 m, dry, sun-exposed, dead twigs of *Discaria chacaye*, 1997, *A. Elvebakk* 97:448 (TROM); Torres del Paine, 51.1278° S, 73.1426°W, dead twigs, 2018, *U. Søchting* 12690; Rio Serrano, 51.18°S, 72.95°W, dead bark of *Salix* sp., 2005, *U. Søchting* 10442,1; 20 km S of Puerto Natales, 51.9417°S, 72.3881°W, 100–200 m, twigs of bush, 2008, *M. Z. Søgaard* 27a; Hosteria Cabo San Isidro, 53.7822°S, 70.9737°W, 2 m, dead *Nothofagus betuloides* trunk on beach, 2009, *U. Søchting* 11351; Seno Almirantazgo, 54.703°S, 69.332°W, 25 m, old dead twigs of *Misodendrum*, 2009, *U. Søchting* 11287; Beagle Channel, Seno Pia, west arm, shore of fjord, 54.7897°S, 69.6946° W, 1 m, twigs of *Chiliotrichum* hanging over the sea, 2 m from the sea, 2015, *U. Søchting* 11308; Cabo Hyades, Bahia Yendegaia, 54.9158°S, 68.7137°W, 1 m, dead twigs of *Berberis*, 2015, *U. Søchting* 12316; Isla Navarino, 30 km WNW of Puerto Williams, Wulaia, 55.0467°S, 68.1467°W, 2 m, twigs of *Berberis* sp., 2005, *U. Søchting* 10336; Isla Navarino, Puerto Williams around the airport, pasture on beach, 54.9291°S, 67.6372°W, 7 m, dead *Berberis* twigs, 2015, *U. Søchting* 12226; 37 km W of Puerto Williams, Caleta Honde, 54.93°S, 68.28°W, 5 m, dead *Chiliotrichum*, 2005, *U. Søchting* 10179; 20 km W of Puerto Williams, Caleta Mejillones, 54.9067°S, 68.1180°W, 5 m, *Berberis* twigs, 2005, *U. Søchting* 10189; Laguna Amarga, 50.9783°S, 72.78°W, 990 m, twigs, 2005, *U. Søchting* 10443; 2 km E of Puerto Navarino, 54.9270°S, 68.2756°W, 0.5 m, dead twigs of *Berberis*, 2015, *U. Søchting* 12333.

Blastenia circumpolaris Søchting, Frödén & Arup

(Fig. 4)

Notes. *Blastenia circumpolaris* was originally described as *Caloplaca wilsonii* S. Y. Kondr. *et al.* from Australia (Kondratyuk *et al.* 2009) but was transferred to *Blastenia* by Arup *et al.* (2013). It is an extremely common epiphyte in Tierra del Fuego, where it is found as dispersed thalli with characteristic orange-brown soralia on the bark of *Nothofagus* in particular. It also colonizes twigs, where it forms thalli with just a small number of soralia; fertile specimens are found only rarely. In the Falkland Islands, Tasmania and New Zealand, it is much

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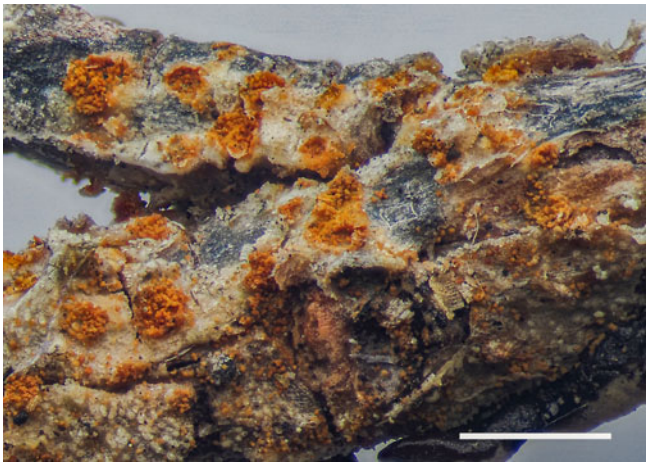

Figure 4. *Blastenia circumpolaris* (*U. Søchting* 11296). Scale = 1 mm. In colour online.

less frequent. Its currently known distribution outside mainland Australia is shown in Fig. 5.

