Plant and Fungal Systematics 71(1): 97–121, 2026
DOI: https://doi.org/10.35535/pfsyst-2026-0011

ISSN 2544-7459 (print)
ISSN 2657-5000 (online)

Which *Ramalina* species occur on the Azores? An approach using TLC and ITS barcoding sequences

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Article info

Received: 28 Feb. 2026
Revision received: 28 Jun. 2026
Accepted: 29 Jun. 2026
Published: 31 Jul. 2026

Associate Editor

Robert Lücking

Abstract. The lichen genus *Ramalina* is well represented on the Azores islands, an isolated archipelago in the Atlantic Ocean. Fieldwork on several islands, loans from several herbaria, and the collecting of fresh samples, allowed us to identify lichen substances by TLC and to estimate the phylogenetic placement of taxa using ITS sequences from many samples. This confirmed the presence of 13 species, including *R. portuensis* as new to the Azores and new to Greece. Evidently the *Ramalina* biota of the Azores is considerably different from that of the Canary Islands and Madeira, by the lower number of species and by their affinities. A commented survey of all reported species, both accepted and rejected, is provided, and an identification key is added.

Key words: biodiversity, identification key, integrative taxonomy, lichenized fungi, phytogeography

Introduction

The islands in the Atlantic Ocean are well-known for their diversity in the genus *Ramalina* (e.g., Krog & Østhagen 1980; Aptroot & Schumm 2008). The Azores archipelago is no exception and has already received considerable attention. The earliest report is probably by Seubert (1844). He listed *R. scopulorum* from the archipelago, without further detail, using a name which is currently considered as a synonym for *R. siliquosa* (Huds.) A.L. Sm. Drouet (1866) reported three species from the islands of São Miguel and Pico, viz. *R. scopulorum* (Ach.) Ach., *R. calicaris* (L.) Röhl. and *R. thrausta* (Ach.) Nyl., and one species without indication of its origin, *R. fraxinea* (L.) Ach. Nylander (1898) was the first lichen taxonomist who presented a survey of lichens on the Azores, listing the following five species for the archipelago: *R. farinacea* (L.) Ach., *R. pollinaria* (Westr.) Ach., *R. pusilla* Duby, *R. cuspidata* (Ach.) Nyl., and *R. subgeniculata* Nyl. Afterwards, Degelius (1941) added three more species, *R. canariensis* J. Steiner, *R. siliquosa*, and *R. maciformis* (Delile) Bory (as *R. evernioides* Nyl.). Tavares (1952) presented a cumulative list of 14 species: *R. bourgaeana* Mont. ex Nyl., *R. calicaris*, *R. canariensis*, *R. cuspidata*, *R. decipiens* Mont., *R. farinacea*, *R. fraxinea*, *R. maciformis*, *R. pusilla*, *R. requienii* (De Not.) Jatta, *R. siliquosa*, *R. subfarinacea* (Nyl. ex Cromb.) Nyl., *R. subgeniculata*, and *R. thrausta* (Ach.) Nyl.

More recently, the development of TLC as a tool for the chemical analysis of lichen species brought significant improvement for the classification of lichens. Krog & Østhagen (1980) used it successfully for a classification of the genus *Ramalina* on the Canary Islands. They recognized a high diversity of 29 species, including 11 endemics. Unfortunately, they did not publish similar treatments for other archipelagos of Macaronesia, like Madeira or the Azores. Attempts to apply their species concepts to these archipelagos using simplified chemical methods (e.g., Aptroot & Schumm 2008; Berger & Priemetzhofer 2008; Aptroot et al. 2010) led to considerable misunderstanding of taxa described from the Canary Islands and supposed to be present also on the Azores. Therefore, and because another new tool, DNA analysis, has become available for classification, we set out to revise the genus *Ramalina* for the Azores combining TLC and ITS barcoding.

Material and methods

A total of 359 specimens was investigated, mostly collected by the second and the third author, or borrowed from the herbaria of A. Aptroot in B and BR, of F. Berger, pr. p. in LI, of O. Breuss, pr. p. in LI, of F. Neuwirth in LI, of F. Priemetzhofer in LI, and of F. Schumm. A list of all examined specimens with TLC results is presented in Appendix 1. Unfortunately, the published records do not always contain voucher data, and where they exist, it was not always possible to obtain the specimens.

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The morphology of the specimens was investigated with a stereomicroscope (Wild M7). For ascospore measurements, a compound microscope (Olympus CX41) was used. A limited number of properly developed ascospores was selected and the range of their values is presented. The secondary metabolites of most samples were investigated by TLC, using solvent systems A, B' and C, following Orange et al. (2010).

Sequencing was done at Alvalab (Oviedo, Spain). Total DNA was extracted from ~2 mm^3 fragments, from which the lichen substances had been extracted for TLC. A modified protocol based on Murray & Thompson (1980) was used. PCR reactions (Mullis & Faloona 1987) included 35 cycles with an annealing temperature of 54°C. The primers ITS1F and ITS4 (White et al. 1990; Gardes & Bruns 1993) were employed to amplify the ITS rDNA region. PCR products were checked in 1% agarose gels and positive reactions were sequenced with one or both PCR primers. The sequences were verified by comparison with published sequences and deposited in GenBank. For a list of all 206 sequences used see Table 1. The sequences were aligned with MAFFT (https://mafft.cbrc.jp/alignment/server/index.html, accessed Nov. 2025; Katoh & Standley 2013), with manual corrections. The minor intron in ITS1, most developed in *Ramalina fraxinea*, was excluded from the analysis. The phylograms were calculated using RAxML (https://cme.h-its.org/exelixis/web/software/raxml/, accessed Nov. 2025; Stamatakis 2014) and visualized in FigTree v1.4.4 (Rambaut 2018).

Results and discussion

Molecular phylogenies based on ITS barcoding sequences

Altogether 76 new ITS sequences were obtained, 46 from Azorean samples (Table 1). The alignments were completed with reference sequences for the identified and the misidentified species, downloaded from GenBank. We used preferably sequences from Spjut et al. (2020), which are more likely from correctly identified specimens. Where enough sequences were available, we downloaded several and selected a few that were complete and resembled each other strongly. When possible, we used sequences from samples that we identified.

The phylogenetic analysis based on ITS sequences (Fig. 1) supports the monophyly of almost all species reported from the Azores and confirms their identities based on morphology and chemistry, demonstrating that their identification based on morphological and chemical data is quite reliable. Complications were encountered in three cases: the species pairs *R. portuensis*/*subpusilla* and *lacera*/*mollis*, and the cluster of *R. krogiae* Guissard & Sérus. and *R. lusitanica* H. Magn. The two available sequences of *R. portuensis* Samp. cluster with

Table 1. The 163 sequences used for Figs 1 and 5, with name, herbarium voucher, locality and GenBank number, when available. The 76 new sequences are in bold.

Species	Voucher	Locality	GenBank number of ITS sequence
Ramalina huei	H. Sipman 62903	Portugal (PortoSanto)	**PZ602694**
Ramalina huei	H. Sipman 62974	Portugal (PortoSanto)	**PZ602693**
Ramalina farinacea2	H. Sipman & T. Raus 61306	Greece/Chios	**PZ602705**
Ramalina farinacea	H. Sipman & T. Raus 62592	Greece/Lesbos	**PZ602706**
Ramalina farinacea	H. Sipman & T. Raus 62226	Greece/Lesbos	**PZ602709**
Ramalina farinacea	H. Sipman & T. Raus 62398	Greece/Lesbos	**PZ602707**
Ramalina farinacea	H. Sipman & T. Raus 61877	Greece/Lesbos	**PZ602715**
Ramalina subfarinacea	H. Sipman & T. Raus 62560	Greece/Lesbos	**PZ602701**
Ramalina subfarinacea	H. Sipman & T. Raus 62298	Greece/Lesbos	**PZ602702**
Ramalina farinacea	H. Sipman & T. Raus 62180	Greece/Lesbos	**PZ602713**
Ramalina farinacea	H. Sipman & T. Raus 60305	Greece/Arcadia	**PZ620606**
Ramalina farinacea	H. Sipman & T. Raus 61300a	Greece/Chios	**PZ602708**
Ramalina farinacea	H. Sipman & T. Raus 62160	Greece/Lesbos	**PZ602710**
Ramalina farinacea	H. Sipman & T. Raus 62166	Greece/Lesbos	**PZ602711**
Ramalina farinacea	H. Sipman & T. Raus 62331	Greece/Lesbos	**PZ602714**
Ramalina calicaris	H. Sipman & T. Raus 61875	Greece/Lesbos	**PZ602696**
Ramalina calicaris	H. Sipman & T. Raus 62166	Greece/Lesbos	**PZ602697**
Ramalina calicaris	H. Sipman & T. Raus 62160pp	Greece/Lesbos	**PZ602698**
Ramalina pollinaria	C. Dolnik 3455	Germany/Rantzau	**PZ602704**
Ramalina fraxinea	A. Aptroot s. coll.	The Netherlands	**PZ602767**
Ramalina capitata	R. Cezanne & M. Eichler 10959	Germany	**PZ602760**
Ramalina pusilla	H. Sipman & T. Raus 63398	Greece/Amorgos	**PZ602717**
Ramalina lacera	H. Sipman & T. Raus 63202	Greece/Amorgos	**PZ602728**
Ramalina farinacea	V. Wirth s.n.	Germany	**PZ602716**
Ramalina pusilla	H. Sipman & T. Raus 66506	Greece/Astipalea	**PZ602722**
Ramalina krogiae	P. van den Boom 61880	Flores	**PZ602733**
Ramalina krogiae	P. van den Boom 61924	Flores	**PZ602740**
Ramalina subgeniculata	P. van den Boom 62285	Flores	**PZ602747**

Table 1. Continued.

Species	Voucher	Locality	GenBank number of ITS sequence
Ramalina azorica	P. van den Boom 62165	Corvo	**PZ602761**
Ramalina wirthii	P. van den Boom 61921	Flores	**PZ602724**
Ramalina subgeniculata	P. van den Boom 62066	Flores	**PZ602749**
Ramalina lacera	P. van den Boom 62171	Corvo	**PZ602729**
Ramalina subgeniculata	P. van den Boom 62297	Flores	**PZ602748**
Ramalina wirthii	P. van den Boom 62012	Flores	**PZ602725**
Ramalina subfarinacea	H. Sipman & T. Raus 66727	Greece/Lemnos	**PZ602699**
Ramalina capitata	H. Sipman & T. Raus 66744	Greece/Lemnos	**PZ602758**
Ramalina subfarinacea	H. Sipman & T. Raus 66776	Greece/Lemnos	**PZ602703**
Ramalina capitata	H. Sipman & T. Raus 66865	Greece/Lemnos	**PZ602759**
Ramalina subfarinacea	H. Sipman & T. Raus 66949	Greece/Lemnos	**PZ602700**
Ramalina azorica	F. Rodrigues Ra 20 (1.2)	Terceira	**PZ602762**
Ramalina azorica	F. Rodrigues Ra 19 (1.1)	Terceira	**PZ602764**
Ramalina azorica	F. Rodrigues Ra 26 (1.8)	Terceira	**PZ602766**
Ramalina azorica	F. Rodrigues Ra 28 (2.1)	Terceira	**PZ602763**
Ramalina azorica	F. Rodrigues Ra 31 (2.4)	Terceira	**PZ602765**
Ramalina lusitanica	F. Rodrigues Ra 11 (PV1)	São Miguel	**PZ602741**
Ramalina lusitanica	F. Rodrigues Ra 15 (CO1)	Terceira	**PZ602743**
Ramalina krogiae	F. Rodrigues Ra 23 (1.5)	Terceira	**PZ602735**
Ramalina subpusilla	F. Rodrigues Ra 02 (FL2)	Flores	**PZ602753**
Ramalina subpusilla	F. Rodrigues Ra 03 (FL3)	Flores	**PZ602754**
Ramalina lacera	F. Rodrigues Ra 13 (RE2)	São Miguel	**PZ602730**
Ramalina peruviana	F. Rodrigues Ra 12 (RE1)	São Miguel	**PZ602755**
Ramalina lusitanica	F. Rodrigues Ra 48 (JPA3)	Terceira	**PZ602742**
Ramalina pusilla	F. Rodrigues Ra 50 (MB1)	Terceira	**PZ602719**
Ramalina pusilla	F. Rodrigues Ra 51 (MB2)	Terceira	**PZ602720**
Ramalina canariensis	F. Rodrigues Ra 52 (MB3)	Terceira	**PZ602695**
Ramalina peruviana	F. Rodrigues Ra 53 (MB4)	Terceira	**PZ602756**
Ramalina subpusilla	F. Rodrigues Ra 56 (MB7)	Terceira	**PZ602750**
Ramalina krogiae	F. Rodrigues Ra 59 (MB10)	Terceira	**PZ602734**
Ramalina wirthii	F. Rodrigues Ra 60 (MB11)	Terceira	**PZ602726**
Ramalina wirthii	F. Rodrigues Ra 61 (MB12)	Terceira	**PZ602727**
Ramalina krogiae	F. Rodrigues Ra 62 (MB13)	Terceira	**PZ602738**
Ramalina pusilla	F. Rodrigues Ra 64 (MB16)	Terceira	**PZ602718**
Ramalina krogiae	F. Rodrigues Ra 66 (MB18)	Terceira	**PZ602736**
Ramalina subpusilla	F. Rodrigues Ra 67 (MB19)	Terceira	**PZ602751**
Ramalina subpusilla	F. Rodrigues Ra 70 (RV1)	Terceira	**PZ602752**
Ramalina lusitanica	F. Rodrigues Ra 71 (RV2)	Terceira	**PZ602744**
Ramalina pusilla	F. Rodrigues Ra 73 (RV4)	Terceira	**PZ602721**
Ramalina krogiae	F. Rodrigues Ra 76 (SF1)	Terceira	**PZ602737**
Ramalina lacera	F. Rodrigues Ra 77 (SF2)	Terceira	**PZ602731**
Ramalina krogiae	F. Rodrigues Ra 78 (SF3)	Terceira	**PZ602739**
Ramalina lusitanica	F. Rodrigues Ra 79 (QA1)	São Miguel	**PZ602745**
Ramalina lacera	F. Rodrigues Ra 81 (QA3)	São Miguel	**PZ602732**
Ramalina pusilla	F. Rodrigues Ra 83 (QA5)	São Miguel	**PZ602723**
Ramalina farinacea	F. Rodrigues Ra 84 (QA6)	São Miguel	**PZ602712**
Ramalina lusitanica	F. Rodrigues Ra 85 (QA7)	São Miguel	**PZ602746**
Ramalina peruviana	F. Rodrigues Ra 86 (QA8)	São Miguel	**PZ602757**
Ramalina farinacea	Pruegger SN089.16/1.	Slovenia	AY462050
Ramalina farinacea	Pruegger SN024.16/1	Slovenia	AY462053
Ramalina peruviana	LMCC 14	Brazil	FJ356151
Ramalina farinacea	gbM8	Iceland	FJ497038
Ramalina bourgaeana	T. Feuerer s.n. (HBG 017037)	Spain/Gran Canaria	FJ871069
Ramalina bourgaeana	A. Seelemann L047 (HBG 017039)	Spain/Lanzarote	FJ871071
Ramalina canariensis	T. Feuerer s.n. (HBG 017040)	Spain/La Palma	FJ871072
Ramalina canariensis	J. M. Bannister 58695 (HBG 017041)	New Zealand	FJ871073
Ramalina chondrina	A. Seelemann H159 (HBG 17042)	Spain/El Hierro	FJ871074
Ramalina chondrina	A. Seelemann P217 (HBG 17043)	Spain/La Palma	FJ871075
Ramalina crispatula	T. Feuerer s.n. (HBG 17044)	Spain/Fuerteventura	FJ871076
Ramalina cupularis	A. Seelemann P017 (HBG 17045)	Spain/La Palma	FJ871077

Table 1. Continued.

Species	Voucher	Locality	GenBank number of ITS sequence
Ramalina maciformis	T. Feuerer s.n. (HBG 017054)	Spain/Fuerteventura	FJ871089
Ramalina mollis	A. Seelemann P032 (HBG 017074)	Spain/La Palma	FJ871092
Ramalina farinacea2	Hur HB070122-a	Korea	GU593041
Ramalina farinacea	E. Sérusiaux s.n. (LG R326)	Spain/Tenerife	GU726346
Ramalina decipiens	E. Sérusiaux s.n. (LG R343)	Spain/Tenerife	GU726350
Ramalina crispatula	E. Sérusiaux s.n. (LG R3)	Spain/Fuerteventura	GU827289
Ramalina lacera	E. Sérusiaux s.n. (LG R7)	Spain/Fuerteventura	GU827290
Ramalina webbii	E. Sérusiaux s.n. (LG R73)	Spain/Fuerteventura	GU827293
Ramalina portuensis	E. Sérusiaux s.n. (LG R175)	UK/Scotland	GU827298
Ramalina subgeniculata	D. Ertz 10489 (LG R179, BR)	Portugal/Madeira	GU827300
Ramalina subpusilla	E. Sérusiaux s.n. (LG R249)	Pico	GU827302
Ramalina azorica	E. Sérusiaux s.n. (LG R303)	Pico	GU827303
Ramalina farinacea	E. Sérusiaux s.n. (LG R326)	Spain/Tenerife	GU827305
Ramalina huei	E. Sérusiaux s.n. (LG R349)	Spain/Tenerife	GU827310
Ramalina bourgaeana	E. Sérusiaux s.n. (LG R351)	Spain/Tenerife	GU827311
Ramalina farinacea	E. Sérusiaux s.n. (LG R374)	France	GU827313
Ramalina requienii	P. van den Boom 38398 (h) R422	Spain	GU827315
Ramalina rosacea	P. van den Boom 38385 (h) R426	Spain	GU827316
Ramalina bourgaeana	D. Ertz 10526 (LG R430, BR)	Portugal/Madeira	GU827318
Ramalina krogiae	D. Ertz 10520 (LG R431, BR)	Portugal/Madeira	GU827319
Ramalina cupularis	E. Sérusiaux s.n. (LG R445)	Spain/Fuerteventura	GU827320
Ramalina implectens	P. van den Boom 37682 (h) R448	Spain/Tenerife	GU827321
Ramalina subfarinacea	E. Sérusiaux s.n. (LG R502)	France/Corse	GU827325
Ramalina pusilla	E. Sérusiaux s.n. (LG R509)	France/Corse	GU827327
Ramalina implexa	E. Sérusiaux s.n. (LG R513)	France/Corse	GU827328
Ramalina requienii	E. Sérusiaux s.n. (LG R529)	France/Corse	GU827331
Ramalina alisiosae	Rf_Re1	Spain/Tenerife	JF414686
Ramalina farinacea	Rf_MH	USA/California	JF414693
Ramalina farinacea	Rf SF	USA/California	JF414694
Ramalina thrausta	R5	Turkey/Bolu	KC960761
Ramalina farinacea	R 6	Turkey/Bolu	KC960762
Ramalina alisiosae	S. Perez-Ortega & M. Arroniz-Crespo s671	Spain/El Hierro	KJ020563
Ramalina alisiosae	S. Perez-Ortega & M. Arroniz-Crespo s672	Spain/El Hierro	KJ020564
Ramalina farinacea	M6	Spain	KJ413044
Ramalina farinacea	M7	Spain	KJ413045
Ramalina fraxinea	–	Spain	KP282350
Ramalina pollinaria	A. Paukov 2335 [UFU L-2515]	Russia	KY362417
Ramalina pollinaria	A. Gasparyan T-14-08 [B 60 0201029]	Armenia	KY362418
Ramalina lacera	Caragol 3	Spain/Mallorca	MH252138
Ramalina siliquosa	O-L-196010	Norway	MK811720
Ramalina cuspidata	O-L-197829	Norway	MK811797
Ramalina cuspidata	O-L-196016	Norway	MK812006
Ramalina farinacea	Sample3	USA/California	MN006779
Ramalina farinacea	Sample40	USA/California	MN006792
Ramalina farinacea	17968	Poland	MN387157
Ramalina farinacea	17980	Poland	MN387158
Ramalina crispatula	H. Sipman 62879	Portugal/Porto Santo	MN586989
Ramalina decipiens	H. Sipman 62865	Portugal/Porto Santo	MN586990
Ramalina decipiens	H. Sipman 62877	Portugal/Porto Santo	MN586991
Ramalina decipiens	H. Sipman 62925a	Portugal/Porto Santo	MN586993
Ramalina decipiens	H. Sipman 62948	Portugal/Porto Santo	MN586994
Ramalina erosa	H. Sipman 62924	Portugal/Porto Santo	MN586996
Ramalina erosa	H. Sipman 62977	Portugal/Porto Santo	MN586997
Ramalina sampaioana	H. Sipman 62892	Portugal/Porto Santo	MN587004
Ramalina nematodes	H. Sipman 62930	Portugal/Porto Santo	MN587007
Ramalina nematodes	H. Sipman 62872	Portugal/Porto Santo	MN587008
Ramalina krogiae	H. Sipman 62862	Portugal/Porto Santo	MN587009
Ramalina krogiae	H. Sipman 62786	Portugal/Porto Santo	MN587010
Ramalina krogiae	H. Sipman 62916	Portugal/Porto Santo	MN587011

Table 1. Continued.

Species	Voucher	Locality	GenBank number of ITS sequence
Ramalina krogiae	H. Sipman 62786a	Portugal/Porto Santo	MN587013
Ramalina krogiae	H. Sipman 62961	Portugal/Porto Santo	MN587016
Ramalina subpusilla	H. Sipman 62956	Portugal/Porto Santo	MN587017
Ramalina subpusilla	H. Sipman 62955	Portugal/Porto Santo	MN587018
Ramalina subpusilla	H. Sipman 62906	Portugal/Porto Santo	MN587019
Ramalina tingitana	H. Sipman 62878	Portugal/Porto Santo	MN587022
Ramalina tingitana	H. Sipman 62903a	Portugal/Porto Santo	MN587023
Ramalina tingitana	H. Sipman 62919	Portugal/Porto Santo	MN587024
Ramalina calicaris	174	UK/Scotland	MN811238
Ramalina canariensis	E. Sérusiaux s.n. (LG 241)	Spain/Teneriffe	MN811240
Ramalina krogiae	M. Dewald, A. Hambuckers & E. Sérusiaux s.n. (LG 459)	Portugal/Porto Santo	MN811241
Ramalina clementeana	P. van den Boom (LG)	Spain/Almera	MN811247
Ramalina krogiae	E. Sérusiaux s.n. (LG 666) TYPE	Spain/La Gomera	MN811250
Ramalina krogiae	E. Sérusiaux s.n. (LG 1169)	Spain/Lanzarote	MN811253
Ramalina tingitana	M. Guissard & E. Sérusiaux s.n. (LG 1510)	Italy/Sardinia	MN811258
Ramalina tingitana	M. Guissard & E. Sérusiaux s.n. (LG 1511)	Italy/Sardinia	MN811259
Ramalina requienii	M. Guissard & E. Sérusiaux s.n. (LG 1514)	Italy/Sardinia	MN811261
Ramalina tingitana	M. Guissard & E. Sérusiaux s.n. (LG 1516)	France/Corsica	MN811262
Ramalina clementeana	M. Guissard & E. Sérusiaux s.n. (LG 1519)	France/Corsica	MN811263
Ramalina tingitana	M. Guissard & E. Sérusiaux s.n. (LG 1520)	France/Corsica	MN811264
Ramalina tingitana	M. Guissard & E. Sérusiaux s.n. (LG)	France/Corsica	MN811265
Ramalina lusitanica	M. Guissard & E. Sérusiaux s.n. (LG 1525)	Italy/Sardinia	MN811266
Ramalina implectens	H. Sipman & T. Raus 56166b	Greece/Karpathos	MN811270
Ramalina portuensis	H. Sipman & T. Raus 56237b	Greece/Karpathos	MN811271
Ramalina lusitanica	M. Guissard & E. Sérusiaux s.n. (LG 1702)	Italy/Sardinia	MN811275
Ramalina clementeana	M. Guissard & E. Sérusiaux s.n. (LG 2111)	Italy/Sardinia	MN811276
Ramalina requienii	M. Guissard & E. Sérusiaux s.n. (LG 2112)	Italy/Sardinia	MN811277
Ramalina maciformis	E. Sérusiaux s.n. (LG 2846)	Tunisia 2008	MN811283
Ramalina calicaris	H. Sipman & T. Raus 63745	Greece/Skyros	MN989289
Ramalina calicaris	H. Sipman & T. Raus 63745	Greece/Skyros	MN989289
Namibialina melanothrix	E. Sérusiaux s.n. (LG 6060)	Namibia	MT465429
Namibialina melanothrix	E. Sérusiaux s.n. (LG 5022)	Namibia	MT465432
Ramalina sinensis	T. Goward s.n. (h, LG)	Canada	MT465436
Ramalina usnea	Gumboski 4060	Brazil	MT659144
Ramalina usnea	Ribeiro_SN	Brazil	MT659145
Ramalina usnea	Vidigal_SN	Brazil	MT659146
Ramalina cuspidata	LaGreca 1359	UK/Wales	OK033104
Ramalina siliquosa	LaGreca 1360	UK/Wales	OK033157
Ramalina conduplicans	CUPVOUCHER-NEA-11L-2018-RC-1	India	OK577892
Ramalina conduplicans	han20191107R04-1	China	OM403502
Ramalina conduplicans	han20191109R03-1	China	OM403504
Ramalina farinacea	H. Sipman & T. Raus 60734	Greece/Chios	OQ695768
Ramalina farinacea	H. Sipman & T. Raus 62173	Greece/Lesbos	OQ695769
Ramalina fraxinea	H. Sipman & T. Raus 62509	Greece/Lesbos	OQ695771
Ramalina peruviana	P. van den Boom 55163	Fajal	OQ695775
Ramalina peruviana	P. van den Boom 57046	Pico	OQ695776
Ramalina peruviana	A. Ramirez s.n.	Peru	OQ695778
Ramalina thrausta	PRA-Vondrak26154	Austria	OQ717594
Ramalina lacera	DAG 1470	Dagestan	OR289700
Ramalina farinacea2	S. Chiva 711	Spain/Castellon	OR978676
Ramalina farinacea2	S. Chiva 719	Spain/Castellon	OR978677
Ramalina farinacea2	S. Chiva 743	Spain/Castellon	OR978678
Ramalina farinacea2	S. Chiva & L. Muggia 135	Italy/Foggia	OR978679
Ramalina farinacea2	S. Chiva & L. Muggia RF_DO	Spain/Castellon	OR978926
Ramalina farinacea2	S. Chiva & L. Muggia FR_BS	Spain/Castellon	OR978928
Ramalina farinacea2	S. Chiva, F. Gasulla & L. Muggia 15_2	Spain/Castellon	OR978958
Ramalina subfarinacea	Leavitt 23.233	Spain/Castellon	OR978959
Ramalina alisiosae	S. Perez-Ortega & M. Arroniz-Crespo G2	Spain/Tenerife	OR979068
Ramalina sinensis	–	USA/Utah	PQ384960

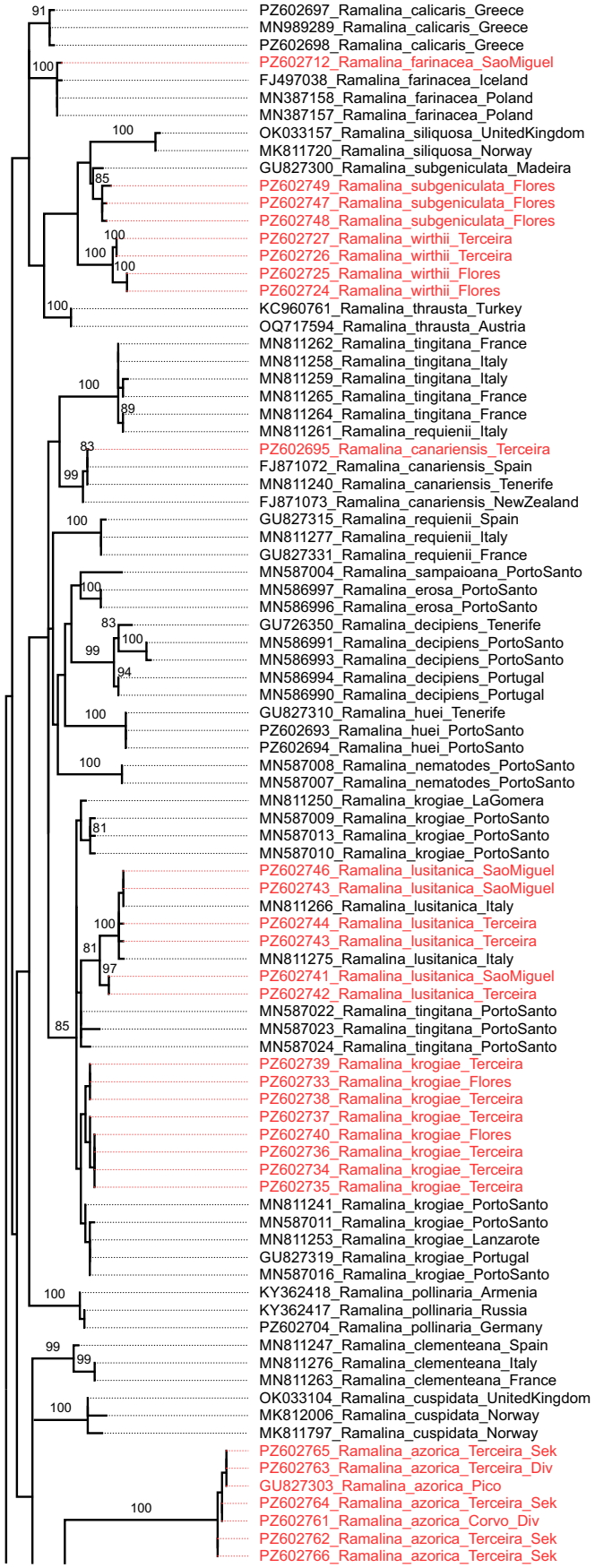

Figure 1. Maximum likelihood phylogenetic tree of ITS sequences from the Azores (in red) with sequences of the same species from other regions and of the unconfirmed species *R. calicaris*, *R. cuspidata*, *R. implectens* Nyl., *R. implexa* (Nyl.) Krog, *R. pollinaria*, *R. siliquosa* and *R. subfarinacea*, and a neotropical species with cork-screw shaped laciniae, *R. usnea* (L.) R. Howe. ML bootstrap support values are shown at the nodes, when over 79. Outgroup is *Namibialina melanothrix* (Laurer) Spjut & Sérus. Island names are given for Macaronesia, elsewhere country names. For *R. azorica* the chemical strains are indicated by the abbreviations "Div" and "Sek" when known. All Azorean *Ramalina* species belong to well separated clades.

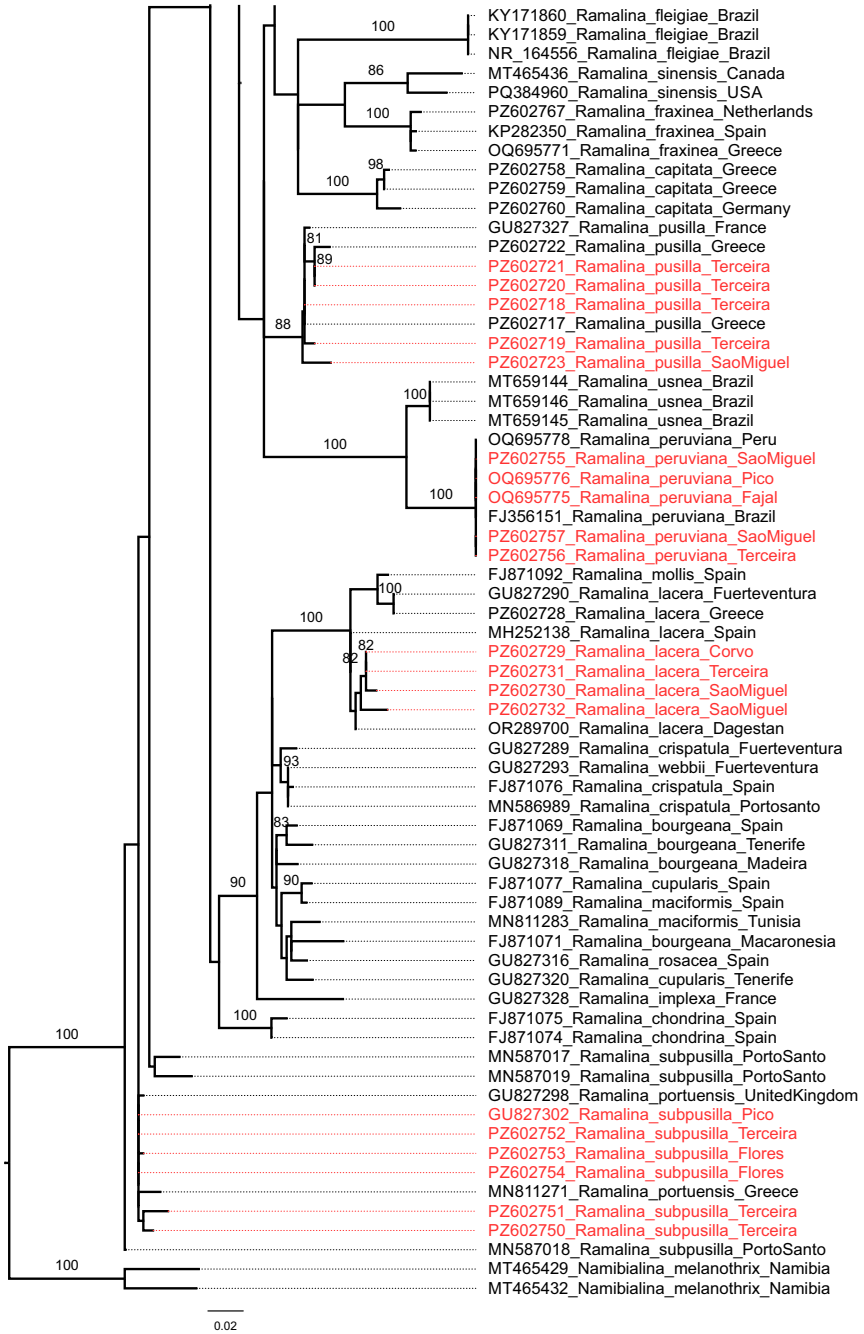

Figure 1. Continued.

R. subpusilla (Nyl.) Pit. & Harm. (Fig. 1). This suggests that *R. portuensis* is a recently separated, secondary, sorediate species derived from the primary, fertile *R. subpusilla*, which has not yet developed its own ITS profile and which shares salazinic acid. The pair *R. lacera*/*R. mollis* belongs to a group of species with affinities to the genus *Niebla* (Spjut et al. 2020). The sequences of this group (*R. bourgaeana*, *R. crispatula* Dèspr. ex Nyl., *R. cupularis* Krog & P. James, *R. lacera* (With.) J.R. Laundon, *R. maciformis*, *R. mollis* Krog & Østh., *R. rosacea* (A. Massal.) Hepp and *R. webbii* Mont.) form a well-supported cluster (Fig. 1), but only one of the species, *R. lacera*, forms a well-supported subcluster. Unfortunately, the other species are represented only by one or few sequences, which do not show further differentiation in the clade. The single sequence of *R. mollis* clusters with *R. lacera* and might be another example of a species pair with a primary, fertile and a secondary, sorediate taxon.

The species *Ramalina krogiae* was recently split off from *R. requienii* based on sequencing data (Spjut et al. 2020). This decision is supported in our phylogram (Fig. 1). However, *R. krogiae* forms more than one clade, albeit with weak support. The sequences from the Azores form their own cluster, separate from the sequences from Porto Santo. *Ramalina lusitanica* clusters with these, reminiscent of a primary, fertile species weakly differentiated from the secondary, granulose-phyllidiate *R. krogiae*.

Survey of *Ramalina* species reported from the Azores

This survey combines the information from all published reports and specimens available to us (listed in

Appendix 1). It presents the distribution on the Azores archipelago and notes on habitat preference and distinguishing characters. The names of the nine main islands are abbreviated and in the same West-East sequence as in Aptroot et al. (2010): COR – Corvo; FLO – Flores; FAI – Faial; PIC – Pico; GRA – Graciosa; SJG – São Jorge; TER – Terceira; SMG – São Miguel; SMR – Santa Maria. The confirmed species are treated first and in more detail, with their name in bold. One species, *R. implectens* Nyl., is expected to occur on the Azores and is treated in more detail, but not in bold.

Ramalina azorica Aptroot & Schumm (Fig. 2A)

Medullary chemistry. Two chemical strains were found: (1) major substance divaricatic acid, (2) major substance sekikaic acid. Terpenoids occur in various amounts and compositions. In Figure 1 the chemical strains of *Ramalina azorica* are marked by the ending "Div" or "Sek". They do not show a correlation with the ITS sequences.

Ecology and distribution. *Ramalina azorica* grows on volcanic rocks and stone walls near the coast. It is reported by Aptroot et al. (2010) from FLO, FAI, PIC, GRA, TER, and SMG. We also saw specimens from COR, SJG and SMR (see Appendix 1). Thus, the species is reported from all larger islands. It is endemic and not known from elsewhere.

Notes. This species has been confused with *Ramalina cuspidata*, *R. siliquosa* (incl. its syn. *R. scopulorum*), *R. cupularis*, *R. decipiens*, and *R. nematodes* (Nyl.) Krog & Østh. The first two look rather similar to *R. azorica*, but are chemically different by the presence of depsidones instead of depsides as major substances and phylogenetically by their ITS barcodes. Moreover, they lack corkscrew-shaped laciniae. The two species are known from Atlantic seashore cliffs, from NW Spain northward to Norway (Purvis et al. 1992). The other three species are known from coastal rock on the Canary Islands and Madeira and differ also chemically. *Ramalina cupularis* contains bourgeanic acid instead of depsides and *R. decipiens* contains the depsidones protocetraric or salazinic acid instead of depsides. *Ramalina nematodes* also contains protocetraric or salazinic acids and moreover has narrow, pendulous laciniae without cortex and is endemic for Porto Santo.

The two chemical strains of *Ramalina azorica* do not show any geographical or phylogenetic correlation and are not recognized as different taxa.

Corkscrew-shaped laciniae are otherwise known from *Ramalina* species in South America (after Marcano et al. 2021, as "contorted branches"): *R. bogotensis* Nyl. (with divaricatic or sekikaic acid and elongated ascospores 18–20 µm long), *R. chilensis* Bertero ex Nyl. (with sekikaic acid and shorter ascospores 12–14 µm long), *R. tenaensis* V. Marcano & A. Morales (with divaricatic acid and very short ascospores 8–10 µm long), and *R. usnea* (L.) R. Howe (with 8 chemical strains, incl. divaricatic acid, and elongated ascospores 18–22 µm long). None of these grows preferably on coastal rocks and their ascospores are distinctly longer than those of *R. azorica*, which measure 8.8–12 × 3.3–4.4 µm (Aptroot & Schumm 2008). ITS sequences are available only for *R. usnea* from Brazil (Fig. 1, Gumboski et al. 2018), and these do not show a close affinity with *R. azorica*.

References. Schumm 2008, 2025; Aptroot & Schumm 2008 (type description); Berger & Priemetzhofer 2008; Aptroot et al. 2010.

Ramalina canariensis J. Steiner (Fig. 3B)

Medullary chemistry. Major substance divaricatic acid, with variable amounts of terpenoids.

Ecology and distribution. *Ramalina canariensis* is an epiphyte and grows usually on twigs. It is reported by Aptroot et al. (2010) from TER, SMG and SMR. We also saw specimens from COR, FLO and FAI (see Appendix 1). Apparently, it is common throughout the Azores, as it is throughout Macaronesia and Mediterranean Europe near the seashores. It is further reported, among other regions, from Australia and Southwestern North America, South Africa and Yemen (Kashiwadani & Nash 2004, specimens in herbarium B).

Note. *Ramalina canariensis* has been confused with *R. baltica* and *R. lacera*. The first is a close relative of *R. obtusata*, both containing evernic instead of divaricatic acid (Krog & James 1977). *Ramalina lacera* contains bourgeanic instead of divaricatic acid, see below.

Unfortunately, sequencing of Azorean specimens failed in most samples.

References. Degelius 1941; Tavares 1952; Hafellner 1995; Schumm 2008; Aptroot et al. 2010; Rodrigues et al. 2024.

Ramalina chondrina J. Steiner

Medullary chemistry. Terpenoids only.

Ecology and distribution. *Ramalina chondrina* is an epiphyte. Aptroot et al. (2010) report the species from the Azores without specifying an island. Probably their record goes back to the record of *R. thrausta* by Drouet (1866) from SMG and PIC, rejected by Nylander (1898). We saw only two specimens, both from SMR (see Appendix 1). The species is also known from the Canary Islands (Krog & Østhagen 1980) and Madeira (herbarium B) in Macaronesia, and from Atlantic Europe (Cannon et al. 2023).

Note. The strong resemblance to *Alectoria*, by its long, cylindrical, greenish, rather scarcely branched thallus branches, makes this species unmistakable. The chondroid cylinder of the branches of this species is very regular and the branches lack pale striae.

Ramalina chondrina forms a well-supported clade (Fig. 1), but sequences from the Azores to confirm their status are unfortunately lacking. The sequences in GenBank support the hypothesis of Krog & Østhagen (1980) that this species is separate from *R. thrausta*.

References. Aptroot et al. 2010.