Specimens studied. **Argentina:** *Provincia de Santa Cruz*: Rio Turbida at border post NE of Puerto Natales, 51.5635°S, 72.3483°E, 620 m, 2005, *U. Søchting* 10425.—**Australia:** *Tasmania*: North-East Tasmania, 15 km S of St Helens, Shelley Point, *Eucalyptus* regrowth forest by coast, 41.435°S, 148.274°E, 5 m, live bark, 2011, *U. Søchting* 11627.—**Chile:** *Región del Biobio*: Alto Bio Bio, 38.635°S, 70.96°W, 2012, *R. Vargas* 3708 (C). *IX Región del Araucania*: Malleco Province, Parque Nacional Conguillio, Sector Melipeuco, Sendero las Vertientes, 38.7669°S, 71.6344°W, bark of *Nothofagus*, 2011, *R. Vargas* (C). *XII Región de Magellanes y de la Antártica Chilena*: Parque Nacíonal Torres del Paine, walk from Lago Grey, 51.1181°S, 73.1419°W, trunk of dead *Nothofagus*, 2008, *M. Z. Søgaard* 55; 10 km north of Punta Arenas, 53.1403°S, 74.0544°W, living *Nothofagus*, 2008, *M. Z. Søgaard* 63, 65; 45 km SW of Punta Arenas, Reserva National Laguna Parillar, 53.4161°S, 71.2614° W, base of *Nothofagus* by lake shore, 2005, *U. Søchting* 10142, 10143; Seno Almirantazgo, Ainsworth Bay, 54.420°S, 69.562°W, dead *Chillotrichum*, 2009, *U. Søchting* 11272; 1 m, dead *Berberis* twigs, *U. Søchting* 11273; *ibid.*, 54.703°S, 69.332°W, 25 m, bark of dead twigs of *Nothofagus antarctica*, 2009, *U. Søchting* 11288; *ibid.,* 54.432°S, 70.118°W, 1 m, dead twigs of *Pernettya mucronulata*, 2009, *U. Søchting* 11296; *ibid.,* 54.432°S, 70.118° W, 1 m, dead twigs of *Berberis*, 2009, *U. Søchting* 11297; Hosteria Cabo San Isidro, 53.7822°S, 70.9737°W, bark of *Nothofagus betuloides* on beach, 2009, *U. Søchting* 11350, 11357; Beagle Channel, Seno Pia, 54.780°S, 69.590°W, 3 m, dead *Misodendrum* on *Nothofagus antarctica*, 2009, *U. Søchting* 11312b; *ibid.,* 54.772°S, 69.606°W, 20 m, old trunk of *Nothofagus betuloides*, 2009, *U. Søchting* 11314; *ibid.,* 54.719°S, 69.705°W, 2 m, old *Nothofagus betuloides*, 2009, *U. Søchting* 11319; *ibid.,* 54.772°S, 69.606°W, 20 m, old trunk of *Nothofagus betuloides*, 2009, *U. Søchting* 11314; *ibid.,* 54.7634°S, 69.6028°W, 98 m, old trunk of *Nothofagus betuloides*, 2015, *U. Søchting* 12282; *ibid.,* 54.7942°S, 69.6987°W, 1 m, dead twigs of *Nothofagus betuloides* overhanging the sea, 2015, *U. Søchting* 12306; Isla Navarino, 30 km W of Puerto Williams, Caleta José, 55.008°S, 68.174°W, 2 m, dry bark of *Nothofagus betuloides*, 2005, *U. Søchting* 10372; 7 km SW of Puerto Williams, Valle Róbalo, 54.9528°S, 67.6386°W, 240 m, trunk of *Nothofagus betuloides*, 2005, *U. Søchting* 10152; *ibid.,* 54.9614°S, 67.1933°W, 2 m, dead *Nothofagus*, 2008, *M. Z. Søgaard* 74.—**New Zealand:** *South Island*: Canterbury, 1 km N of Akaroa, volcanic outcrops in pasture, 43.7973°S, 173.0274°E, 742 m, rotten wood, 2012, *U. Søchting* 11989.—**Falkland Islands:** *East Island*: Gipsy Bay, outcrops in heathland, 51.7042°S, 57.9165°W, dead *Bolax* cushions, 2018, *U. Søchting* 12606; *ibid.,* dead *Empetrum* twigs, *U. Søchting* 12605. *Pebble Island*: pebbles on protected beach, 51.3039°S, 59.6032°W, rotten wood, 2018, *U. Søchting* 12663; *ibid.,* 51.3095°S, 59.6123°W, dead *Empetrum* twigs, 2018, *U. Søchting* 12653; *ibid.,* 51.3090°S, 59.4721°W, driftwood on beach, 2018, *U. Søchting* 12662.