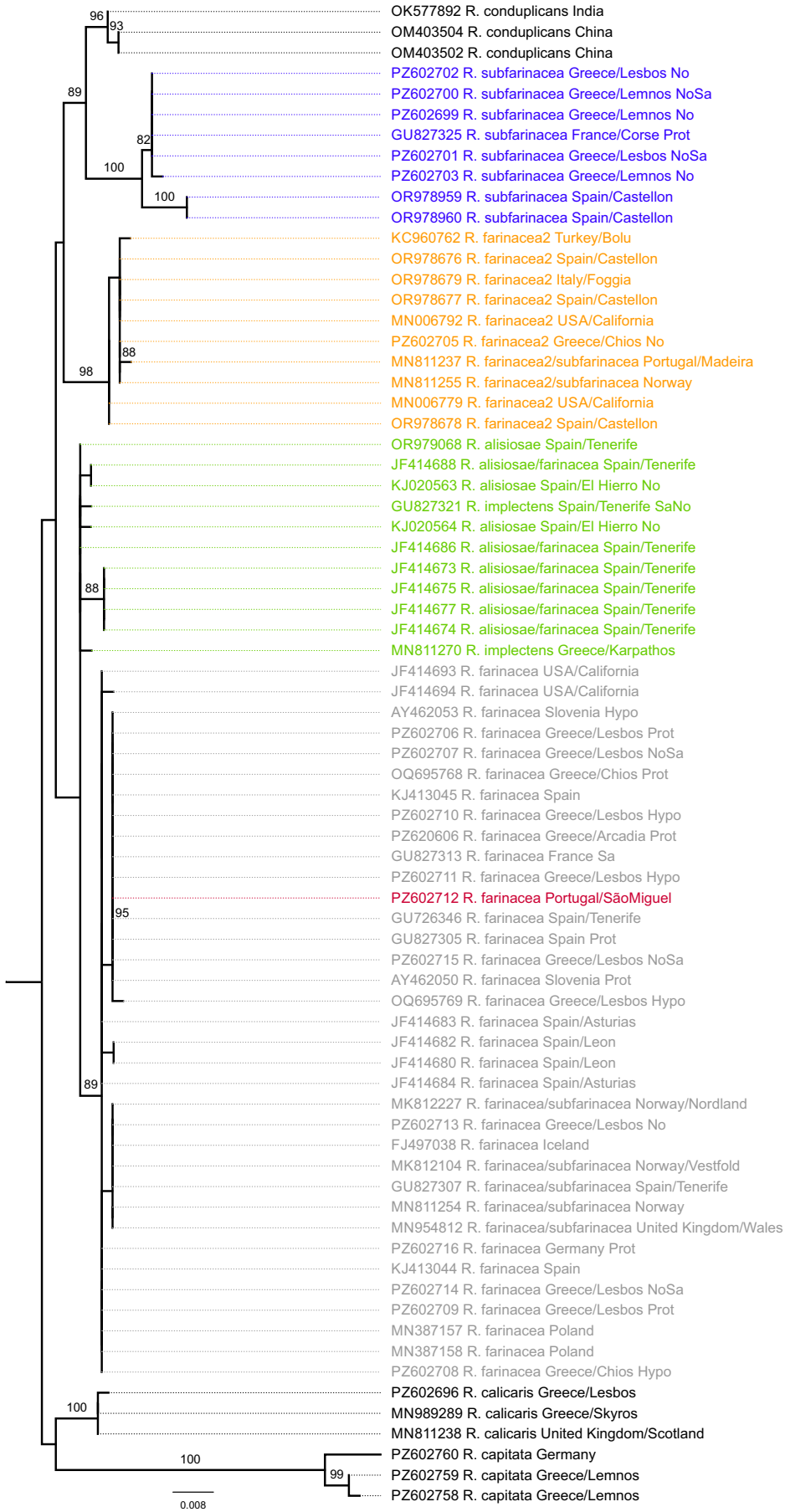

Figure 2. Maximum likelihood phylogenetic tree of ITS sequences from the Azores (in red) with all available GenBank sequences from the *Ramalina farinacea* group; for the large, terminal cluster (in pale blue) only a small part of the available sequences is used. ML values under 80 are not shown. Outgroups are *R. calicaris* and *R. capitata* (Ach.) Nyl. The ITS sequences suggest the presence of at least four different clades. The single sequence from the Azores belongs to the largest clade. This should be *R. farinacea* s.str., because the other clades occur in more southern regions.

Ramalina farinacea (L.) Ach.

Medullary chemistry. Five chemical strains were found: (1) major substance salazinic acid, sometimes with a trace of norstictic or consalazinic acid, (2) major substance norstictic acid, (3) major substance protocetraric acid, (4) major substances norstictic, hypoprotocetraric and salazinic acids, (5) major substances hypoprotocetraric and protocetraric acids. On São Miguel, all five strains were found.

Ecology and distribution. *Ramalina farinacea* **usually** grows epiphytic on branches and rarely on stone. Aptroot et al. (2010) report this species from FAI, GRA, TER, SMG and SMR. We saw material from TER, SMG and SMR (see Appendix 1). We suppose that the species is widespread on the Azores and neglected or mistaken. The available sequences are all from Europe, Macaronesia and North America. The species is considered cosmopolitan, but the presence outside the range of the sequenced specimens is in need of more study.

Notes. This species is easily confused with the much more common *Ramalina peruviana* Ach. Both have densely branched thalli with linear laciniae and marginal soralia. *Ramalina farinacea* forms small tufts with a blackish base, the soralia are always marginal, and the thallus contains depsidones, while *R. peruviana* grows in cushions which are broadly attached by hyphae from the thallus laciniae. Towards the lacinia tips the soralia are often enlarged and expand on the lower side of the thallus laciniae, and chemically the species contains the depsid sekikaic acid. *Ramalina farinacea* has occasionally been confused with *R. implectens* and *R. portuensis*. The first is considered the sexual parent morph of *R. farinacea* (Krog & Østhagen 1980). The second has more rounded laciniae with laminal, not marginal soralia (see below).

The ITS sequences of the *Ramalina farinacea* group (Fig. 2) suggest that the group is composed of more than one species. The subdivision of *R. farinacea* is treated in detail by Campo et al. (2013), Marthinsen et al. (2019) and Moya et al. (2023, 2024). Figure 2 serves only to show that the single sequenced specimen from the Azores belongs to *R. farinacea* s.str.

The Azores specimens deviate from continental Europe by their mixed medullary chemistry. While strains with only protocetraric acid, only hypoprotocetraric acid, and norstictic with salazinic acid dominate on mainland Europe, some specimens from the Azores contain the unusual combinations hypoprotocetraric with protocetraric acids and norstictic with hypoprotocetraric and salazinic acids.

References. Henriques 1895; Nylander 1898; Navás 1909; Degelius 1941; Tavares 1952; Hafellner 1995; Berger & Priemetzhofer 2008.

Ramalina implectens Nyl.

Medullary chemistry. No Azorean specimens were available for analysis. However, the same range of variation as in *R. farinacea* is expected, because Krog & Østhagen (1980) report five substances from the Canary Islands: (1) salazinic acid, with or without a trace of norstictic acid, (2) norstictic acid, with or without a trace of salazinic acid, (3) protocetraric acid, (4) hypoprotocetraric acid, (5) no medullary substances.

Ecology and distribution. Like *Ramalina farinacea*, *R. implectens* usually grows epiphytic on branches and rarely on stone. We have seen no convincing specimen from the Azores and the available ITS sequences (Fig. 1) are from Southern Europe and the Canary Islands.

Notes. One available specimen identified as *Ramalina implectens*, Priemetzhofer 5010 (LI 754322), has both soralia and apothecia and is here included in *R. farinacea*. Other misidentified specimens appeared to belong to *R. subpusilla*.

Although the species is common on the Canary Islands (Krog & Østhagen 1980), we have not seen convincing specimens from the Azores. It is tentatively included in the key because its presence on the Azores seems probable and it is easily confused with *R. subgeniculata* and *R. subpusilla*.

The two sequences in Figure 2 confirm that this species is very close to *Ramalina farinacea* and might be considered as its sexually reproducing primary species.

References. Berger & Priemetzhofer 2008; Schumm 2008; Aptroot et al. 2010.

Ramalina krogiae Guissard & Sérus. (Fig. 3C, D)

Medullary chemistry. Major substance divaricatic acid, usually with considerable amounts of terpenoids.

Ecology and distribution. *Ramalina krogiae* is a species growing on volcanic rocks and stone walls near the coast. Aptroot et al. (2010) report it, under the name *R. requienii*, from FAI, PIC, GRA, SJG, TER, SMG and SMR. We saw also specimens from FLO (see Appendix 1). The species is apparently common all over the archipelago. Elsewhere, it is only known from the Canary Islands and Madeira (Spjut et al. 2020).

Note. This species has been treated as *Ramalina requienii* until Spjut et al (2020) introduced the new species *R. krogiae* for the Macaronesian specimens of this complex. *Ramalina krogiae* has been confused occasionally with *R. crispatula* and *R. maciformis*, which both contain bourgeanic acid instead of divaricatic acid. It is the only *Ramalina* species on the Azores that displays vegetative reproduction by means of corticate granules, mainly along the lacinia margins.

References. Aptroot 1989; Hafellner 1995; Schumm 2008, 2025 (all as *R. requienii*); Aptroot et al. 2010; Rodrigues et al. 2024.

Ramalina lacera (With.) J.R. Laundon

Medullary chemistry. Major substance bourgeanic acid, alone or with terpenoids. See also Krog & Østhagen (1980, *sub Ramalina duriaei*).

Ecology and distribution. *Ramalina lacera* is an epiphyte on shrubs. Aptroot et al. (2010) report it from FLO, FAI, GRA, SJG, TER and SMG. We saw also specimens

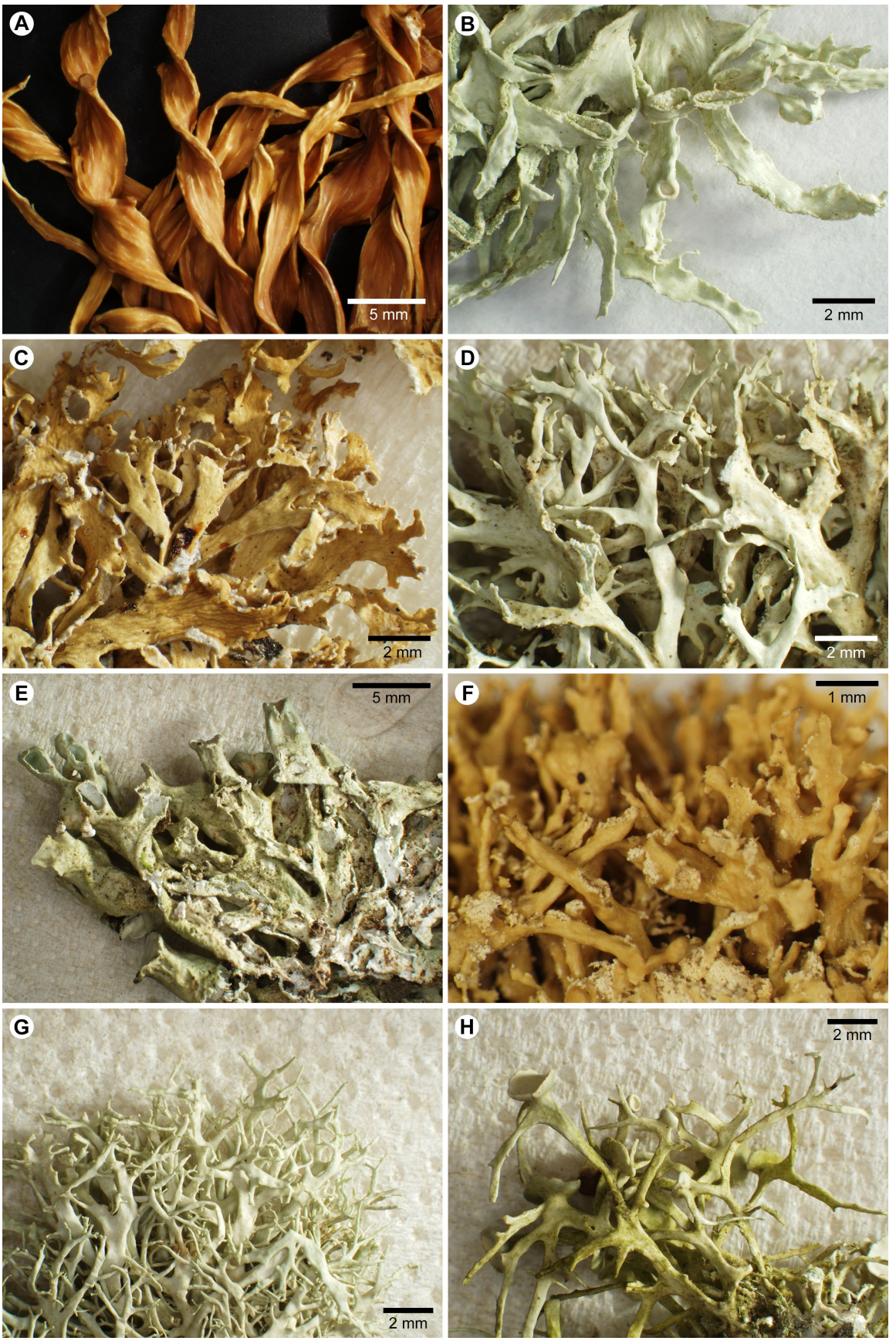

Figure 3. Details of *Azorean Ramalina* species. A – *Ramalina azorica*, contorted laciniae (Hecker AC 497); B – *Ramalina canariensis*, soralia in opened, marginal blisters [Rodrigues Ra 63 (MB14)]; C, D – *Ramalina krogiae*, thallus laciniae producing fragile, often granular, marginal thallus fragments, which may grow out into isidioid structures when not dropped [C: browned herbarium specimen, Aptroot 16454, D: fresh specimen, Rodrigues Ra 62 (MB13)]; E – *Ramalina portuensis*, thallus with cylindrical to slightly flattened laciniae, with punctiform to wide soralia (from foreign specimen, Vězda, *Lichenes Selecti Exsiccati* 1669); F – *Ramalina pusilla*, thallus with hollow, rather tubiform laciniae, the white inner side visible where damaged [Rodrigues Ra 65 (MB17)]; G, H – *Ramalina subpusilla*, thallus with spine-like branchlets [G: Rodrigues Ra 2 (Fl2), H: Rodrigues Ra 67 (MB19)]. Scales: A = 5 mm; B–D = 2 mm; E = 1 mm; F = 5 mm; G, H = 2 mm.

from COR and SMR (see Appendix 1). The species is probably the most widespread of the *bourgaeana*-group and is known from Atlantic and Mediterranean Europe, Macaronesia, North America, and South America (Chile) (Kashiwadani & Nash 2004).

Note. *Ramalina lacera* is easily recognizable because it grows epiphytic and has rather wide laciniae which become finely sorediate along the margins on the underside. Older parts of the thallus become reticulately ridged. *Ramalina lacera* is the sorediate morph of *R. mollis* Krog & Østh., a species described from the Canary Islands and not with certainty known from the Azores.

References. Degelius 1941, as *R. evernioides*; Abbayes 1947, as *R. duriaei*; Schumm 2008; Aptroot et al. 2010; Rodrigues & Aptroot 2024.

Ramalina lusitanica H. Magn.

Medullary chemistry. Major substance divaricatic acid, often with many terpenoids.

Ecology and distribution. *Ramalina lusitanica* is usually epiphytic and only occasionally found on rock [Rodrigues Ra 38 (2)]. Aptroot et al. (2010) report this species from GRA, TER, SMG and SMR. We saw specimens from the same islands, mostly from SMG and SMR (see Appendix 1). This little-known species has according to specimens in herbarium B a wide distribution in Mediterranean Europe, from Portugal via Corsica to southern Greece. Cera et al. (2022) report it from Spain. In Macaronesia, it is absent from the Canary Islands and the few specimens seen from Porto Santo look unusual by their large size and would need sequencing for confirmation of their identity. However, on the Azores it is among the most common *Ramalina* species.

Notes. *Ramalina lusitanica* has been confused occasionally with *R. mollis*, which contains bourgeanic acid instead of divaricatic acid. The species deviates from most *Ramalina* species by its scarcely and shallowly lobate and short laciniae with mainly apical apothecia. For differences with the probably closest species, *R. huei* Harm., see above.

References. Aptroot & Rodrigues 2005; Schumm 2008, 2025; Aptroot et al. 2010; Rodrigues & Aptroot 2024.

Ramalina peruviana Ach.

Medullary chemistry. Major substance sekikaic acid.

Ecology and distribution. *Ramalina peruviana* usually grows epiphytic and occasionally on rock. Aptroot et al. (2010) report this species only from SJG, TER and SMG. We saw also specimens from COR, FLO, FAI, PIC and GRA (see Appendix 1). This species is much misunderstood and probably the most common species of *Ramalina* on the Azores, present all over the Archipelago. Remarkably, it is not known from elsewhere in Macaronesia and has been found in the Mediterranean only locally in the south (Sipman & Ramírez Ordaya 2023). The supposed world distribution of this species is very wide, but for most regions still no sequenced records are available. Sipman & Ramírez Ordaya (2023) report it from South America from the type locality in coastal Peru and from southern Brazil, confirmed by ITS sequencing.

Note. By its densely branched thallus with linear laciniae and often lateral soralia, this species is easily confused with *R. farinacea*, see under that species. The presence of *R. peruviana* on the Azores was first recognized by Aptroot (1989).

References. Aptroot 1989; Hafellner 1995; Schumm 2025.

Ramalina portuensis Samp. (Fig. 3F)

Medullary chemistry. Major substance salazinic acid.

Ecology and distribution. *Ramalina portuensis* usually grows on mossy bark. The species is reported here for the first time from the Azores, from FLO, SMG and TER (see Appendix 1). It is probably more widespread, because it is tiny and easily overlooked. The species was first described from coastal Portugal (Sampaio 1924) and is known only from Atlantic and Southern Europe and Macaronesia (Krog & Østhagen 1980; Smith et al. 2009; Cannon et al. 2023).

Note. *Ramalina portuensis* is a small, inconspicuous species with tiny, cylindrical laciniae, with cavities in the medulla and with tiny soralia scattered over the thallus, which start as punctiform and may increase to a width exceeding the diameter of the laciniae. It is reported here for the first time from the Azores and also from Greece (confirmed by ITS sequence data, see Fig. 1).

Ramalina pusilla Le Prévost ex Duby (Fig. 3E)

Medullary chemistry. Three chemical strains were found: (1) major substance sekikaic acid with terpenoids, (2) major substances sekikaic and protocetraric acids with terpenoids [Rodrigues Ra 47 (JPA2)], (3) major substances sekikaic and stictic acid with terpenoids [Rodrigues Ra 51 (MB2)].

Ecology and distribution. *Ramalina pusilla* is an epiphyte, preferably on twigs. Aptroot et al. (2010) report this species from TER, SMG and SMR (see also Appendix 1). Krog & Østhagen (1980) report it from Mediterranean Europe, the Canary Islands and the Azores.

Note. *Ramalina pusilla* is easily recognizable by the hollow, tubulose thallus laciniae with continuous, wide cavity in all branches and a thin, compact medulla layer around the cavity, not a lax, arachnoid, interrupted medulla with small cavities in the lower branches as in, e.g., *R. subgeniculata*.

References. Henriques 1895; Nylander 1898; Navás 1909; Tavares 1952; Hafellner 1995; Schumm 2008; Aptroot et al. 2010.

Ramalina subgeniculata Nyl.

Medullary chemistry. Two chemical strains were found: (1) major substance divaricatic acid, (2) major substances divaricatic and salazinic acids. The two substances are about equally common. For a phylogenetic evaluation of the strains insufficient ITS sequences were available; one of strain 1 and two of strain 2.

Ecology and distribution. *Ramalina subgeniculata* is an epiphyte found mostly on twigs. Aptroot et al. (2010) reported this species from PIC, GRA, SJG, TER and SMG. We saw also specimens from COR, FAI, FLO and SMR (see Appendix 1). *Ramalina subgeniculata* was described from Madeira and is known also from the Canary Islands and in the western Mediterranean from southern Spain.

Notes. *Ramalina subgeniculata* is very similar to the equally epiphytic *R. subpusilla* by its small, densely branched thalli often with apothecia, with spine-like terminal laciniae and a very loose medulla with cavities and sometimes pores. The two are well separated by their ITS sequences and, chemically, by the presence of divaricatic acid in *R. subgeniculata*, with (K+ yellow turning red) or without (K−) salazinic acid, whereas *R. subpusilla* contains salazinic acid alone (K+ yellow turning red). Morphologically, there seems to be no completely reliable distinguishing character. In *R. subgeniculata*, the thallus laciniae tend to be more flattened, with some rather small pores up to about halfway on the lower side of the thallus laciniae.

The species is rather similar to the tropical *Ramalina calcarata* Krog & Swinscow (Krog & Swinscow 1974), which shares the shrubby morphology with many apothecia, loose medulla with cavities, often spine-like terminal laciniae and divaricatic acid. *Ramalina calcarata* deviates by the wide and often long pores on the underside of the laciniae, often as wide as the laciniae.

References. Trelease 1897; Nylander 1898; Navás 1909; Tavares 1952; Hafellner 1995; Schumm 2008; Aptroot et al. 2010.

Ramalina subpusilla (Nyl.) Krog & Swinscow (Fig. 3G, H)

Medullary chemistry. Two chemical strains were found: (1) major substance salazinic acid, once with an unknown trace; (2) no substance.

Ecology and distribution. *Ramalina subpusilla* grows mostly on twigs. Aptroot et al. (2010) reported this species from FAI, PIC, GRA, SJG and TER. We also saw specimens from COR, FLO, SMR and SMG (see Appendix 1). According to Krog & Østhagen (1980), *R. subpusilla* has a wide distribution in the Palaeotropics and is in Macaronesia otherwise only known from Gomera. In view of the difficulty to distinguish *R. subpusilla* from *R. subgeminata*, it is very desirable to check the distribution by sequencing.

Notes. *Ramalina subpusilla* is morphologically often indistinguishable from *R. subgeniculata*. For differences see under that species. In view of the absence of molecular data, the chemical substance 2 may just as well belong to *R. subgeniculata*.

References. Berger & Aptroot 2001; Schumm 2008; Aptroot et al. 2010.

Ramalina wirthii Aptroot & Schumm

Medullary chemistry. Major substance salazinic acid.

Ecology and distribution. *Ramalina wirthii* is widespread on basalt rocks along the coasts. Aptroot et al. (2010) reported this species from PIC, GRA, SJG and SMG. We also saw specimens from FLO, FAI and TER (see Appendix 1). *R. wirthii* is so far known only from the Azores.

Notes. *Ramalina wirthii* has, like *R. azorica*, been confused with the *R. siliquosa* group. It is rather similar to *R. azorica* by its tufts of linear laciniae on basalt rock, but the laciniae are narrower, more frequently branched, and contain salazinic acid instead of divaricatic or sekikaic acids.

A considerable set of sequences from FLO is available in GenBank, published by Blázquez et al. (2025) in a detailed account of the species, with good photographs.

References. Schumm 2008, 2025; Aptroot & Schumm 2008 (Type description); Berger & Priemetzhofer 2008; Aptroot et al. 2010; Blázquez et al. 2025.

Rejected species

Ramalina arabum (Dill. ex Ach.) Meyen & Flot. – Tavares 1952; Hafellner 1995; Aptroot et al. 2010. – According to Krog (1994), *Ramalina arabum* is a tropical species, known from Madagascar and Mauritius, and the Mediterranean specimens published under this name belong to *R. implexa* (Nyl.) Krog – We exclude this species because we found no citation of voucher specimens or other confirmation for the presence of this species on the Azores.

Ramalina baltica Lettau – This name has been mistaken occasionally for *Ramalina canariensis*, e.g., in Great Britain (Krog & James 1977). See below under *R. canariensis*. We found no citation of voucher specimens or other confirmation for the presence of this species on the Azores and therefore exclude it.

Ramalina bourgaeana Mont. ex Nyl. – Tavares 1952; Hafellner 1995; Schumm 2008; Aptroot et al. 2010. – *Ramalina bourgaeana* belongs to a group which was formerly included in *Niebla* (Spjut et al. 2020). It is chemically well-defined by the presence of bourgeanic acid. On the Azores, only *R. lacera* (With.) J.R. Laundon contains this substance. This species differs from the epilithic, non-sorediate *R. bourgaeana* by its epiphytic substrate and sorediate thallus, and it forms a well-separated clade (Fig. 1). We found no citation of voucher specimens or other confirmation for the presence of *R. bourgaeana* on the Azores and exclude it.

Ramalina calicaris (L.) Röhl. – Drouet 1866; Trelease 1897; Tavares 1952; Hafellner 1995. – No new observations after 1866 are reported from the Azores and we follow Nylander (1898) and consider this early record as erroneous.

Ramalina crispatula Nyl. – Berger & Priemetzhofer 2008; Aptroot et al. 2010. – Following Krog & Østhagen (1980), *Ramalina crispatula* belongs to the group of *R. bourgaeana*, containing bourgeanic acid. Specimens named so were available from LI: Priemetzhofer 4818, 4823, 4891. Their chemistry, lacking bourgeanic acid and instead containing divaricatic acid, indicates that they

are not related to *R. crispatula* and belong to *R. krogiae* Guissard & Sérus. We found no other confirmation for the presence of this species on the Azores and so exclude it.

Ramalina cupularis Krog & P. James – Schumm 2008; Aptroot et al. 2010. – According to Krog & Østhagen (1980), the non-sorediate, saxicolous *Ramalina cupularis* belongs to the *R. bourgaeana* group, containing bourgeanic acid. Of this group, only the sorediate, epiphytic *R. lacera* is confirmed for the Azores (see Fig. 2). The only available herbarium specimen identified as *R. cupularis* (Priemetzhofer 4835, LI) contains sekikaic acid and lacks bourgeanic acid or depsidones, and belongs to *R. azorica*. We found no other confirmation for the presence of this species on the Azores and so exclude it.

Ramalina cuspidata (Ach.) Nyl. – Trelease 1897; Nylander 1898; Navás 1909; Tavares 1952; Hafellner 1995; Rodrigues et al. 2024. – *Ramalina cuspidata* belongs to the recently revised group of *R. siliquosa* (LaGreca et al. 2020). No specimens with the chemical characteristics or the ITS barcode of this group were found among the Azorean specimens examined. Therefore, we consider all records as misidentifications of *R. azorica* and exclude the species for the Azores.

Ramalina decipiens Mont. – Abbayes 1947; Tavares 1952; Hafellner 1995; Schumm 2008; Rodrigues et al. 2024. – We found no evidence for the presence of *Ramalina decipiens* on the Azores. Specimens identified as such deviate chemically by the presence of divaricatic or sekikaic acid instead of protocetraric or salazinic acid and belong to *R. azorica*. The *R. decipiens* group was recently studied by Blázquez et al. (2024), who presented an additional character to recognize *R. decipiens*, namely black pycnidia. They describe two species with divaricatic acid, *R. sampaioana* Blázquez, Pérez-Vargas & Pérez-Ort. and *R. delicata* Blázquez, Pérez-Vargas & Pérez-Ort. *Ramalina sampaioana* is characterized by black pycnidia and found only on Porto Santo, while *R. delicata* is characterized by fragile laciniae and known only from the Canary Islands.

Ramalina deminuta Krog & Østh. – Aptroot et al. 2010. – The report of this species (Aptroot et al. 2010) does not include any voucher or other evidence. According to Krog & Østhagen (1980), *Ramalina deminuta* is a rare species known only from La Gomera. The accompanying fig. 18 in Krog & Østhagen (1980) and the presence of divaricatic acid suggest a resemblance with another common species of the Azores, *R. lusitanica*. Therefore, we suppose a confusion with that species and do not accept *R. deminuta* for the Azores.

Ramalina duriaei (De Not.) Bagl. – Abbayes 1947; Berger & Aptroot 2001. – This name is currently considered as a synonym of *Ramalina lacera*. The records in Berger & Aptroot 2001 are most probably mistakes: in herb. Berger 2 specimens from SMG (nrs. 15894, 15897) named "*R. duriaei*" are present, which both belong to *R. peruviana*.

Ramalina evernioides Nyl. – Degelius (1941). – This name has been used for the taxon here called *Ramalina lacera*, before it was recognized as a synonym of *R. maciformis* (Krog & Østhagen 1980).

Ramalina fraxinea (L.) Ach. – Drouet 1866; Trelease 1897; Tavares 1952; Hafellner 1995. – All published reports refer to one record (Drouet 1866), without locality or voucher. Therefore, we assume a misidentification and exclude the species for the time being from the Azorean biota.

Ramalina huei Harm. – Aptroot et al. 2010. – According to Krog & Østhagen (1980), *R. huei* resembles *R. lusitanica* H. Magn. by the presence of divaricatic acid and the common presence of apothecia, but its thallus is deeply incised with linear, branched, apically acuminate laciniae with lateral apothecia instead of scarcely and often shallowly lobate laciniae with mainly apical apothecia. This species is common on the Canary Islands but unknown elsewhere. We found morphologically ambiguous specimens with similar ITS on Porto Santo (Madeira), see Fig. 1. For the Azores, no published vouchers exist and we did not see any convincing specimens, so we exclude it.

Ramalina maciformis (Delile) Bory – Tavares 1952; Hafellner 1995; Berger & Priemetzhofer 2008; Aptroot et al. 2010. – The affinities of this taxon within the *R. bourgaeana*-group, where it belongs, are unclear, because the sequences of this species are not well separated from the other supposed species, see Fig. 1. *Ramalina maciformis* is currently considered to be a species from dry rocks in coastal deserts, and produces coarse, isidium-like propagules. The presence of this species on the Azores is unlikely, because it seems to prefer desert-like conditions (Krog & Østhagen 1980), and so we exclude it. Three published specimens (Berger & Priemetzhofer 2008) appeared to belong to *R. krogiae*. The name *R. evernioides*, a synonym, has in the past been used for the species now called *R. lacera*, and early reports might concern *R. lacera*.

Ramalina mollis Krog – Berger & Priemetzhofer 2008; Aptroot et al. 2010. – *Ramalina mollis* is considered as a primary, corticolous relative of sorediate, corticolous *R. lacera* and isidiate, saxicolous *R. maciformis* (Krog & Østhagen 1980). Two specimens were available from herbarium LI: Priemetzhofer 5081 and 5101. Both appeared to have a different chemistry, divaricatic instead of bourgeanic acid, and belong to *R. lusitanica*. Consequently, we exclude this species from the Azores.

Ramalina nematodes (Nyl.) Krog & Østh. – Aptroot 1989; Aptroot et al. 2010. – Two Azorean specimens identified as *Ramalina nematodes* were available in B (Aptroot 16427, 16486). They were later published as paratypes of *R. azorica* (Aptroot & Schumm 2008), although 16427 belongs to *R. wirthii*. This excludes *R. nematodes* from the Azores lichen biota.

Ramalina pollinaria (Westr.) Ach. – Henriques 1895; Trelease 1897; Nylander 1898; Navás 1909; Degelius 1941; Tavares 1952; Hafellner 1995. – *Ramalina pollinaria* is easily confused with *R. peruviana*. It shares the usually marginal soralia, which may become superficial on the underside of the thallus laciniae near the tips. Chemically, it is clearly distinct, containing evernic acid instead of the sekikaic acid aggr. (Krog & James 1977; Cannon et al. 2023). Early references, such as Nylander (1898), probably confused the species with *R. peruviana*. Among the available specimens from the Azores, no real

R. pollinaria was found, and so we exclude the species from the Azorean lichen mycota. Occasionally, it has been confused with *R. duriaei* (= *R. lacera*) and *R. subfarinacea*, which both lack substances of the sekikaic acid aggr.

Ramalina requienii (De Not.) Jatta – Aptroot 1989; Hafellner 1995; Schumm 2008, 2025; Aptroot et al. 2010; Rodrigues et al. 2024. – Spjut et al (2020) introduced the new species *Ramalina krogiae* for the Macaronesian populations of *R. requienii*, see above. All specimens seen from the Azores agree with their concept and all reports of *R. requieni* from the Azores are here considered to refer to *R. krogiae.*

Ramalina scopulorum (Ach.) Ach. – Seubert 1844; Drouet 1866; Trelease 1897; Abbayes 1947. – This is a synonym of *Ramalina siliquosa*, see, e.g., LaGreca et al. 2020. Specimens reported from the Azores belong to *R. azorica*, see there.

Ramalina siliquosa (Huds.) A.L. Sm. – Russell 1858; Degelius 1941; Tavares 1952; Hafellner 1995; Berger & Priemetzhofer 2008; Rodrigues et al. 2024. – This concerns misidentifications of *R. azorica*, see there.

Ramalina subfarinacea (Nyl. ex Cromb.) Nyl. – Tavares 1952; Hafellner 1995; Aptroot et al. 2010; Rodrigues & Aptroot 2024. – No correctly identified specimen was available for study and we do not accept it as belonging to the Azores biota. The species is very similar to the norstictic acid strain of *R. farinacea* (Cannon et al. 2023) and easily confused with it. An unpublished specimen, Breuss 34321 (LI), appears to belong to *R. peruviana*.

Ramalina thrausta (Ach.) Nyl. – Drouet 1866; Trelease 1897; Tavares 1952; Hafellner 1995. – All later records refer to Drouet (1866), who did not indicate a locality or voucher. Most probably the material reported by him does not correspond to *R. thrausta*, but represents the similar *R. chondrina*, which was described after 1866 (Krog & Østhagen 1980). Therefore, we exclude the species from the Azores. See also under *R. chondrina*.

Ramalina vulcanica (Mont.) Nyl. – Trelease 1897; Tavares, 1952. – *Ramalina vulcanica* is treated by Krog & Østhagen (1980) as a probable synonym of *R. bourgaeana*. The latter species is not accepted as occurring on the Azores, see above. *Ramalina bourgaeana* is well characterized by the presence of bourgeanic acid, a substance found on the Azores only in *R. lacera*, a sorediate, epiphytic species. The original record of *R. vulcanica* may have been based on a specimen of *R. azorica*.

Reassessment of the *Ramalina* biota of the Azores

The investigation of 359 *Ramalina* specimens from the Azores resulted in a strong reduction of the number of species known to occur on this archipelago. The total number of *Ramalina* species, based on morphology, chemistry and phylogeny, is now 13 (Table 2). This is a much lower figure than for Madeira (29) and the Canary Islands (34) (after Krog & Osthagen 1980; Aptroot & Schumm 2008; Blázquez et al. 2024). The Cape Verde Islands are not taken into consideration here, because there is a large difference between the species numbers of Mies (1993) and Aptroot & Schumm (2008), 26 vs. 17, and the islands seem to be much less well investigated. The *Ramalina* biota of the Azores is rather comparable in richness with European countries with an Atlantic climate: the United Kingdom (14) and mainland Portugal (18) (after Llimona & Hladun 2001; Cannon et al. 2023). Probably this is due to the more northern situation of the Azores, and consequently the cooler and more humid climate.

Table 2. Numbers of *Ramalina* species in the Macaronesian archipelagos and adjacent areas, with their shared species.

	United Kingdom	Portugal	Azores	Madeira	Canary Islands
United Kingdom	**14**	14	4	6	6
Portugal	14	**18**	7	8	9
Azores	4	7	**13**	10	8
Madeira	6	8	10	**29**	18
Canary Islands	6	9	8	18	**34**

There seem to be also differences in species composition at higher taxonomic levels. Unfortunately, the phylogenetic relations of ITS sequences above species level in *Ramalina* get almost always low support values (Spjut et al. 2020) and only the group of species containing bourgeanic acid is a promising candidate for a natural supraspecific group, with a support of 88 (Fig. 1). This group contains several species, which are reported mainly from the Canary Islands (Krog & Osthagen 1980; Aptroot & Schumm 2008). This diversity is absent from the Azores, where only one species of the group is confirmed, the widespread *R. lacera*.

The two endemic *Ramalina* species of the Azores, *R. azorica* and *R. wirthii*, have so far not been found elsewhere. Numerous new records have become available (Appendix 1), but only from the Azores. Several ITS sequences are now available (Fig. 1) which cluster together, and so support the distinction of these species. Recent BLAST searches (June 2026) did not give new indications for their affinity. The corkscrew-shaped laciniae could be considered an argument that these two species may have an affinity to neotropical taxa with similar morphology. However, sequences from a neotropical species with this feature, *R. usnea*, did not show a close affinity (Fig. 1). The recently published key for saxicolous *Ramalina* species in the Neotropics (Gumboski et al. 2018) does not treat any other neotropical taxon that might be considered close to *R. azorica* or *R. wirthii*.

The *Ramalina* species on the Azores do not show a distinct altitudinal zonation (Appendix 1). All specimens originate from sea level to 550 m and all epiphytic species may be found anywhere within this range. The saxicolous species are mainly found at sea level. However, saxicolous taxa were found on Flores as high as 400 m on tall coastal cliffs. In contrast, *R. peruviana* was rarely found below 50 m. Unfortunately, no information is available from higher elevations, which reach up to 2,300 m only on Pico.

A survey of the island distribution of the *Ramalina* species is presented in Table 3. This shows that the islands that provided most specimens and most species are Terceira and Sao Miguel. They are also the most visited

Table 3. Geographical distribution of the investigated *Ramalina* specimens on the Azores (derived from Appendix 1).

Species (specimen number)	COR	FLO	FAI	PIC	GRA	SJG	TER	SMG	SMR
Ramalina azorica (42)	01	01	01	07	00	16	11	03	02
Ramalina canariensis (23)	01	02	03	00	00	00	07	09	01
Ramalina chondrina (2)	00	00	00	00	00	00	00	00	02
Ramalina farinacea (10)	00	00	00	00	00	00	01	08	01
Ramalina krogiae (47)	00	08	05	01	02	10	13	03	05
Ramalina lacera (14)	01	00	01	00	04	00	03	03	02
Ramalina lusitanica (47)	00	00	00	00	04	00	20	20	03
Ramalina peruviana (72)	01	01	01	01	10	02	18	30	08
Ramalina portuensis (6)	00	01	00	00	00	00	04	01	00
Ramalina pusilla (22)	00	00	00	00	00	00	12	06	04
Ramalina subgeniculata (29)	08	06	03	02	02	01	00	06	01
Ramalina subpusilla (24)	01	02	04	01	01	02	07	05	01
Ramalina wirthii (20)	00	06	01	00	01	06	04	02	00
Species number/island	06	08	08	05	07	06	11	12	11
Total (359)	13	27	19	12	24	37	100	96	30

and most investigated islands. The island poorest in species is Pico, although it has the highest mountain of the archipelago, up to over 2,300 m. However, the higher elevations of Pico above 1,000 m are not accessible by car and probably not well investigated.

The most frequently collected species are the saxicolous *R. azorica* and *R. krogiae*, and the corticolous *R. lusitanica* and *R. peruviana*. The least frequently collected species are *R. chondrina*, *R. portuensis* and *R. farinacea*. *Ramalina chondrina* was found only on Santa Maria, whereas *R. portuensis* was found on three islands, but is probably overlooked because it is a tiny species. The low number of specimens of *R. farinacea* is unexpected. Possibly it has been confused with *R. peruviana* and the more conspicuous of the two, *R. peruviana*, has been collected more often. Otherwise, most species seem to occur all over the islands. This is expected because all islands are very similar in climate and geomorphology.

Identification key

1 Vegetative reproduction by corticate granules or farinose soredia, apothecia rare 2
Vegetative reproduction absent, apothecia frequent . . . 7

2(1) Coarse, often over 0.1 mm wide, corticate granules present, more or less scattered along the margins of the thallus laciniae . . . . . ***R. krogiae***
Fine, about 0.05 mm wide, mealy soredia present in distinct, laminal or marginal soralia 3

3(2) Thallus laciniae usually less than 1 cm long, with more or less hollow, mainly cylindrical branches; soralia apical or lateral, rounded, at first minute and convex, ~0.01 mm wide, at age becoming about 1 mm wide and concave or irregular . . . . . ***R. portuensis***
Thallus laciniae often several cm long, with solid, flat branches; soralia marginal or laminal, often oval, flat, ~0.5 mm long 4

4(3) Thallus branches linear, ~0.5 mm wide; soralia mainly marginal, ± oval and ~0.5 mm long 5
Thallus branches of variable shape and width; soralia laminal, often near the margins and tips of the laciniae, irregularly spreading 6

5(4) Soralia marginal only; thallus with distinct, blackish basal attachment, rarely with secondary attachments; norstictic acid (K+ yellow turning red) or other depsidones present . . . . . ***R. farinacea***
Soralia marginal and near the lacinia tips on the lower sides; thallus without blackish basal attachment, frequently with secondary attachments; no depsidones present (K–) . . . . . ***R. peruviana***

6(4) Soralia in marginal, spreading blisters, where the thallus splits open, exposing the soredia; thallus smooth or shallowly wrinkled . . . . . ***R. canariensis***
Soralia superficial, spreading along the margin on the lower side of the thallus laciniae; basal parts of thallus often reticulately ridged . . . . . ***R. lacera***

7(1) Thallus laciniae cylindrical except sometimes at branching points 8
Thallus laciniae largely flattened, often twice or more as wide as thick, cylindrical mainly near the base and/or the tips 9

8(7) Thallus laciniae solid, mostly 0.2–0.4 mm thick, long and *Alectoria*-like . . . . . ***R. chondrina***
Thallus laciniae hollow, about 2–5 mm thick, with thin thallus layer on the outside, scarcely branched, short and often with terminal apothecia, on the lower side often with 1–3 mm wide pores . . . . . ***R. pusilla***

9(7) Saxicolous on coastal rocks; thallus laciniae over most of their length linear and little branched 10
Corticolous; thallus laciniae densely branched and/or irregularly incised 11

10(9) Divaricatic or sekikaic acid (K−); thallus laciniae 1–4 mm wide when full-grown, scarcely (~0–2 times) branched, sometimes corkscrew-like contorted at age . . . ***R. azorica***
Salazinic acid (K+ yellow turning red); thallus laciniae 1–2 mm wide, more densely (~4 times) branched, not corkscrew-like . . . . . ***R. wirthii***

11(9) Thallus laciniae flat, shallowly divided with short, wide branches to submonophyllous . . . . . ***R. lusitanica***
Thallus laciniae subcylindrical to about twice as wide as thick 12

12(11) Thallus laciniae mostly subcylindrical; apical branchlets often spine-like, often forming a spine under each apothecium; chemistry divaricatic and/or salazinic acid . . . 13

Thallus laciniae mostly about twice as wide as thick, somewhat canaliculate when wide; apical branchlets not spine-like; chemistry variable, often salazinic or norstictic acid . . . . . ***R. implectens***

13(12) Divaricatic with or without salazinic acid (K− or K+ yellow turning red); thallus laciniae near the base often flattened and with small perforations . . . . . ***R. subgeniculata***

Salazinic acid alone (K+ yellow turning red); thallus laciniae near the base swollen and subcylindrical, without perforations . . . . . ***R. subpusilla***

Acknowledgements

It is our great pleasure to dedicate this contribution to André Aptroot, in recognition of his manyfold contributions to the exploration of lichen diversity. He contributed greatly to the knowledge of the Azores Islands lichens, and discovered *Ramalina azorica*, *R. lusitanica*, *R. peruviana* and *R. wirthii* on these islands, the first and the last of these being endemics described by him. Our colleague Pablo Alvarado (Oviedo) is thanked for his great service to make sequencing more widely available for lichen taxonomists. Without his dedication, the present study would not have been possible. The Verein der Freunde des Botanischen Gartens und Botanischen Museums Berlin-Dahlem is gratefully acknowledged for their generous financial support of the chemical TLC analyses and the director of the Botanic Garden and Botanical Museum generously provided a working space.