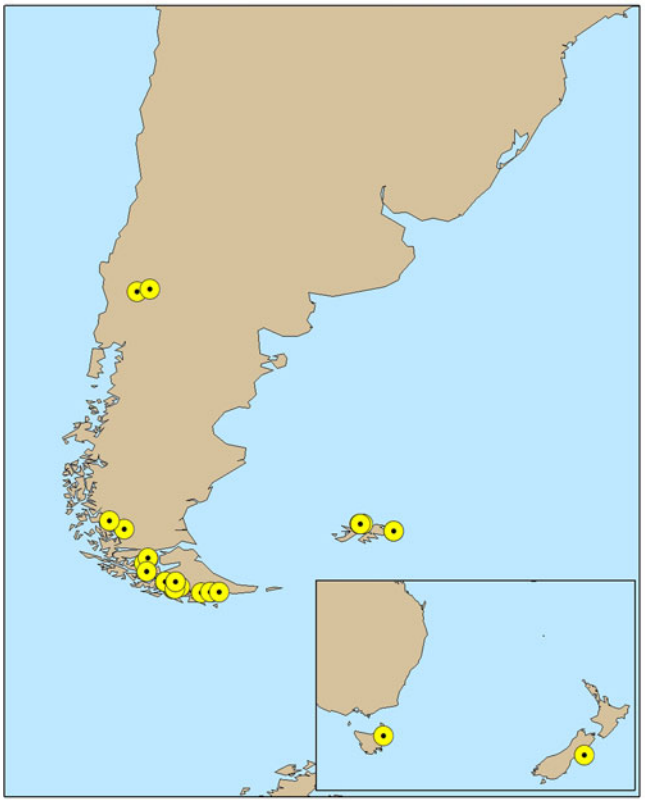

Figure 5. Distribution map of *Blastenia circumpolaris* occurring outside the Australian mainland. In colour online.

Marchantiana asserigena (J. Lahm) Søchting & Arup

Notes. The very insignificant species *Marchantiana asserigena* has recently been shown to be fairly common in Denmark and Norway (Søchting & Fröberg 2003; Søchting & Arup 2018; Tønsberg *et al.* 2021), but it has also been found in Sweden, Italy, France, Germany, Austria and the British Isles. Based on morphology, secondary chemistry and ITS data, it was identified from the Falkland Islands where it grew in similar habitats to those in the Northern Hemisphere, namely very thin twigs of dwarf shrubs. It is the first proven record from the Southern Hemisphere but it may have a much wider distribution.

Specimen studied. **Falkland Islands:** *East Island*: Gipsy Bay, 51.6765°S, 57.8101°W, 26 m, heathland, dead *Empetrum* twigs, 2018, *U. Søchting* 12604.

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The molecular phylogeny (Fig. 2), combined with distribution and secondary chemistry, place *Marchantiana pyramus* in a sister position to *Marchantiana epibrya*, which is combined here into the genus *Marchantiana* as:

Marchantiana epibrya (Kantvilas & Søchting) Søchting & Arup comb. nov.

MycoBank No: MB 848017

Basionym: *Caloplaca epibrya* Kantvilas & Søchting, *Kanunnah* **6**, 110 (2013) (MycoBank No.: MB 805211).

Based on the molecular data (Fig. 1), *Caloplaca queenslandica* is combined into *Marchantiana* as:

Marchantiana queenslandica (Kalb, S. Y. Kondr., Elix & Kärnefelt) Arup & Søchting comb. nov.

MycoBank No.: MB 848018

Basionym: *Caloplaca queenslandica* Kalb *et al.*, *Australas. Lichenol.* **66**, 35 (2010) (MycoBank No.: MB 548337).

Marchantiana pyramus Søchting & Arup sp. nov.

MycoBank No.: MB 848019

Thallus crustose, inconspicuous; similar to *Marchantiana ramulicola*, but apothecia orange and C+ red due to dominance of the anthraquinone emodin; ascospores polardiblastic, 12 × 5.5 µm, septum 5 µm; on twigs in Patagonia.

Type: Chile, XII Región de Magellanes y de la Antártica Chilena, Seno Almirantazgo, Ainsworth Bay, 54.420°S, 69.562° W, 1 m, dead *Chiliotrichum*, 6 December 2009, *Søchting* 11272.2a (C—holotype; LD—isotype).

(Fig. 6)

Thallus inconspicuous or smooth, thin and whitish.