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Appendix 1. List of 359 *Ramalina* specimens from the Azores used for this study.

Herbarium abbreviations follow the Index Herbariorum (Index Herbariorum: A Global Directory of Public Herbaria and Associated Staff. New York Botanical Garden. Published online: https://sweetgum.nybg.org/science/ih/ (accessed June 2026).), often with registration number. The collections of the two most important collectors, P. & B. van den Boom and F. Rodrigues, are kept in their private herbaria. Admixtures are indicated by "in" before the collector's name. Added are the tlc results and, in brackets (" "), previous identifications.

Ramalina azorica Aptroot & Schumm

CORVO. W of Vila do Corvo, trail to Pão de Açucar, outcrops on S exposed slope, 39°40.50′N, 31°07.03′W, alt. 70 m, on wall, 12 Sept. 2023, P. & B. van den Boom 62165, tlc 1288m701: divaricatic acid, traces, few terpenoids.

FAIAL. Capelinhos, alt. 25 m, Uferklippen, auf Basalt, 8 Aug. 2001, F. Berger 15899 (herb. F. Berger), tlc 1294m957: usnic, sekikaic acids, terpenoids ("*Ramalina decipiens*"); W side of the island, SE of Capelo, S of Varadouro, Ponta do Varadouro, S exposed coastal area, 38°33.88′N, 28°46.51′W, alt. 5 m, on volcanic rock outcrop, 5 Jun. 2016, P. & B. van den Boom 55467 (herb. P. van den Boom, B 60 0210347), tlc 1288m693: tr. usnic, sekikaic acid, traces, few terpenoids.

FLORES. N of Fajã Grande, N of Igreja de Nossa Senhora do Carmo. Small trail, coastal area, along very high steep rockface, 39°28.53′N, 31°15.40′W, alt. 400 m, on N-exposed rock, Sept. 2023, P. & B. van den Boom 61910, tlc 1305n382: tr. usnic, divaricatic acids, terpenoids.

PICO. SE of Piedade, W of Manhenha, S exposed coastal volcanic rocks, 38°24.50′N, 28°02.50′W, alt. 15 m, on coastal volcanic rock, 31 Aug. 2017, P. & B. van den Boom 56737 (herb. P. van den Boom, B 60 0210346), tlc 1288m697: tr. usnic, sekikaic acid, traces, few terpenoids; Cachorro, Lava Felsen am Meer, 21 Mar. 1970, U. Hecker AC 497 (B), tlc 1308n528, 529: sekikaik acid; In and near Madalena, alt. 0–10 m, on walls of lava along fields, July 1986, A. Aptroot 16486 (BR-LICH 32716-27), tlc 1294m944: tr. usnic, sekikaik acid agg., tr. terpenoids ("*Ramalina nematodes*"); Lajes, Silveiro, alt. 5 m, on coastal lava, 5 Aug. 2007, A. Aptroot 67851 (BR-LICH 4028-51), tlc 1294m940: tr. usnic, sekikaik acid agg., tr. terpenoids; Ponta da Ilha, alt. 5 m, on coastal lava, 8 Aug. 2007, A. Aptroot 67854 (BR-LICH 32570-75), tlc 1294m942: tr. usnic, sekikaik acid agg., tr. terpenoids; Lajes, Silveiro, alt. 5 m, on coastal lava, 5 Aug. 2007, A. Aptroot 67851 (BR-LICH 32715-26), tlc 1294m943: tr. usnic, sekikaik acid agg., tr. terpenoids.

SÃO JORGE. Velas, Klippenbereich W des Meerwasserschwimmingpool, alt. 5 m, Basalt, 29 Aug. 2003, F. Priemetzhofer 4809 (LI 754326), tlc 1302n263: sekikaic acid agg., terpenoids ("*Ramalina siliquosa*"); id., F. Priemetzhofer 4822 (LI 754330), tlc 1302n264: sekikaik acid agg., terpenoids ("*Ramalina siliquosa*"); id., F. Priemetzhofer 4824 (LI 754329), tlc 1301n267: sekikaic acid agg., terpenoids ("*Ramalina siliquosa*"); id., F. Priemetzhofer 4835 (LI 754304), tlc 1302n264: sekikaic acid agg., terpenoids ("*Ramalina cupularis*"); id., F. Priemetzhofer 4837 (LI 754311), tlc 1301n223: usnic, sekikaic acid agg., terpenoids ("*Ramalina decipiens*"); id., F. Priemetzhofer 4838 (LI 754315), tlc 1301n220: sekikaic acid agg. ("*Ramalina decipiens*"); id., F. Priemetzhofer 4839 (LI 754310), tlc 1301n219: sekikaic acid agg. ("*Ramalina decipiens*"); id., F. Priemetzhofer 4840 (LI 754304), tlc 1302n266: sekikaic acid agg., terpenoids ("*Ramalina siliquosa*"); Velas, S side of the town. near natural swimming pool, volcanic outcrops at coast, 38°40.70′N, 28°12.55′W, alt. 9 m, on volcanic rock, 7 Sept. 2017, P. & B. van den Boom 57210, tlc 1288m698: sekikaic? acid; id., P. & B. van den Boom 57215. tlc 1305n384: tr. usnic, sekikaic acid, traces, few terpenoids; Velas, 38°40′51″N, 28°12′48″W, basalt, 5 May 2024, F. Rodrigues Ra 37 (1) (B 60 0211522), tlc 1304n342: sekikaic acid; Velas, Morro Grande, Gratzacken an der Westseite, schräge, südexponierte Tuff und Basalt, alt. 140 m, Basalt, 30 Jul. 2003, F. Priemetzhofer 4901 (LI 754312), tlc 1301n222: divaricatic acid, many terpenoids ("*Ramalina decipiens*"); id., F. Priemetzhofer 4902 (LI 754328), tlc 1302n262: tr. usnic, divaricatic acids, many terpenoids ("*Ramalina siliquosa*"); Velas, Klippenbereich beim Sea-pool, alt. 3 m, Basalt, 01 Aug. 2003, F. Priemetzhofer 4668 (LI 754309), tlc 1302n260: sekikaic acid agg., terpenoids ("*Ramalina siliquosa*"); Velhas, Klippen S Hotel S. Jorge, Punta das Eiras, 38°40.8′N, 28°12.7′W, alt. 10 m, supralitoral, auf Basalt, 1. Aug. 2001, F. Berger 15902 (herb. F. Berger), tlc 1294m958: usnic, sekikaiic acids, terpenoids ("*Ramalina decipiens*"); Velas, Klippenbereich W des Meerwasserschwimmingpool, alt. 5 m, basalt, 29 Aug. 2003, F. Priemetzhofer 4841 (LI 754331), tlc 1302n261: sekikaic acid agg., terpenoids ("*Ramalina siliquosa*").

TERCEIRA. Poça dos Frades, 38°39′22″N, 27°15′03″W, basalt, 12 Apr. 2025, F. Rodrigues Ra 19 (1.1) (B 60 0211516), tlc 1304n333: sekikaic acid; id., F. Rodrigues Ra 20 (1.2) (B 60 0211517), tlc 1304n331: sekikaic acid; id., F. Rodrigues Ra 24 (1.6) (B 60 0211518), tlc 1304n332: sekikaic acid; id., F. Rodrigues Ra 26 (1.8) (B 60 0211519), tlc 1304n335: sekikaic acid; Santa Barbara, 38°40.746′N, 27°13.942′W, Küstenfelsen, 13.07.2008, F. Schumm 14114 (herb. F. Schumm), tlc 1316n829: tr. usnic, sekikaic acid agg.; São Mateus, 38°39′17″N, 27°15′21″W, basalt, 12 Apr. 2025, F. Rodrigues Ra 28 (2.1) (B 60 0211523), tlc 1304n337: divaricatic acid; id., F. Rodrigues Ra 31 (2.4) (B 60 0211520), tlc 1304n338: sekikaic acid; id., F. Rodrigues Ra 32 (2.5) (B 60 0211521), tlc 1304n339: sekikaic acid; Ponta dos Biscottos, basalt blocks at coast, 6 Apr. 1978, Juvik L-15 (B), tlc 1306n444: divaricatic acid, terpenoids; W of Angra do Heroismo, W of São Mateus, Forte do Negrito, coastal volcanic outcrops, 38°39.34′N, 27°17.06′W, alt. 5 m, on volcanic rock, 1 Jul. 2014, P. & B. van den Boom 51571, tlc 1288m692: tr. usnic, sekikaic acid, traces, few terpenoids; Baia da Salga, 38 38.7′N, 27°04.8′W, alt. 25 m, on lava, 11 Jul. 2008, A. Aptroot 68212 (BR-LICH 32714-25), tlc 1294m941: tr. usnic, sekikaik acid agg., tr. terpenoids.

SÃO MIGUEL. NW of Ponta Delgada, NW of Ginetes, Ponta da Ferraria, viewpoint with low sloping outcrops and *Erica azorica* shrubs and steep outcrops near road, in W exposed coastal area, 37°51.50′N, 25°51.10′W, alt. 110 m, SW-exposed cliff, on acidic rock, 28 Oct. 2011, P. & B. van den Boom 46713, tlc 1288m691: tr. usnic, divaricatic acid, traces, few terpenoids; WNW of Ponta Delgada, NW of Relva, along trail from Vigia to Rocha da Relva, steep cliffs in coastal area, 37°46.50′N, 25°45.30′W, alt. 35 m, on acidic rock of cliff, 28 Oct. 2011, P. & B. van den Boom 46693, tlc 1305n383: tr. usnic, divaricatic acids, terpenoids; Bei Candelaria, Felsküste, 17 Mar. 1970, U. Hecker AC 194 (B), tlc 1308n530: divaricatic acid.

SANTA MARIA. S of Santo Espirito, S of Maia, Ponta do Castelo, near lighthouse, vertical and overhanging acidic outcrops, 36°55.79′N, 25°01.05′W, alt. 100 m, on volcanic rock, 15 Sept. 2019, P. & B. van den Boom 58885, tlc 1288m700: divaricatic acid, traces, few terpenoids; S of Santo Espirito, S of Maia, Ponta do Castelo, near lighthouse, vertical and overhanging acidic outcrops, 36°55.79′N, 25°01.05′W, alt. 100 m, on volcanic rock, 15 Sept. 2019, P. & B. van den Boom 58887, tlc 1288m694: divaricatic acid, traces, few terpenoids.

Ramalina canariensis J. Steiner

CORVO. NNE of Vila do Corvo, miradouro do Portao, W exposed slope, open area with mainly *Erica azorica*, alt. 100 m, on *Erica*, Sept. 2023, P. & B. van den Boom 62322, tlc canar 1305n393: divaricatic acid, terpenoids.

FAIAL. E side of the island, Horta, N side of village, Alagoa municipal park, mixed trees, 38°32.67′N, 28°37.17′W, alt. 25 m, on unidentified tree, 2 Jun. 2016, P. & B. van den Boom 55289; E side of the island, N of Horta, Porto da Boca da Ribeira, coastal area with wooden fence posts along meadow and small road, 38°35.48′N, 28°36.15′W, alt. 40 m, on wood of fence post, 2 Jun. 2016, P. & B. van den Boom 55267, tlc 1288m696: divaricatic acid, traces, few terpenoids; SW of Horta, Lajinha, along road EN1, outcrops and *Erica* shrubs along coast, at mirador, 38°31.42′N, 28°39.43′W, alt. 55 m, on acidic rock, 4 Jun. 2016, P. & B. van den Boom 55443.

FLORES. Lajes das Flores, 39°22′41″N, 31°10′29″W, on *Pinus* sp., 23 Apr. 2025, F. Rodrigues Ra 01 (Fl1) (B 60 0211525), tlc 1304n344: divaricatic acid; N of Lajes das Flores, Fazenda das Lajes, centre, small parkland, mixed trees and shrubs, including mature *Metrosideros*, 39°23.32′N, 31°09.97′W, alt. 120 m, on unidentified shrub, 18 Sept. 2023, P. & B. van den Boom 62141.

TERCEIRA. Angra do Heroismo, park in centre, with mixed trees and shrubs, including some exotic trees, 38°39.30′N, 27°12.57′W, alt. 275 m, on unidentified shrub, 17 Sept. 2021, P. & B. van den Boom 60760. tlc: divaricatic acid; id., P. & B. van den Boom 60760, tlc 1288m695: divaricatic acid, traces, many terpenoids; Jardim Público de Angra de

Appendix 1. Continued.

Heroísmo, 38°39′25″N, 27°13′04″W, on *Rhododendron* sp., 3 May 2025, F. Rodrigues Ra 49 (JPA4) (B 60 0211557), tlc 1308n491: divaricatic acid; Monte Brasil, 38°38′37″N, 27°13′58″W, on *Erica azorica*, 17 May 2025, F. Rodrigues Ra 52 (MB3) (B 60 0211558), tlc 1308n496: divaricatic acid; id., F. Rodrigues Ra 57 (MB8) (B 60 0211559); Palácio dos Capitães Generais, Angra do Heroísmo, 38°39′22″N, 27°13′12″W, on *Metrosideros excelsa*, 3 May 2025, F. Rodrigues Ra 69 (PCG1) (B 60 0211561), tlc 1308n510: usnic, divaricatic acids; Relvão, 38°39′03″N, 27°13′24″W, on *Camellia japonica*, 4 May 2025, F. Rodrigues Ra 72 (RV3) (B 60 0211562), tlc 1308n513: divaricatic acid.

SÃO MIGUEL. Sete Cidades, 25 May 2016, O. Breuss 33686 (LI), tlc 1301n212: divaricatic acid, many terpenoids; id., M. Strudl & O. Breuss 33686 (LI 811787), tlc 1301n212: divaricatic acid, many terpenoids; Gorreana, Teeplantage, 37°49′N, 25°44′W, alt. 200 m, auf *Erica azorica*, 31 Jul. 2001, F. Berger 15872 (herb. F. Berger), tlc 1294m954: divaricatic acid, terpenoids (“*Ramalina baltica*”); NW of Ponta Delgada, Sete Cidades, centre of village, two rows of mature *Cryptomeria japonica* trees in front of the church and small park with mixed small trees, 37°51.80′N, 25°47.90′W, alt. 270 m, on unidentified small tree, 25 Oct. 2011, P. & B. van den Boom 46559, tlc 1288m705: divaricatic acid, traces, many terpenoids; Ponta Delgada (SÃO MIGUEL Park Garden), 37°44′37″N, 25°40′23″W, on azalea (*Rhododendron* sp.), 8 Apr. 2025, F. Rodrigues Ra 08 (PD1) (B 60 0211524), tlc 1304n347: divaricatic acid; Ponta Delgada, Straßen- und Parkbäume in der Umgebung des Parkhotels und des Jardim António Borges, alt. ~100 m, 30 Jul. 2017, M. Strudl & O. Breuss 34033 (herb. Breuss), tlc 1301n211: divaricatic acid, many terpenoids; id., O. Breuss 34032 (LI 812912), tlc 1302n252: divaricatic acid, many terpenoids (“*Ramalina lacera*”); Ponta Delgada, Straßen- und Parkbäume in der Umgebung des Parkhotels und des Jardim António Borges, alt. ~100 m, 30 Jul. 2017, O. Breuss 34033 (LI 813099), tlc 1301n211: divaricatic acid, many terpenoids; Quinta dos Açores, 37°45′25″N, 25°39′52″W, on oak tree, 22 May 2025, F. Rodrigues Ra 89 (QA11) (B 60 0211563), tlc 1308n527: divaricatic acid, terpenoids.

SANTA MARIA. N of Vila Do Porto, Anjos, wall of acidic stones, two long rows of *Metrosideros* trees in field, 37°00.37′N, 25°09.23′W, alt. 20 m, on *Metrosideros*, 12 Sept. 2019, P. & B. van den Boom 58674.

Ramalina chondrina J. Steiner

SANTA MARIA. NE of São Pedro, road ER-2-2, nearby N. Sra. de Fátima, old, neglected barn, on N exposed wall of acidic stones and some *Pittosporum* trees along field, 37°00.11′N, 25°06.25′W, alt. 250 m, on *Pittosporum*, 13 Sept. 2019, P. & B. van den Boom 58777, tlc 1288m707: terpenoids; S of Santo Espirito, S of Cardal, trail in field with a row of small trees, *Erica* and *Myrica faya*, 36°56.15′N, 25°02.85′W, alt. 240 m, on *Myrica faya*, 17 Sept. 2019, P. & B. van den Boom 59052, tlc 1288m706: terpenoids.

Ramalina farinacea (L.) Ach.

TERCEIRA. Angra do Heroismo, Monte Brasil, top, area of Pico das Cruzinhas, including picnic area, mixed trees and shrubs, included *Myrica faya* and *Erica*, 38°38.78′N, 27°13.73′W, alt. 100 m, *Myrica faya*, 30 Jun. 2014, P. & B. van den Boom 51545a, tlc 1289m733: tr. usnic, norstictic, connorstictic acids.

SÃO MIGUEL. ENE of Vila Franca, Furnas centre, botanical garden ‘Terra Nostra’, origin from 1780, with mixed exotic and endemic trees and shrubs, 37°46.40′N, 25°18.80′W, alt. 205 m, on *Acer*, 27 Oct. 2011, P. & B. van den Boom 46633, tlc 1288m708: norstictic, connorstictic acids, traces; Furnas, Parque Terra Nostra, alt. 210 m, azalea, 27 Jul. 2003, F. Priemetzhofer 4987 (LI 754316) pr. P., tlc 1301n229: norstictic, hypoprotocetraric, salazinic acids; Gorreana, Teeplantage, 37°49′N, 25°44′W, alt. 200 m, auf *Erica azorica*, 31 Jul. 2001, F. Berger 15896 (herb. F. Berger), tlc 1294m952: tr. norstictic, salazinic, consalazinic acids; Lagoa das Furnas, Ost-Seite, div. Bäume am Strassenrand, alt. 300 m, *Fraxinus*, 26 Jul. 2003, F. Priemetzhofer 5132 (LI 754318), tlc 1301n226, 227: usnic, tr. norstictic, salazinic acids; id., *Camellia sinensis*, 26 Jul. 2003, F. Priemetzhofer 5156 (LI 754324), tlc 1301n228: usnic, norstictic, hypoprotocetraric, salazinic acids; Ponta Delgada, Parque Urbano, alt. ~100 m, 29 Mar. 2018, O. Breuss 34322 (herb. Breuss), tlc 1301n232: tr. usnic, hypoprotocetraric, protocetraric acids, trace; Porto Formosa, Klippe westlich von Praia dos Moinhas, alt. 56 m, *Erica azorica*, 27 Jul. 2003, F. Priemetzhofer 5010 (LI 754322), tlc 1302n251: tr. usnic, salazinic acids (“*Ramalina implectens*”); Quinta dos Açores, 37°45′19″N, 25°39′43″W, on oak tree, 22 May 2025, F. Rodrigues Ra 84 (QA6) (B 60 0211564), tlc 1308n523: protocetraric acid.

SANTA MARIA. SE of Santa Barbara, S side of the main road to São Lourenço, Pico Vermelho, Poço da Pedreira, *Erica* forest with viewpoint, 36°58.89′N, 25°03.67′W, alt. 305 m, on leaf of *Buxus*, 16 Sept. 2019, In P. & B. van den Boom 58916, tlc 1144h462: usnic, tr. norstictic, salazinic acids.

Ramalina krogiae Guissard & Sérus.

FAIAL. Laginha, 4 km W of Horta, alt. 0–10 m, maritime lava rock, July 1986, A. Aptroot 16454 (B 60 0053290), tlc: pl.389, nr.4143: divaricatic, tr. usnic acids, indet. trace (“*Ramalina requienii*”); S of Horta, Senhora da Guia, volcanic outcrops near end of the road and outcrops under small church, 38°31.27′N, 28°37.67′W, alt. 140 m, on volcanic rock, 4 Jun. 2016, P. & B. van den Boom 55432; SW of Horta, between Pasteleiro and Lajinha, just W of Pasteleiro, along road EN1, volcanic outcrops and *Erica* shrubs along coast, 38°31.42′N, 28°38.93′W, alt. 10 m, on acidic rock, 5 Jun. 2016, P. & B. van den Boom 55517; W of Castelo Branco, Morro de Castelo Branco, just E of the mountain, coastal area with abundantly *Erica azorica* and volcanic outcrops, 38°31.52′N, 28°44.82′W, alt. 80 m, on acidic rock, 4 Jun. 2016, P. & B. van den Boom 55450; W side of island, W of Praia do Norte, Norte Pequeno, wall with N exposed volcanic stones, 38°36.25′N, 28°47.71′W, alt. 160 m, on stone of wall, 31 May 2016, P. & B. van den Boom 55077.

FLORES. Lajes, centre of village, wall of stones, small park with mixed trees, including *Ficus*, 39°22.67′N, 31°10.44′W, alt. 70 m, on stone of wall, 9 Sept. 2023, P. & B. van den Boom 61872, tlc 1284m533: divaricatic acid, terpenoids; id., P. & B. van den Boom 61880 (herb. P. van den Boom, B 60 0210838), tlc 1284m532: divaricatic acid, terpenoids, P. & B. van den Boom 61878, tlc 1284m542: high traces, terpenoids; N of Fajã Grande, N of Igreja de Nossa Senhora Do Carmo, small trail, coastal area, along very high steep rock face, 39°28.53′N, 31°15.40′W, alt. 400 m, on siliceous rock, 10 Sept. 2023, P. & B. van den Boom 61911, tlc 1284m541: divaricatic acid, terpenoids, P. & B. van den Boom 61924 (herb. P. van den Boom, B 60 0210839), tlc 1284m547: divaricatic acid, terpenoids; S of Cedros, Parc de campismo e Lazer da Alagoa, wall of acidic stones, wood of fence, unidentified shrubs, 39°28.50′N, 31°08.93′W, alt. 45 m, 16 Sept. 2023, P. & B. van den Boom 61911, tlc 1284m541: divaricatic acid, terpenoids, P. & B. van den Boom 62012, tlc 1284m540: divaricatic acid, terpenoids; Santa Cruz das Flores, 39°27′47″N, 31°07′44″W, volcanic rock, 22 Apr. 2025, F. Rodrigues Ra 06 (Fl 6) (B 60 0211526), tlc 1304n348: divaricatic acid.