Apothecia regular, biatorine, mostly few together and dispersed, sessile, 0.3–0.4 mm diam.; *disc* flat, orange, only slightly darker than the exciple, with coarse epipsamma; *proper margin* regular, orange, often brownish near the disc, eventually sometimes almost black at the surface, 30–50 µm thick, almost level with disc; *true exciple* fan-shaped, laterally up to *c.* 40 µm, close to surface with tissue of elongated cells, 3 × 10 µm; *hymenium c.* 60 µm; *paraphyses* simple to poorly branched, 1.5–2 µm thick, terminal cells up to 3 µm thick. *Asci* clavate, 8-spored. *Ascospores* polardiblastic, (10)12 ± 1.2(15) × (4.5)5.3 ± 0.4(6) µm, length/width ratio 2.3 ± 0.3, septum (3.5)4.8 ± 0.6(6) µm, length/septum ratio 2.6 ± 0.4 (n = 22).

Figure 6. *Marchantiana pyramus* (*U. Søchting* 10178). Scale = 0.5 mm. In colour online.

Chemistry. Chemosyndrome named here as E3: emodin 20–60%, with oxidation products citreorosein 30–50%, emodinal 20–30% and emodinic acid 15–40%. Thallus K−; apothecia K+ purple and C+ dark reddish.

Etymology. The epithet commemorates the mythological person Pyramus, appearing in Ovid's classic play '*Metamorphoses*' with his beloved Thisbe, whose name is used in this paper for a new *Austroplaca* species, very often growing intricately together with *M. pyramus* (see below and Fig. 3).

Ecology and distribution. *Marchantiana pyramus* grows on thin branches of shrubs and on twigs of *Nothofagus*. It is very common in southern Patagonia, both along the coast and inland. Often associated with *Austroplaca thisbe* (Fig. 3). In the Falkland Islands it grew on dead twigs of dwarf bushes. It has not been recorded from Tasmania or New Zealand.

Notes. *Marchantiana pyramus* shares its morphology and ecology with most of the other species in the genus *Marchantiana*, particularly with *M. asserigena*, which also occurs in the Northern Hemisphere.

Additional specimens studied. **Chile:** *XII Región de Magellanes y de la Antártica Chilena*: Parque Nacíonal Torres del Paine, walk from Lago Grey, 51.1181°S, 73.1419°W, branch of *Ribes*, 2008, *M. Z. Søgaard* 57b; 20 km S of Puerto Natales, twig of *Berberis*, *M. Z. Søgaard* 58; Provinzia Ultima Esperanza, 20 km S of Puerto Natales, on twigs of *Berberis*, 2008, *M. Z. Søgaard* 27b, 28; Seno Otway, 100 m from the sea, 53.0936°S, 71.3365°W, 1 m, dead stems of *Empetrum*, 2018, *U. Søchting* 12667; Montes Admiral, 52.0111°S, 72.3682°W, dead *Berberis* twigs, 2018, *Søchting* 12698; Hosteria Cabo San Isidro, 53.7822°S, 70.9737° W, 2 m, dead *Ribes*, 2009, *U. Søchting* 11363, 11369, 11372; Beagle Channel, Cabo Hyades, Bahia Yendegaia, 54.9158°S, 68.7137°W, 1 m, dead twigs of *Nothofagus*, 2015, *U. Søchting* 12317; Seno Pia, 54.780°S, 69.590°W, 3 m, dead *Misodendrum* on *Nothofagus antarctica*, 2009, *U. Søchting* 11312a; Isla Navarino, Puerto Williams around the airport, 54.9269°S, 67.6177°W, 9 m, *Berberis* twig, 2015, *U. Søchting* 12241; 37 km W of Puerto Williams, Caleta Honde, 54.93°S, 68.28°W, 5 m, dead *Chiliotrichum*, 2005, *U. Søchting* 10178; *ibid.*, 54.92°S, 68.23°W, 10 m, dead twigs of *Pernettya*, 2015, *U. Søchting* 12340.—**Falkland Islands:** *East Falkland*: Gypsy Cove, 51.674340°S, 57.808660°W, 10 m, *Bolax* on cliff top, 2015, *A.M. Fryday* 11279 (C, MSC). *Pebble Island*: maritime rocks and pebbles on shore, 51.3094°S, 59.6124°W, 40 m, dead *Empetrum* stem, 2018, *U. Søchting* 12654.

Marchantiana ramulicola Søchting & Arup sp. nov.