GRACIOSA. N of Vitoria, coastal area, low outcrops in field along road, 39°05.36′N, 28°03.09′W, alt. 20 m, on volcanic rock, 14 Sept. 2021, P. & B. van den Boom 60678; SW of Luz, coastal area, trail to Baia da Folga, along walls of stones, with a few small outcrops, 39°01.02′N, 27°59.37′W, alt. 50 m, on stone of wall, 10 Sept. 2021, P. & B. van den Boom 60450, tlc 1284m531: divaricatic acid, terpenoids.

PICO. SE of Piedade, W of Manhenha, S exposed coastal volcanic rocks and wall of stones, 38°24.50′N, 28°02.50′W, alt. 15 m, on volcanic rock, 31 Aug. 2017, P. & B. van den Boom 56736.

SÃO JORGE. Feldmauern bei Faja da Caldeira de Sto Cristo bis Faja do Belo, alt. 10 m, Basalt, 31 Jul. 2003, F. Priemetzhofer 4682 (LI 754325), tlc 1302n256: divaricatic acid, many terpenoids (“*Ramalina requienii*”), F. Priemetzhofer 4752 (LI 754306), tlc 1302n256: divaricatic acid, many terpenoids (“*Ramalina maciformis*”); SW of Manadas, Sta. Barbara, trees near church and old walls of stones, 38°37.92′N, 28°05.82′W, alt. 15 m, on stone of wall, 5 Sept. 2017, P. & B. van den Boom 57113; Velas, Klippenbereich W des Meerwasserschwimmingpool, alt. 5 m, Basalt, 29 Aug. 2003, F. Priemetzhofer 4815 (LI 754307), tlc 1302n259: divaricatic acid, many terpenoids (“*Ramalina maciformis*”); id., F. Priemetzhofer 4818 (LI 754303), tlc 1301n218: divaricatic acid, many terpenoids (“*Ramalina crispatula*”); id., F. Priemetzhofer 4823 (LI 754305), tlc 1301n217: divaricatic acid, many terpenoids (“*Ramalina crispatula*”); Velas, Morro Grande, Gratzacken an der Westseite, schräge, südostexponierte Tuff und Basalt, alt. 500 m, Tuff, 30 Jul. 2003, F. Priemetzhofer 4891 (LI 754302), tlc 1301n216: divaricatic acid, many terpenoids (“*Ramalina crispatula*”); Velas, Morro Grande, schräge,

Appendix 1. Continued.

ostexponierte Tuff, alt. 80 m, Tuff, 01 Aug. 2003, F. Priemetzhofer 4645 (LI 754308), tlc 1302n258: divaricatic acid, many terpenoids ("*Ramalina maciformis*"); Velhas, Klippen S Hotel S. Jorge: Punta das Eiras, 38°40.8′N, 28°12.7′W, alt. 10 m, supralitoral, auf Basalt, 1. Aug. 2001, F. Berger 15898 (herb. F. Berger), tlc 1294m956: divaricatic acid, terpenoids ("*Ramalina requienii*"); id., F. Berger 15900 (herb. F. Berger), tlc 1294m955: divaricatic acid, terpenoids ("*Ramalina requienii*").

TERCEIRA. Angra do Heroismo, Monte Brasil, recreation-ground, small (low) shrubs of *Camellia*, *Tamarix* and old wall of fortress, 38°39.00′N, 27°13.47′W, alt. 60 m, on stone of N-exposed wall, 30 Jun. 2014, P. & B. van den Boom 51538, tlc 1289m736: divaricatic acid, traces, terpenoids; Hotel Terceira Mar, 38°39.347′N, 27°13.924′W, alt. ~8 m, 14 Jul. 2008, F. Schumm 14127 (herb. F. Schumm), tlc 1316n830: tr. usnic, divaricatic acids, terpenoids; Monte Brasil, 38°38′44″N, 27°13′42″W, on volcanic tuff, 17 May 2025, F. Rodrigues Ra 59 (MB10) (B 60 0211556), tlc 1308n501: usnic, divaricatic acids, terpenoids; id., F. Rodrigues Ra 62 (MB13) (B 60 0211565), tlc 1308n504: usnic, divaricatic acids, terpenoids; id., F. Rodrigues Ra 66 (MB18) (B 60 0211566), tlc 1308n508: usnic, divaricatic acids, terpenoids; Poça dos Frades, 38°39′22″N, 27°15′03″W, volcanic stone, 12 Apr. 2025, F. Rodrigues Ra 21 (1.3) (B 60 0211527), tlc 1304n357: divaricatic acid; id., F. Rodrigues Ra 22 (1.4) (B 60 0211528), tlc 1304n358: divaricatic acid; id., F. Rodrigues Ra 23 (1.5) (B 60 0211529), tlc 1304n359: divaricatic acid; São Mateus, 38°39′17″N, 27°15′21″W, basalt, 12 Apr. 2025, F. Rodrigues Ra 30 (2.3) (B 60 0211530), tlc 1304n360: divaricatic acid; Serra do Facho, 38°44′02″N, 27°02′51″W, on volcanic rock, 5 May 2025, F. Rodrigues Ra 76 (SF1) (B 60 0211567), tlc 1308n515: divaricatic acid; id., F. Rodrigues Ra 78 (SF3) (B 60 0211568), tlc 1308n518: divaricatic acid; W of Angra do Heroismo, W of São Mateus, Forte do Negrito, coastal volcanic outcrops, 38°39.34′N, 27°17.06′W, alt. 5 m, on volcanic rock, 1 Jul. 2014, P. & B. van den Boom 51581; WNW of Vila Nova, SW of Furnas das Pombas, coastal area, Farroco, small trail to the coast from road EN1, rather shaded area with mixed trees and shrubs, 38°47.71′N, 27°11.99′W, alt. 25 m, on stone of wall, 3 Jul. 2014, P. & B. van den Boom 51798.

SÃO MIGUEL. Calhetas, 37.82090°N, 25.60475°W, alt. 24 m, 23 Sept. 2011, F. Schumm 17467 (herb. F. Schumm), tlc 1316n831: tr. usnic, divaricatic acids; N of Nordeste, trail NE of Lomba Fazenda, Parque de Endémicas, coastal area with mainly *Erica azorica* shrubs and shaded and sheltered volcanic outcrops in small valley, 37°51.00′N, 25°09.10′W, alt. 30 m, on volcanic rock outcrop, 29 Oct. 2011, P. & B. van den Boom 46780, tlc 1289m739: divaricatic acid, traces, terpenoids; NW of Ponta Delgada, NW of Ginetes, Ponta da Ferraria, viewpoint with low sloping outcrops and *Erica azorica* shrubs and steep outcrops near road, in W exposed coastal area, 37°51.50′N, 25°51.10′W, alt. 110 m, on W-sloping, acidic rock outcrop, 28 Oct. 2011, P. & B. van den Boom 46721, tlc 1289m737: divaricatic acid, traces, terpenoids.

SANTA MARIA. N of Vila do Porto, road to Anjos, c. 500 m SE of village, near picnic area, acidic outcrops in field, steep outcrops along road and a *Metrosideros* tree, 37°00.20′N, 25°09.10′W, alt. 50 m, on volcanic rock, 14 Sept. 2019, P. & B. van den Boom 58858, P. & B. van den Boom 58846; NE of São Pedro, road ER-2-2, nearby N. Sra. de Fátima, old, neglected barn, on N exposed wall of acidic stones and some *Pittosporum* trees along field, 37°00.11′N, 25°06.25′W, alt. 250 m, on stone of wall, 13 Sept. 2019, P. & B. van den Boom 58768; S of Santo Espirito, S of Maia, Ponta do Castelo, near lighthouse, vertical and overhanging acidic outcrops, 36°55.79′N, 25°01.05′W, alt. 100 m, on volcanic rock, 15 Sept. 2019, P. & B. van den Boom 58891; S of São Pedro, along road ER-2-2, a row of mature palm trees, 36°58.70′N, 25°07.42′W, on palm, alt. 160 m, 14 Sept. 2019, P. & B. van den Boom 58793.

Ramalina lacera (With.) J.R. Laundon

CORVO. W of Vila do Corvo, trail to Pão de Açucar, outcrops on S exposed slope, on stone of wall, Sept. 2023, P. & B. van den Boom 62171, tlc 1288m718: terpenoids, bourgeanic acid.

FAIAL. Castelo Branco, 38°31′21″N, 28°43′01″W, basalt, 8 May 2024, F. Rodrigues Ra 45 (FA) (B 60 0211531), tlc 1304n367: bourgeanic acid.

GRACIOSA. E of Luz, Ribeira, Casa Perpétua, garden with mixed trees, shrubs and wall of stones, 39°01.31′N, 27°59.23′W, alt. 85 m, on *Erica azorica*, 9 Sept. 2021, P. & B. van den Boom 60432; S of Ribeirinha, road just outside the village, to the south, roadside and along fields, *Tamarix* shrubs and trees, 39°02.90′N, 28°02.54′W, alt. 140 m, on *Tamarix*, 12 Sept. 2021, P. & B. van den Boom 60547; SW of Luz, coastal area, trail to Baia da Folga, along walls of stones, with a few small outcrops, 39°01.02′N, 27°59.37′W, alt. 50 m, on stone of wall, 10 Sept. 2021, P. & B. van den Boom 60471; WSW of Luz, area of Carapacho, coastal area, roadside trees, including *Tamarix* and wall of stones along fields with a few *Populus* trees, 39°00.58′N, 27°58.04′W, alt. 50 m, on stone of wall, 11 Sept. 2021, P. & B. van den Boom 60499, tlc 1288m717: terpenoids, bourgeanic acid.

TERCEIRA. Angra do Heroismo, Monte Brasil, recreation-ground, small (low) shrubs of *Camellia*, *Tamarix* and old wall of fortress, 38°39.00′N, 27°13.47′W, alt. 60 m, on *Camellia*, 30 Jun. 2014, P. & B. van den Boom 51519; São João de Deus, 38°39′57″N, 27°13′22″W, *Pinus pinaster*, 22 Apr. 2024, F. Rodrigues Ra 39 (3) (B 60 0211534), tlc 1304n366: bourgeanic acid; Serra do Facho, 38°44′02″N, 27°02′50″W, on volcanic stone, 5 May 2025, F. Rodrigues Ra 77 (SF2) (B 60 0211569), tlc 1308n517: bourgeanic acid, terpenoids.

SÃO MIGUEL. Ponta Delgada, SÃO MIGUEL Park Garden, 37°44′37″N, 25°40′23″W, *Pinus pinaster*, 29 Apr. 2025, F. Rodrigues Ra 09 (PD2) (B 60 0211533), tlc 1304n373: bourgeanic acid; Quinta dos Açores, 37°45′21″N, 25°39′47″W, on oak tree, 22 May 2025, F. Rodrigues Ra 81 (QA3) (B 60 0211570), tlc 1308n521: bourgeanic acid; Relva, 37°45′03″N, 25°42′45″W, exotic tree, 10 Apr. 2025, F. Rodrigues Ra 13 (RE2) (B 60 0211532), tlc 1304n365: bourgeanic acid.

SANTA MARIA. Just west of Almagreira, wall of acidic stones at roadside with some *Metrosideros* trees, 36°57.94′N, 25°06.42′W, alt. 125 m, on stone of wall, 13 Sept. 2019, P. & B. van den Boom 58719; N of Vila Do Porto, Anjos, wall of acidic stones, two long rows of *Metrosideros* trees in field, 37°00.37′N, 25°09.23′W, alt. 20 m, on *Metrosideros*, 12 Sept. 2019, P. & B. van den Boom 58674b, tlc 1288m720: terpenoids, bourgeanic acid.

Ramalina lusitanica H. Magn.

GRACIOSA. E of Luz, Ribeira, Casa Perpétua, garden with mixed trees, shrubs and wall of stones, 39°01.31′N, 27°59.23′W, alt. 85 m, on dead *Ficus*, 9 Sept. 2021, P. & B. van den Boom 60433; id., on *Pittosporum*, 9 Sept. 2021, P. & B. van den Boom 60416; id., on *Ficus*, 9 Sept. 2021, P. & B. van den Boom 60408, tlc 1288m723: tr. usnic, divaricatic acids, traces, terpenoids; WSW of Luz, area of Carapacho, coastal area, roadside trees, including *Tamarix* and wall of stones along fields with a few *Populus* trees, 39°00.58′N, 27°58.04′W, alt. 50 m, on *Tamarix*, 11 Sept. 2021, P. & B. van den Boom 60487.

TERCEIRA. Angra do Heroismo, city, 38°39.3′N, 27°13.1′W, alt. 40 m, on concrete of silo, 14 Jul. 2008, A. Aptroot 68359 (BR-LICH 32735-46), tlc 1294m939: tr. usnic, divaricatic acids, terpenoids; Angra do Heroismo, Fortaleza de Sao Joao Baptista, 38°39.171′N, 27°13.457′W, alt. ~44 m, 17 Jul. 2008, F. Schumm 14186 (herb. F. Schumm), tlc 1316n835: tr. usnic, divaricatic acid; Angra do Heroismo, Monte Brasil, recreation-ground, small (low) shrubs of *Camellia*, *Tamarix* and old wall of fortress, 38°39.00′N, 27°13.47′W, alt. 60 m, on *Camellia*, 30 Jun. 2014, P. & B. van den Boom 51517; Angra, Monte Brasil, Relvão, 38°39.1′N, 27°13.4′W, alt. 50 m, on *Catalpa*, 17 Jul. 2008, A. Aptroot 68404 (BR-LICH 32551-56), tlc 1294m937: tr. usnic, divaricatic acids, terpenoids; bei São Bartolomeu, 38°40.482′N, 27°17.586′W, alt. 125 m, 13 Jul. 2008, F. Schumm 14099 (herb. F. Schumm), tlc 1316n833: tr. usnic, divaricatic acids; Conceição, Angra do Heroísmo, 38°39′15″N, 27°12′51″W, Exotic tree, 11 Apr. 2025, F. Rodrigues Ra 15 (CO1) (B 60 0211537), tlc 1304n351: divaricatic acid; Jardim Público de Angra de Heroísmo, 38°39′29″N, 27°13′07″W, on exotic tree, 3 May 2025, F. Rodrigues Ra 48 (JPA3) (B 60 0211571), tlc 1308n492: divaricatic acid; Lagoa de Falca, 38°43.097′N, 27°17.222′W, alt. ~520 m, 16 Jul. 2008, F. Schumm 14174 (herb. F. Schumm), tlc 1316n832: tr. usnic, divaricatic acid; id., F. Schumm 14181 (herb. F. Schumm), tlc 1316n834: tr. usnic, divaricatic acids; Lajes, 38°45′07″N, 27°05′08″W, *Dracaena draco*, 18 Apr. 2025, F. Rodrigues Ra 16 (L1) (B 60 0211538), tlc 1304n352: divaricatic acid; Monte Brasil, 38°38′37″N, 27°13′58″W, on exotic tree, 17 May 2025, F. Rodrigues Ra 63 (MB14) (B 60 0211560), tlc 1308n505: usnic, divaricatic acids, terpenoids; Paul da Praia da Vitória, 38°44′08″N, 27°03′36″W, *Morella faya*, 1 May 2025,

Appendix 1. Continued.

F. Rodrigues Ra 18 (PP1) (B 60 0211539), tlc 1304n353: divaricatic acid; Relvão, 38°39′04″N, 27°13′22″W, on exotic tree, 4 May 2025, F. Rodrigues Ra 71 (RV2) (B 60 0211572), tlc 1308n512: divaricatic acid; id., F. Rodrigues Ra 74 (RV5) (B 60 0211573); São Bartolomeu, near bridge, 38°40.4′N, 27°17.5′W, alt. 125 m, on *Populus alba*, 13 Jul. 2008, A. Aptroot 68229 (BR-LICH 32734-45), tlc 1294m936: tr. usnic, divaricatic acids, terpenoids; Sé, Angra do Heroísmo, 38°39′19″N, 27°13′16″W, on exotic tree, 3 May 2025, F. Rodrigues Ra 75 (S1) (B 60 0211574); Serra de Santiago, 38°44′02″N, 27°02′50″W, volcanic stone, 20 May 2024, F. Rodrigues Ra 38 (2) (B 60 0211540), tlc 1304n354: divaricatic acid; Silos mitten in Angra do Heroismo, 13 Jul. 2008, F. Schumm 14276 (herb. F. Schumm), tlc 1316n836: divaricatic acid; Terra-Cha, University Campus, 38°40.4′N, 27°15.0′W, alt. 120 m, on *Catalpa*, 17 Jul. 2008, A. Aptroot 68456 (BR-LICH 32552-57), tlc 1294m938: tr. usnic, divaricatic acids, terpenoids; W of Angra do Heroismo, W of São Mateus, SW of Cinco Ribeiras, coastal area, near porto das Cinco Ribeiras, campsite, *Tamarix* trees, 38°40.57′N, 27°19.76′W, alt. 15 m, on *Tamarix*, 1 july 2014, P. & B. van den Boom 51588.

SÃO MIGUEL. Aeroporto João Paulo II, 37°45′00″N, 25°42′36″W, exotic tree, 30 Apr. 2025, F. Rodrigues Ra 10 (JP1) (B 60 0211535), tlc 1304n349: divaricatic acid; Caminho do Praja, alt. 120 m, *Eucalyptus globulus* fallen branch, 26 Jul. 2003, F. Priemetzhofer 5081 (LI 754512), tlc 1302n255: divaricatic acid, many terpenoids ("*Ramalina mollis*"); id., F. Priemetzhofer 5101 (LI 754323), tlc 1302n254: divaricatic acid, many terpenoids ("*Ramalina mollis*"); Lagoa Azul, 37.87493°N, 25.79012°W, alt. 260 m, 19 Sept. 2011, in F. Schumm 17342 (herb. F. Schumm), tlc 1316n838: divaricatic acid; Lagoa das Furnas, NW-Ufer, alt. ~300 m, 01 Jun. 2016, M. Strudl & O. Breuss 33691 (LI 812988), tlc 1302n253: divaricatic acid, many terpenoids; NW of Ponta Delgada, E of Sete Cidades, peninsula 'Tufo' in Lagoa Azul, mixed trees along trail along lake, 37°51.55′N, 25°47.10′W, alt. 275 m, on bark of fallen branch, 25 Oct. 2011, P. & B. van den Boom 46590, tlc 1288m724: tr. usnic, divaricatic acids, traces, terpenoids; NW of Ponta Delgada, NW of Ginetes, Ponta da Ferraria, viewpoint with low sloping outcrops and *Erica azorica* shrubs and steep outcrops near road, in W exposed coastal area, 37°51.50′N, 25°51.10′W, alt. 110 m, on *Erica azorica*, 28 Oct. 2011, P. & B. van den Boom 46727, tlc 1288m722: divaricatic acid, traces, terpenoids; Pico Vermelho, 37°48′04″N, 25°30′21″W, *Pinus pinaster*, 8 Apr. 2025, F. Rodrigues Ra 11 (PV1) (B 60 0211536), tlc 1304n350: divaricatic acid; Ponta Delgada, Parque Urbano, alt. ~100 m, 29 Mar. 2018, O. Breuss 34318 (LI 868521), O. Breuss 34319 (herb. Breuss), tlc 1301n247: divaricatic acid, many terpenoids; Ponta Delgada, Straßen- und Parkbäume in der Umgebung des Parkhotels und des Jardim António Borges, alt. ~100 m, 30 Jul. 2017, O. Breuss 34035 (LI 813001); id., O. Breuss 34035 (LI 813004), tlc 1301n248: divaricatic acid, many terpenoids; id., O. Breuss 34035 (LI 813015); Quinta dos Açores, 37°45′24″N, 25°39′50″W, on oak tree, 22 May 2025, F. Rodrigues Ra 79 (QA1) (B 60 0211575), tlc 1308n519: divaricatic acid; id., F. Rodrigues Ra 80 (QA2) (B 60 0211576), tlc 1308n520: divaricatic acid, terpenoids; id., F. Rodrigues Ra 85 (QA7) (B 60 0211577), tlc 1308n524: divaricatic acid, terpenoids; Sete Cidades, Lagoa Azul, NW-Ufer, alt. ~250 m, 31 Jul. 2017, O. Breuss 34087 (LI 813066), tlc 1301n249: divaricatic acid, many terpenoids; id., O. Breuss 34088 (LI 813058), tlc 1301n250: divaricatic acid, many terpenoids; id., O. Breuss 34088 (LI 868522); Sete Cidades, Lagoa Azul, W-Ufer, alt. ~250 m, 27 Apr. 2017, O. Breuss 33839 (herb. Breuss), tlc 1306n417: divaricatic acid, terpenoids.