MycoBank No.: MB 848020

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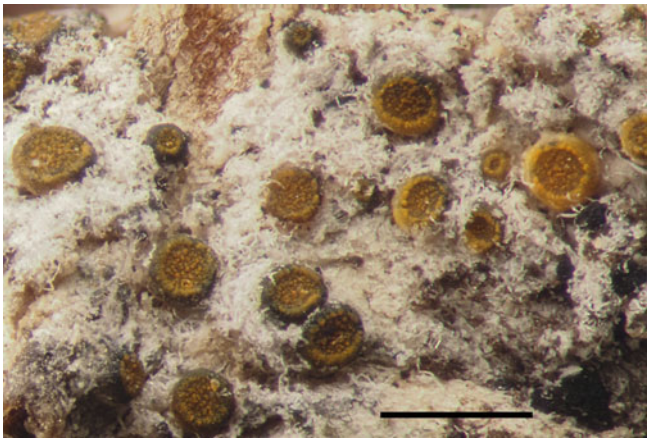

Figure 7. *Marchantiana ramulicola* (*U. Søchting* 11377). Scale = 0.5 mm. In colour online.

Thallus crustose, inconspicuous; similar to *Marchantiana pyramus* but apothecia more olive and C− due to chemosyndrome A dominated by parietin; ascospores polardiblastic, 13 × 8 µm, septum 4.5 µm; on twigs in Patagonia.

Type: Chile, XII Region de Magellanes y de la Antártica Chilena, Hosteria Cabo San Isidro, 53.7822°S, 70.9737°W, 2 m, dead twigs of *Chiliotrichum*, 17 December 2009, *U. Søchting* 11377 (C—holotype; LD—isotype).

(Fig. 7)

Thallus inconspicuous or smooth, thin and greyish, on smooth bark with a blackish hypothallus.

Apothecia regular, biatorine, dispersed to aggregated, initially immersed, eventually sessile and restricted at the base, 0.2–0.4 mm diam.; *disc* flat, yellow to dark orange, with coarse epipsamma; *proper margin* regular, olive in outer part, with a brighter yellow tinge near the disc, *c.* 50 µm thick, initially sometimes urniform, inflated below and constricted above, prominent, with a sharp edge towards the disc; *true exciple* fan-shaped, laterally up to *c.* 40 µm; *hypothecium* very thin, *c.* 15 µm; *hymenium c.* 60 µm; *paraphyses* mostly simple, *c.* 1.5 µm thick, terminal cells slightly thickened, up to 3 µm. *Asci* clavate, 8-spored. *Ascospores* (10.5)13.1 ± 1.3 (15) × (6.5)7.8 ± 0.8(10) µm, length/width ratio 1.7 ± 0.2, septum (3.5)4.6 ± 0.5(5) µm, length/septum ratio 2.9 ± 0.4 (n = 20).

Chemistry. Chemosyndrome A of Søchting (1997): 6–10% teloschistin, 0–5% fallacinal, 0–4% parietinic acid and 85–90% parietin (n = 3).

Etymology. The epithet refers to the preferred growth on thin twigs.

Ecology and distribution. The species grows on thin, dead branches and twigs of, for example, *Chiliotrichum* and *Fuchsia*. It is so far known only from two localities in southern Chile.

Additional specimens studied. **Chile:** *XII Región de Magellanes y Antártica Chilena*: Seno Almirantazgo, 54.432°S, 70.118°W, 1 m, dead twigs of *Chiliotrichum*, 2009, *U. Søchting* 11295; Beagle Channel, Seno Pia, west arm, shore of fjord, 54.7897°S, 69.6946°W, 2 m from the sea, 1 m, twigs of *Chiliotrichum* hanging over the sea, 2015, *U. Søchting* 12308; Hosteria Cabo San Isidro, 53.7822°S, 70.9737°W, 2 m, dead twigs, 2009, *U. Søchting* 11353, 11367.

Based on the molecular results *Caloplaca subpyracea* (Nyl.) Zahlbr. from New Zealand is combined into *Marchantiana*:

Marchantiana subpyracea (Nyl.) Søchting & Arup comb. nov.

MycoBank No.: MB 848016

Basionym: *Lecanora subpyracea* Nyl. *Lich. Nov. Zel.*, 59 (1888) (MycoBank No.: MB 389373); type: New Zealand, *sine loco*, 1867, *Charles Knight* (H–NYL 29847—lectotype selected here, MBT 10014522).

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