SANTA MARIA. N of Vila Do Porto, Anjos, wall of acidic stones, two long rows of *Metrosideros* trees in field, 37°00.37′N, 25°09.23′W, alt. 20 m, on *Metrosideros*, 12 Sept. 2019, P. & B. van den Boom 58674c, tlc 1288m721: divaricatic acid, traces, terpenoids; N of Vila do Porto, road to Anjos, c. 500 m SE of village, near picnic area, acidic outcrops in field, steep outcrops along road and a *Metrosideros* tree, 37°00.20′N, 25°09.10′W, alt. 50 m, on *Metrosideros*, 14 Sept. 2019, P. & B. van den Boom 58850, tlc 1288m727: divaricatic acid, traces, terpenoids; NNE of Santa Barbara, near Pico do Norte, N of picnic area, just S of Norte, small forest with mainly *Myrica faya*, along secondary road, 37°00.18′N, 25°03.77′W, alt. 225 m, on unidentified tree, 16 Sept. 2019, in P. & B. van den Boom 58984, tlc 1284m548: sekikaic acid.

Ramalina peruviana Ach.

CORVO. NNE of Vila do Corvo, E of volcano, playground and forestal area, Parc da Quinta, walls of stones and small forests, 39°41.87′N, 31°05.14′W, alt. 205 m, on Citrus, 14 Sept 2023, P. & B. van den Boom 62287, tlc 1284m543: homosekikaic, sekikaic acids.

FAIAL. E side of the island, ESE of Flamengos, Botanical Garden, with mixed trees and shrubs, 38°33.03′N, 28°38.36′W, alt. 100 m, on *Aesculus*, 1 Jun. 2016, in P. & B. van den Boom 55165.

FLORES. WSW of Lajes, coastal area, miradouro da Fajã do Lopo Vaz, mixed trees, including *Lagerstroemia indica*, 39°22.53′N, 31°11.73′W, on *Lagerstroemia indica*, Sept. 2023, P. & B. van den Boom 61902, tlc 1288m728: sekikaic acid agg., traces.

GRACIOSA. E of Luz, Ribeira, Casa Perpétua, garden with mixed trees, shrubs and wall of stones, 39°01.31′N, 27°59.23′W, alt. 85 m, on dead *Ficus*, 9 Sept. 2021, P. & B. van den Boom 60431, tlc 1284m536: homosekikaic, sekikaic acids; S of Ribeirinha, along road R1-2, W of Serra Branca, a group of *Cryptomeria* trees and some *Erica azorica* shrubs, along field, 39°01.92′N, 28°02.22′W, alt. 285 m, on *Cryptomeria* needles, 15 Sept. 2021, P. & B. van den Boom 60741; SE of Ribeirinha, SE of Tanque, small road to R3-2, NW of Serra Dormida, mixed forest, 39°02.60′N, 28°01.35′W, alt. 270 m, on *Erica*, 12 Sept. 2021, P. & B. van den Boom 60528; WNW of Luz, inside volcano crater, road from tunnel to Centro de Visitantes da Furna do Enxofre, N of the road, open place, including *Castanea* trees, 39°01.55′N, 27°58.54′W, alt. 150 m, on *Castanea*, 13 Sept. 2021, P. & B. van den Boom 60562; id., on *Myrica faya*, 13 Sept. 2021, P. & B. van den Boom 60589; id., P. & B. van den Boom 60574; WNW of Luz, margin of volcano crater, near cave, viewpoint, mixed trees and steep shaded outcrops, 39°01.77′N, 27°58.83′W, alt. 230 m, on *Erica*, 14 Sept. 2021, P. & B. van den Boom 60651; WNW of Luz, margin of volcano crater, open grassy trail to watch-tower, small *Erica azorica* shrubs, 39°01.65′N, 27°58.85′W, alt. 285 m, on *Erica*, 14 Sept. 2021, P. & B. van den Boom 60660; WNW of Luz, trail outside (around) the volcano crater, road above tunnel close to the crater top (NE side), mixed trees and small forests, 39°01.77′N, 27°58.01′W, alt. 250 m, on *Erica*, 13 Sept. 2021, P. & B. van den Boom 60600; WSW of Luz, area of Carapacho, coastal area, roadside trees, including *Tamarix* and wall of stones along fields with a few *Populus* trees, 39°00.58′N, 27°58.04′W, alt. 50 m, on stone of wall, 11 Sept. 2021, P. & B. van den Boom 60490, tlc 1288m730: sekikaic acid agg., traces.

PICO. SSE of Piedade, Cabeço da Junça, florestal, Parque Matos Souto, mixed trees and shrubs, 38°25.17′N, 28°03.54′W, alt. 150 m, on *Thuja*, 31 Aug. 2017, P. & B. van den Boom 56765.

SÃO JORGE. E of Santo Amaro, Reserva Florestal das Macelas, small open forest with mixed trees and shrubs, including *Metrosideros* trees and *Camellia* shrubs, 38°40.61′N, 28°09.78′W, alt. 450 m, on *Cryptomeria* needle, 4 Sept. 2017, P. & B. van den Boom 57033, tlc m553: homosekikaic, sekikaic acid; NE of Calheta, Reserva Florestal da Silveira, picnic area, small open forest with mixed trees and shrubs, including *Pinus*, *Cryptomeria*, tree ferns and *Camellia* shrubs, 38°36.79′N, 27°58.62′W, alt. 290 m, on *Thuja*, 5 Sept. 2017, P. & B. van den Boom 57082, tlc 1284m554: homosekikaic, sekikaic acids.

TERCEIRA. Angra do Heroismo, Monte Brasil, top, area of Pico das Cruzinhas, including picnic area, mixed trees and shrubs, included *Myrica faya* and *Erica*, 38°38.78′N, 27°13.73′W, alt. 100 m, on *Myrica faya*, 30 Jun. 2014, P. & B. van den Boom 51544, tlc 1289m731: sekikaic acid agg., traces; Angra do Heroismo, Monte Brasil, top, area of Pico das Cruzinhas, including picnic area, mixed trees and shrubs, included *Myrica faya* and *Erica*, 38°38.78′N, 27°13.73′W, alt. 100 m, on *Myrica faya*, 30 Jun. 2014, P. & B. van den Boom 51554, tlc 1284 m552: homosekikaic, sekikaic acids; id., on *Erica*, 30 Jun. 2014, P. & B. van den Boom 51558, tlc: 1289m734: sekikaic acid agg., traces; Angra do Heroismo, park in centre, with mixed trees and shrubs, including some exotic trees, 38°39.30′N, 27°12.57′W, alt. 275 m, on unidentified shrub, 17 Sept. 2021, P. & B. van den Boom 60758, tlc 1268l921: sekikaic + homosekikaic? acids; id., P. & B. van den Boom 60759, tlc 1268l922: sekikaic + homosekikaic? acids; id., P. & B. van den Boom 60758, tlc 1268l921: sekikaic + homosekikaic? acids; id., P. & B. van den Boom 60759. tlc: 1268l922: Sekikaic, homosekikaic? acids; Feteira, 38°39′10″N, 27°08′40″W, *Pittosporum undulatum*, 30 May 2024, F. Rodrigues Ra 14 (QP1) (B 60 0211543), tlc 1306n431: sekikaic acid

Appendix 1. Continued.

agg.; Jardim Público de Angra de Heroísmo, 38°39′25″N, 27°13′04″W, on *Rhododendron* sp., 3 May 2025, F. Rodrigues Ra 46 (JPA1) (B 60 0211578); Lagoa de Falca, 38°43.097′N, 27°17.222′W, alt. ~520 m, 16 Jul. 2008, F. Schumm 14182 (herb. F. Schumm), tlc 1316n842: sekikaic acid agg.; id., F. Schumm 14175 (herb. F. Schumm), tlc 1316n845: sekikaic acid agg.; Monte Brasil, 38°38′41″N, 27°13′54″W, on *Morella faya*, 17 May 2025, F. Rodrigues Ra 53 (MB4) (B 60 0211579), tlc 1308n497: sekikaic, homosekikaic acids; id., on *Erica azorica*, 17 May 2025, F. Rodrigues Ra 54 (MB5) (B 60 0211580), tlc 1308n498: sekikaic, homosekikaic acids; id., on exotic tree, 17 May 2025, F. Rodrigues Ra 68 (MB20) (B 60 0211581); N of Serreta, Reserva Florestal da Serreta, picnic area in open forest with mixed trees and shrubs, 38°46.27′N, 27°21.42′W, alt. 80 m, on azalea, 2 Jul. 2014, P. & B. van den Boom 51749, tlc 1288m710: sekikaic acid agg., traces; Nasce Agua, 38°41′16″N, 27°12′32″W, on iron pipe, april 2024, F. Rodrigues 406 (M-0366252), tlc 1309n544: sekikaic acid agg. ("*Ramalina farinacea*"); São Bartolomeu, 38°39′54″N, 27°15′10″W, *Pittosporum undulatum*, 20 Apr. 2025, F. Rodrigues Ra 17 (SB1) (B 60 0211541), tlc 1304n345: sekikaic acid agg.; São João de Deus, 38°39′57″N, 27°13′22″W, *Acacia* sp., 22 Apr. 2024, F. Rodrigues Ra 42 (6) (B 60 0211542), tlc 1304n346: sekikaic acid agg.

SÃO MIGUEL. Lagoa Sete Cidades, Kraterrand NW Vista do Rei, Kraterrandweg, 37°52′N, 25°49′W, alt. 470 m, 29 Jul. 2001, F. Berger 15901 (herb. F. Berger), tlc 1294m949: tr. usnic, sekikaik acid agg. ("*Ramalina farinacea*"); Furnas, Botanischer Garten Terras Nostras, 37°46.2′N, 25°18′W, alt. 280 m, extrem klim. ozean. Park, auf Palme, 31 Jul. 2001, F. Berger 15965 (herb. F. Berger), tlc 1294m953: tr. usnic, sekikaik acid agg.; Furnas, Gartenanlage, alt. ~300 m, an Baumstamm, 25 Apr. 2017, O. Breuss 33754 (LI 812172) ("*Ramalina farinacea*"); Furnas, Parque Terra Nostra, alt. 210 m, *Archophoenix cunninghamii*, 28 Jul. 2003, F. Priemetzhofer 4951 (LI 754319), tlc 1301n233: sekikaic acid agg. ("*Ramalina farinacea*"); id., azalea, 27 Jul. 2003, F. Priemetzhofer 4987 (LI 754316), tlc 1301n229: usnic, sekikaic acid agg. ("*Ramalina farinacea*"); Lagoa Azul, 37.87493°N, 25.79012°W, alt. 260 m, 19 Sept. 2011, F. Schumm 17309 (herb. F. Schumm), tlc 1316n847: sekikaic acid agg.; id., F. Schumm 17310 (herb. F. Schumm), tlc 1316n846: sekikaic acid agg.; id., F. Schumm 17318 (herb. F. Schumm), tlc 1316n843: sekikaic acid agg.; id., F. Schumm 17336 (herb. F. Schumm), tlc 1316n844: sekikaic acid agg.; Lagoa das Furnas, Nordufer, 37°45′N, 25°19′W, alt. 285 m, 31 Jul. 2001, F. Berger 15894 (herb. F. Berger), tlc 1294m950: tr. usnic, sekikaik acid agg. ("*Ramalina duriaei*"); Lagoa das Furnas, NW-Ufer, alt. ~300 m, 26 Apr. 2017, O. Breuss 33780 (LI 812181), tlc 1301n234: sekikaic acid agg. ("*Ramalina farinacea*"); id., O. Breuss 33802 (LI 812109) ("*Ramalina farinacea*"); NW of Ponta Delgada, road to Sete Cidades, SE of village, near viewpoints between Lagoa de Santiago and Lagoa Verde, 37°51.10′N, 25°46.00′W, alt. 440 m, on young *Quercus* trunk, 8 cm, 25 Oct. 2011, P. & B. van den Boom 46538a, tlc 1289m742: sekikaic acid agg., traces; NW of Ponta Delgada, Sete Cidades, centre of village, two rows of mature *Cryptomeria japonica* trees in front of the church and small park with mixed small trees, 37°51.80′N, 25°47.90′W, alt. 270 m, on *Cryptomeria*, 25 Oct. 2011, P. & B. van den Boom 46571, tlc 1288m709: sekikaic acid agg., traces; Parque Terra Nostra, Furnas, 2.6 km S v. Salga, 37°48′7″N, 25°18′W, alt. 500 m, May 2014, G. Neuwirth 12111 (LI 784187), tlc 1301n235: sekikaic acid agg. ("*Ramalina farinacea*"); Ponta Delgada, Parque Urbano, alt. ~100 m, 29 Mar. 2018, O. Breuss 34321 (herb. Breuss), tlc 1301n215: sekikaic acid agg. ("*Ramalina subfarinacea*"); id., auf Fels, 31 Mar. 2018, in O. Breuss 34322 (herb. Breuss), tlc 1301n231: sekikaic acid agg.; Quinta dos Açores, 37°45′20″N, 25°39′45″W, on oak tree, 22 May 2025, F. Rodrigues Ra 82 (QA4) (B 60 0211582); id., on *Rhododendron* sp., 22 May 2025, F. Rodrigues Ra 86 (QA8) (B 60 0211583), tlc 1308n525: sekikaic, homosekikaic acids; id., F. Rodrigues Ra 88 (QA10) (B 60 0211584), tlc 1308n526: sekikaic, homosekikaic acids; Relva, 37°45′03″N, 25°42′45″W, exotic tree, 10 Apr. 2025, F. Rodrigues Ra 12 (RE1) (B 60 0211545), tlc 1306n430: sekikaic acid agg.; Rua Embaixador Faria e Maia, Ponta Delgada, 37°45′07″N, 45°40′01″W, exotic tree, 10 Apr. 2025, F. Rodrigues Ra 07 (FM1) (B 60 0211544), tlc 1306n429: sekikaic acid agg.; Sete Cidades, Kirchenallee, 37 51.8′N, 25°48.4′W, alt. 255 m, auf *Cupressus* cult, 29 Jul. 2001, F. Berger 15897 (herb. F. Berger), tlc 1294m951: tr. usnic, sekikaik acid agg. ("*Ramalina duriaei*"); Sete Cidades, Lagoa Azul, NW-Ufer, alt. ~250 m, 27 Apr. 2017, O. Breuss 33832 (LI 812139), tlc 1301n236: sekikaic acid agg ("*Ramalina farinacea*"); id., 31 Jul. 2017, O. Breuss 34065 (LI 813082) ("*Ramalina farinacea*"); id., O. Breuss 34092 (LI 813063), tlc 1301n230: sekikaic acid agg. ("*Ramalina farinacea*"); Sete Cidades, Lagoa Azul, W-Ufer, alt. ~250 m, 27 Apr. 2017, O. Breuss 33843 (LI 812134) ("*Ramalina farinacea*"); id., 28 Apr. 2017, O. Breuss 33887 (LI 811720), tlc 1301n237: sekikaic acid agg. ("*Ramalina farinacea*"); Sete Cidades, 25 May 2016, M. Strudl & O. Breuss 33685 (LI 811894) ("*Ramalina farinacea*"); near Socorro on the west of the island, alt. 200 m, on *Populus alba* along the road, July 1986, A. Aptroot 16194 (B 60 0053293), tlc pl. 313, nr. 3151: homosekikaic, sekikaic acids.

SANTA MARIA. E of São Pedro, along secondary road, from Ribeira do Engenho to Almagreira, area of Monteiro, wood of fence and a small group of trees in meadow, 36°58.77′N, 25°06.48′W, alt. 250 m, on wood of fence, 14 Sept. 2019, P. & B. van den Boom 58808; NE of São Pedro, road ER-2-2, nearby N. Sra. de Fátima, old, neglected barn, on N exposed wall of acidic stones and some *Pittosporum* trees along field, 37°00.11′N, 25°06.25′W, alt. 250 m, on *Pittosporum*, 13 Sept. 2019, P. & B. van den Boom 58775; NE side of Vila Do Porto, Reserva Florestal de Valverde, mixed trees and shrubs, dominated by *Thuja* trees, 36°57.52′N, 25°08.06′W, alt. 135 m, on unidentified tree, 12 Sept. 2019, P. & B. van den Boom 58662; id., on *Hibiscus*, 12 Sept. 2019, P. & B. van den Boom 58631; S of Santo Espirito, S of Cardal, trail in field with a row of small trees, *Erica* and *Myrica faya*, 36°56.15′N, 25°02.85′W, alt. 240 m, on *Myrica faya*, 17 Sept. 2019, P. & B. van den Boom 59074, tlc 1284m534: homosekikaic, sekikaic acids; id., P. & B. van den Boom 59070, tlc 1284m 535: homosekikaic, sekikaic acids; SE of Santa Barbara, S side of the main road to São Lourenço, Pico Vermelho, Poço da Pedreira, *Erica* forest with viewpoint, 36°58.89′N, 25°03.67′W, alt. 305 m, on *Erica azorica*, 16 Sept. 2019, P. & B. van den Boom 58916; SE of the island, along road ER-1, between Santo Espirito and Castelo, Calheta, near house and small forest, steep facing soil and *Buxus* in garden, 36°56.72′N, 25°01.96′W, alt. 255 m, on leaf of *Buxus*, 15 Sept. 2019, P. & B. van den Boom 58916, tlc 1284m551: homosekikaic, sekikaic acids.

Ramalina portuensis Samp.

FLORES. E of Mosteiro, between lakes Caldeira Rasa and Caldeira Funda, shrubs along road, alt. 530 m, on *Erica*, Sept. 2023, P. & B. van den Boom 61954.

TERCEIRA. N of Serreta, Reserva Florestal da Serreta, picnic area in open forest with mixed trees and shrubs, 38°46.27′N, 27°21.42′W, alt. 80 m, on azalea, 2 Jul. 2014, P. & B. van den Boom 51746, tlc 1288m729: usnic, salazinic acids; W of Angra do Heroismo, W of São Mateus, Forte do Negrito, coastal volcanical outcrops, 38°39.34′N, 27°17.06′W, alt. 5 m, on volcanic rock, 1 Jul. 2014, P. & B. van den Boom 51575; W of Praia da Vitória, S of São Brás, S of Baldio, picnic area, starting point for trail to Biscoito da Fontinhas, mixed trees, including *Myrica faya*, 38°44.90′N, 27°07.83′W, alt. 195 m, on stone of wall, 29 Jun. 2014, P. & B. van den Boom 51474; WNW of Vila Nova, SE of Furnas das Pombas, coastal area, small road with W exposed volcanic outcrops, 38°47.68′N, 27°11.70′W, alt. 50 m, on volcanic rock, 3 Jul. 2014, P. & B. van den Boom 51785.

SÃO MIGUEL. Lagoa das Furnas, Ost-Seite, div. Bäume am Strassenrand, alt. 300 m, *Camellia sinensis*, 26 Jul. 2003, in F. Priemetzhofer 5156 (LI 754324).

Ramalina pusilla Le Prévost ex Duby

TERCEIRA. Angra do Heroismo, Monte Brasil, top, area of Pico das Cruzinhas, including picnic area, mixed trees and shrubs, included *Myrica faya* and *Erica*, 38°38.78′N, 27°13.73′W, alt. 100 m, on *Myrica faya*, 30 Jun. 2014, P. & B. van den Boom 51550; Angra, Monte Brasil, Relvão, 38°39.1′N, 27°13.4′W, alt. 50 m, on *Catalpa*, 17 Jul. 2008, A. Aptroot 68405 (BR-LICH 32741-52), tlc 1294m945: sekikaic acid, terpenoids, indet. low spot; Jardim Público de Angra de Heroísmo, 38°39′29″N, 27°13′06″W, on palm tree, 3 May 2025, F. Rodrigues Ra 47 (JPA2) (B 60 0211585), tlc 1308n493: sekikaic, terpenoids, protocetraric acids; Monte Brasil, 38°38′37″N, 27°13′58″W, on *Erica azorica*, 17 May 2025, F. Rodrigues Ra 50 (MB1) (B 60 0211586), tlc 1308n494: usnic, sekikaic acids, terpenoids; id., F. Rodrigues Ra 51 (MB2) (B 60 0211587), tlc 1308n495: usnic, sekikaic, tr. stictic acids, terpenoids; Monte Brasil, 38°38′46″N, 27°13′46″W, on exotic tree, 17 May 2025,

Appendix 1. Continued.

F. Rodrigues Ra 64 (MB16) (B 60 0211588), tlc 1308n506: sekikaic acid, terpenoids; id., F. Rodrigues Ra 65 (MB17) (B 60 0211589), tlc 1308n507: sekikaic acid, terpenoids; Relvão, 38°39′07″N, 27°13′25″W, on exotic tree, 4 May 2025, F. Rodrigues Ra 73 (RV4) (B 60 0211590), tlc 1308n514: sekikaic acid, terpenoids; S of Angra do Heroismo, Monte Brasil, top of hill, nearby monument, mixed trees, including *Myrica faya*, 38°38.75′N, 27°13.31′W, alt. 90 m, on *Myrica faya*, 20 Sept. 2021, P. & B. van den Boom 60834, tlc 1289m735: sekikaic, salazinic acids, terpenoids; id., P. & B. van den Boom 60834, tlc 1289m735: sekikaic, salazinic acids, terpenoids; São João de Deus (wood), 38°39′53″N, 27°13′20″W, on *Acacia*, April 2024, F. Rodrigues 401 (M-0366253), tlc 1309n545: sekikaic acid agg. ("*Ramalina fastigiata*"); WNW of Vila Nova, SW of Furnas das Pombas, coastal area, Farroco, small trail to the coast from road EN1, rather shaded area with mixed trees and shrubs, 38°47.71′N, 27°11.99′W, alt. 25 m, on unidentified shrub, 3 Jul. 2014, P. & B. van den Boom 51796.

SÃO MIGUEL. Lagoa Azul, 37.87493°N, 25.79012°W, alt. 260 m, 19 Sept. 2011, F. Schumm 17342 (herb. F. Schumm), tlc 1316n838: sekikaik acid; NW of Ponta Delgada, E of Sete Cidades, peninsula 'Tufo' in Lagoa Azul, mixed trees along trail along lake, 37°51.55′N, 25°47.10′W, alt. 275 m, on bark of fallen branch, 25 Oct. 2011, P. & B. van den Boom 46590a, tlc 1288m725: sekikaic acid agg., traces, terpenoids; NW of Ponta Delgada, NW of Ginetes, Ponta da Ferraria, viewpoint with low sloping outcrops and *Erica azorica* shrubs and steep outcrops near road, in W exposed coastal area, 37°51.50′N, 25°51.10′W, alt. 110 m, on *Erica azorica*, 28 Oct. 2011, P. & B. van den Boom 46728, tlc 1289m738: sekikaic acid, terpenoids; Quinta dos Açores, 37°45′19″N, 25°39′43″W, on oak tree, 22 May 2025, F. Rodrigues Ra 83 (QA5) (B 60 0211593), tlc 1308n522: sekikaic acid, terpenoids; Sete Cidades, Lagoa Azul, NW-Ufer, alt. ~250 m, 31 Jul. 2017, O. Breuss 34089 (herb. Breuss), tlc 1306n416: tr. usnic, sekikaic acid agg., terpenoids; id., W-Ufer, alt. ~250 m, 27 Apr. 2017, O. Breuss 33844 (herb. Breuss), tlc 1306n415: tr. usnic, sekikaic acid agg., terpenoids.

SANTA MARIA. E of São Pedro, along secondary road, from Ribeira do Engenho to Almagreira, area of Monteiro, wood of fence and a small group of trees in meadow, 36°58.77′N, 25°06.48′W, alt. 250 m, on wood of fence, 14 Sept. 2019, in P. & B. van den Boom 55808; N of Vila Do Porto, Anjos, wall of acidic stones, two long rows of *Metrosideros* trees in field, 37°00.37′N, 25°09.23′W, alt. 20 m, on *Metrosideros*, 12 Sept. 2019, P. & B. van den Boom 58674a, tlc 1288m719: sekikaic acid, terpenoids; NNE of Santa Barbara, near Pico do Norte, N of picnic area, just S of Norte, small forest with mainly *Myrica faya*, along secondary road, 37°00.18′N, 25°03.77′W, alt. 225 m, on unidentified tree, 16 Sept. 2019, in P. & B. van den Boom 58982; id., P. & B. van den Boom 58984, tlc 1284m548: sekikaic acid.

Ramalina subgeniculata Nyl.

CORVO. NNE of Vila do Corvo, E of volcano, playground and forestal area, Parc da Quinta, walls of stones and small forests, 39°41.87′N, 31°05.14′W, alt. 205 m, on *Pittosporum*, 14 Sept. 2023, P. & B. van den Boom 62305, tlc 1289m740: divaricatic, salazinic acids, traces, terpenoids; id., on *Pittosporum*, 14 Sept. 2023, P. & B. van den Boom 62259, tlc 1284m555: divaricatic acid, terpenoids; id., on Sambucus, 14 Sept. 2023, P. & B. van den Boom 62267, tlc 1284m546: divaricatic acid, terpenoids B, trace salazinic acid; id., on *Citrus*, 14 Sept. 2023, P. & B. van den Boom 62285 (herb. P. van den Boom, B 60 0210840), tlc 1284m560: divaricatic, salazinic acids, terpenoids B; id., on fallen branch, 14 Sept. 2023, P. & B. van den Boom 62297, tlc 1289m746: divaricatic, tr. salazinic acids, traces, terpenoids; id., on *Pittosporum*, Sept. 2023, P. & B. van den Boom 62261, tlc 1305n394: divaricatic acid, terpenoids; id., on *Pittosporum* branch, Sept. 2023, P. & B. van den Boom 62305, tlc 1289m740: divaricatic, salazinic acids, traces, terpenoids; id., P. & B. van den Boom 62306. tlc: 1305n387: usnic, divaricatic acids.

FAIAL. E side of the centre of the island, NNW of Flamengos, Jardim Botanico de Pedro Miquel, area with swamps and mainly *Erica azorica*, with some mixed trees, including *Frangula azorica*, 38°35.00′N, 28°39.36′W, alt. 400 m, on *Frangula azorica*, 3 Jun. 2016, P. & B. van den Boom 55378, tlc 1284m545: divaricatic acid, terpenoids; W of Castelo Branco, Morro de Castelo Branco, just E of the mountain, coastal area with abundantly *Erica azorica* and volcanic outcrops, 38°31.52′N, 28°44.82′W, alt. 80 m, on acidic rock, 4 Jun. 2016, P. & B. van den Boom 55449, tlc 1305n385: salazinic acid; W side of the island, Praia do Norte, centre, in front of restaurant, solitar unidentified tree along the road, 38°35.97′N, 28°45.66′W, alt. 270 m, on unidentified tree, 31 May 2016, P. & B. van den Boom 55130, tlc 1284m544: divaricatic acid, terpenoids.

FLORES. between Cedros and Ponte Delgada, NE of Alto da Corva, road to Ponta Ruiva, ~200 m from crossing with ER1, 39°29.38′N, 31°10.22′W, alt. 445 m, on *Pittosporum*, 17 Sept. 2023, P. & B. van den Boom 62066, tlc 1288m711: tr. usnic, divaricatic, salazinic acids, traces, terpenoids; Floras, Wanderweg in den Klippen zw. Ponta da Faja und Fora da Rocha, alt. 90 m, *Eucalyptus globulus* fallen branch, F. Priemetzhofer 4604 (LI 754332), tlc 1302n272: divaricatic acid, many terpenoids; N of Lajes das Flores, Fazenda das Lajes, centre, small parkland, mixed trees and shrubs, including mature *Metrosideros*, 39°23.32′N, 31°09.97′W, alt. 120 m, on unidentified shrub, 18 Sept. 2023, P. & B. van den Boom 62140, tlc m713: tr. usnic, divaricatic, salazinic acids, traces, terpenoids; SSE of Fajã Grande, Cuada, very old renovated small village, walls of acidic stones, shrubs and trees in gardens, alt. 140 m, on *Camellia*, Sept. 2023, P. & B. van den Boom 61779; WSW of Lajes, coastal area, miradouro da Fajã do Lopo Vaz, 39°22.53′N, 31°11.73′W, alt. 200 m, on *Lagerstroemia indica*, Sept. 2023, P. & B. van den Boom 61906, tlc 1305n388: tr. usnic, divaricatic acids, terpenoids; id., P. & B. van den Boom 61901, tlc 1305n396: divaricatic acid, traces.

GRACIOSA. WNW of Luz, inside volcano crater, road from tunnel to Centro de Visitantes da Furna do Enxofre, N of the road, open place, including *Castanea* trees, 39°01.55′N, 27°58.54′W, alt. 150 m, on *Castanea*, 13 Sept. 2021, P. & B. van den Boom 60590, tlc 1288m712: tr. usnic, divaricatic acids, traces, tr. salazinic acid, terpenoids; id., on *Myrica*, 13 Sept. 2021, P. & B. van den Boom 60590, tlc 1288m712: tr. usnic, divaricatic acids, traces, tr. salazinic acid, terpenoids.

PICO. SSE of Piedade, Cabeço da Junça, florestal, Parque Matos Souto, mixed trees and shrubs, 38°25.17′N, 28°03.54′W, alt. 150 m, on *Thuja*, 31 Aug. 2017, P. & B. van den Boom 56763, tlc 1289m749: divaricatic acid, traces, terpenoids.

SÃO JORGE. NE of Calheta, Reserva Florestal da Silveira, picnic area, small open forest with mixed trees and shrubs, including *Pinus*, *Cryptomeria*, tree ferns and *Camellia* shrubs, 38°36.79′N, 27°58.62′W, alt. 290 m, on *Thuja*, 5 Sept. 2017, P. & B. van den Boom 57072, tlc 1284m549: divaricatic acid, terpenoids.

SÃO MIGUEL. Lagoa Azul, 37.87493°N, 25.79012°W, alt. 260 m, 19 Sept. 2011, F. Schumm 17339 (herb. F. Schumm), tlc 1316n841: tr. usnic, divaricatic, salazinic acids; NW of Ponta Delgada, E of Sete Cidades, peninsula 'Tufo' in Lagoa Azul, mixed trees along trail along lake, 37°51.55′N, 25°47.10′W, alt. 275 m, on *Laurus*, 25 Oct. 2011, P. & B. van den Boom 46587, tlc 1288m715: tr. usnic, divaricatic acids, traces, terpenoids; id., on bark of fallen branch, 25 Oct. 2011, P. & B. van den Boom 46589, tlc 1288m724: tr. usnic, divaricatic, salazinic acids, traces, terpenoids; NW of Ponta Delgada, road to Sete Cidades, SE of village, near viewpoints between Lagoa de Santiago and Lagoa Verde, 37°51.10′N, 25°46.00′W, alt. 440 m, on young *Quercus* trunk, 8 cm, 25 Oct. 2011, P. & B. van den Boom 46538, tlc 1289m741: divaricatic, salazinic acids, traces, terpenoids; Sete Cidades, Lagoa Azul, W-Ufer, alt. ~250 m, 27 Apr. 2017, O. Breuss 33845 (herb. Breuss), tlc 1306n419: divaricatic acid, terpenoids; Lagoa das Furnas, Ost-Seite, div. Bäume am Strassenrand, alt. 300 m, *Camellia sinensis*, 26 Jul. 2003, F. Priemetzhofer 5157 (LI 754335), tlc 1302n268: divaricatic acid, many terpenoids.

SANTA MARIA. S of Santo Espirito, S of Cardal, trail in forest along brooklet, with mainly *Picconia* and *Pittosporum* trees, 36°56.09′N, 25°03.01′W, alt. 180 m, on *Eucalyptus*, 17 Sept. 2019, P. & B. van den Boom 59103, tlc 1289m745: usnic, divaricatic, tr. salazinic acids, traces, terpenoids.

Ramalina subpusilla (Nyl.) Krog & Swinscow

CORVO. NNE of Vila do Corvo, miradouro do Portao, W exposed slope, open area with mainly *Erica azorica*, alt. 100 m, on *Erica*, Sept. 2023, P. & B. van den Boom 62307, tlc 1305n389: usnic, salazinic acids.

Appendix 1. Continued.

FAIAL. E side of the island, ESE of Flamengos, Botanical Garden, with mixed trees and shrubs, 38°33.03′N, 28°38.36′W, alt. 100 m, on *Aesculus*, 1 Jun. 2016, P. & B. van den Boom 55165, tlc 1284m538: tr. usnic, salazinic acid; E side of the island, N of Horta, Porto da Boca da Ribeira, coastal area with wooden fence posts along meadow and small road, 38°35.48′N, 28°36.15′W, alt. 40 m, on wood of fence post, 2 Jun. 2016, P. & B. van den Boom 55266, tlc 1284m537: tr. usnic, salazinic acid; W of Castelo Branco, Morro de Castelo Branco, just E of the mountain, coastal area with abundant *Erica azorica* and volcanic outcrops, 38°31.52′N, 28°44.82′W, alt. 80 m, on *Erica azorica*, 4 Jun. 2016, P. & B. van den Boom 55453, tlc 1284m550: tr. usnic, salazinic acid; W side of island, NNE of Praia do Norte, Baia da Ribeira das Cabras, coastal area, some scattered trees, outcrops and walls with volcanic stones along field, 38°36.72′N, 28°45.74′W, alt. 35 m, on *Erica azorica*, 31 May 2016, P. & B. van den Boom 55109, tlc m710: salazinic acid.

FLORES. Ponta Ruiva, 39°29′41″N, 31°09′24″W, *Erica azorica*, 24 Apr. 2025, F. Rodrigues Ra 02 (Fl2) (B 60 0211546), tlc 1304n361: salazinic acid; id., F. Rodrigues Ra 03 (Fl3) (B 60 0211547), tlc 1304n362: salazinic acid.

GRACIOSA. WSW of Luz, area of Carapacho, coastal area, roadside trees, including *Tamarix* and wall of stones along fields with a few *Populus* trees, 39°00.58′N, 27°58.04′W, alt. 50 m, on stone of wall, 11 Sept. 2021, P. & B. van den Boom 60493, tlc 1257l477: no substances.

PICO. E of Madalena, Parque Florestal da Quinta das Rosas, botanical garden with mixed shrubs and trees, including some exotic trees, 38°31.38′N, 28°29.38′W, alt. 150 m, on *Olea*, 29 Aug. 2017, P. & B. van den Boom 56589, tlc 1289m743: usnic, salazinic acids, terpenoids.

SÃO JORGE. Velas, Morro Grande, Gratzacken an der Westseite, schräge, südostexponierte Tuff und *Erica azorica*, alt. 500 m, *Erica azorica*, 30 Jul. 2003, F. Priemetzhofer 4892 (LI 754334), tlc 1302n273: tr. usnic acid, traces; Velhas, E-Abhang des Morro Grande, 38°40′N, 28°13′W, alt. 80 m, *Erica* Gebüsch, auf *Erica azorica*, 1. Aug. 2001, F. Berger 15895 (herb. F. Berger in LI), tlc 1294m959: tr. usnic, salazinic, consalazinic acids.

TERCEIRA. Angra do Heroismo, Monte Brasil, recreation-ground, small (low) shrubs of *Camellia*, *Tamarix* and old wall of fortress, 38°39.00′N, 27°13.47′W, alt. 60 m, on *Camellia*, 30 Jun. 2014, P. & B. van den Boom 51518, tlc 1289m748: usnic, salazinic acids, terpenoids; Mirodauro do Raminho, 38°46.820′N, 27°21.422′W, alt. ~164 m, 18 Jul. 2008, F. Schumm 14250 (herb. F. Schumm), tlc 1316n840: tr. usnic, salazinic acids; Monte Brasil, 38°38′37″N, 27°13′58″W, on *Erica azorica*, 17 May 2025, F. Rodrigues Ra 56 (MB7) (B 60 0211591), tlc 1308n499: usnic, salazinic acids; id., F. Rodrigues Ra 67 (MB19) (B 60 0211594), tlc 1308n509: salazinic acids; Relvão, 38°39′00″N, 27°13′24″W, on exotic tree, 4 May 2025, F. Rodrigues Ra 70 (RV1) (B 60 0211595), tlc 1308n511: salazinic acid; WNW of Vila Nova, SW of Furnas das Pombas, coastal area, Farroco, small trail to the coast from road EN1, rather shaded area with mixed trees and shrubs, 38°47.71′N, 27°11.99′W, alt. 25 m, on unidentified shrub, 3 Jul. 2014, P. & B. van den Boom 51797, tlc 1289m747: usnic, salazinic acids, terpenoids; Monte Brasil, 38°38′54″N, 27°13′48″W, on *Cryptomeria japonica*, 17 May 2025, F. Rodrigues Ra 58 (MB9) (B 60 0211592), tlc subpusilla 1308n500: salazinic acid.

SÃO MIGUEL. Batalha, 37°48′14″N, 25°38′02″W, exotic tree, 28 May 2024, F. Rodrigues Ra 36 (3.1) (B 60 0211548), tlc 1304n363: salazinic acid; id., F. Rodrigues Ra 44 (10) (B 60 0211549), tlc 1304n364: salazinic acid; Lagoa Azul, 37.87493°N, 25.79012°W, alt. 260 m, 19 Sept. 2011, F. Schumm 17343 (herb. F. Schumm), tlc 1316n839: tr. usnic, salazinic acids; NW of Ponta Delgada, E of Sete Cidades, peninsula 'Tufo' in Lagoa Azul, mixed trees along trail along lake, 37°51.55′N, 25°47.10′W, alt. 275 m, on bark of fallen branch, 25 Oct. 2011, P. & B. van den Boom 46590b, tlc 1288m726: usnic, salazinic acids; Lagoa das Furnas, NW-Ufer, alt. ~300 m, 26 Apr. 2017, O. Breuss 33798 (herb. Breuss), tlc 1306n418: usnic acid (cf.).

SANTA MARIA. NNE of Santa Barbara, near Pico do Norte, N of picnic area, just S of Norte, small forest with mainly *Myrica faya*, along secondary road, 37°00.18′N, 25°03.77′W, alt. 225 m, on *Myrica faya*, 16 Sept. 2019, P. & B. van den Boom 58982, tlc 1289m744: usnic, salazinic acids, terpenoids.

Ramalina wirthii Aptroot & Schumm

FAIAL. Laginha, 4 km W of Horta, maritime lava rock, July 1986, A. Aptroot 16427 (B), tlc 1306n445: tr. usnic, salazinic acids ("*Ramalina nematodes*").

FLORES. Fajãzinha, 39°26′18″N, 31°15′10″W, on volcanic stone, 12 Aug. 2021, F. Rodrigues 437 (M-0366251), tlc 1309n543: salazinic acid ("*Ramalina decipiens*"); Fajãzinha, 39°26′04″N, 31°15′06″W, volcanic stone, 12 Aug. 2021, F. Rodrigues Ra 41 (5) (B 60 0211552), tlc 1304n343: salazinic acid; N of Fajã Grande, N of Igreja de Nossa Senhora Do Carmo, small trail, coastal area, along very high steep rock face, 39°28.53′N, 31°15.40′W, alt. 400 m, on siliceous rock outcrop, 10 Sept. 2023, P. & B. van den Boom 61921, tlc 1288m704: tr. usnic, salazinic acids, few terpenoids; Ponta Ruiva, 39°29′41″N, 31°09′24″W, trachybasalt stone, 24 Apr. 2025, F. Rodrigues Ra 04 (Fl4) (B 60 0211550), tlc 1304n368: salazinic acid; id., F. Rodrigues Ra 05 (Fl5) (B 60 0211551), tlc 1304n369: salazinic acid; S of Cedros, Parc de campismo e Lazer da Alagoa, wall of acidic stones, wood of fence, unidentified shrubs, 39°28.50′N, 31°08.93′W, alt. 45 m, on stone wall, 16 Sept. 2023, P. & B. van den Boom 62012a, tlc 1289m751: usnic, salazinic acids.

GRACIOSA. WSW of Luz, area of Carapacho, coastal area, roadside trees, including *Tamarix* and wall of stones along fields with a few *Populus* trees, 39°00.58′N, 27°58.04′W, alt. 50 m, on *Tamarix*, 11 Sept. 2021, P. & B. van den Boom 60479 (herb. P. van den Boom, B 60 0166267), tlc 1268l923: salazinic acid.

SÃO JORGE. Velas, Klippenbereich beim Sea-pool, alt. 3 m, Basalt, 01 Aug. 2003, F. Priemetzhofer 4674 (LI 754320), tlc 1301n238: tr. usnic, salazinic acids ("*Ramalina hamulosa*"); Velas, Klippenbereich W des Meerwasserschwimmingpool, alt. 5 m, Basalt, 29 Aug. 2003, F. Priemetzhofer 4810 (LI 754313), tlc 1301n221: tr. usnic, salazinic acids ("*Ramalina decipiens*"); id., F. Priemetzhofer 4811 (LI 754314), tlc 1301n224: tr. usnic, salazinic acids ("*Ramalina decipiens*"); id., F. Priemetzhofer 4817 (LI 754321), tlc 1301n239: tr. usnic, salazinic acids ("*Ramalina hamulosa*"); Velas, S side of the town. near natural swimming pool, volcanic outcrops at coast, 38°40.70′N, 28°12.55′W, alt. 9 m, on volcanic rock, 7 Sept. 2017, P. & B. van den Boom 57210a, tlc 1288m699: tr. usnic, salazinic acids, few terpenoids; Velas, 38°40′51″N, 28°12′48″W, basalt, 5 May 2024, F. Rodrigues Ra 40 (4) (B 60 0211555), tlc 1304n371: salazinic acid.

TERCEIRA. Monte Brasil, 38°38′44″N, 27°13′42″W, on volcanic tuff, 17 May 2025, F. Rodrigues Ra 61 (MB12) (B 60 0211597), tlc 1308n503: salazinic acid; id., F. Rodrigues Ra 60 (MB11) (B 60 0211596), tlc 1308n502: usnic, salazinic acids; (c. apoth.); São Mateus, 38°39′17″N, 27°15′21″W, basalt, 12 Apr. 2025, F. Rodrigues Ra 29 (2.2) (B 60 0211554), tlc 1304n370: salazinic acid; id., F. Rodrigues Ra 35 (2.8) (B 60 0211553), tlc 1304n341: salazinic acid.

SÃO MIGUEL. N of Nordeste, trail NE of Lomba Fazenda, Parque de Endémicas, coastal area with mainly *Erica azorica* shrubs and shaded and sheltered volcanic outcrops in small valley, 37°51.00′N, 25°09.10′W, alt. 30 m, on volcanic rock outcrop, 29 Oct. 2011, P. & B. van den Boom 46779, tlc 1288m702: tr. usnic, salazinic acids, few terpenoids; id., P. & B. van den Boom 46766, tlc 1288m703: tr. usnic, salazinic acids, few terpenoids.