

Further new or interesting lichens and lichenicolous fungi from Madeira with notes on the genus *Gyalidea* in Macaronesia

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Abstract: As a contribution to the lichen mycota of the island Madeira (Macaronesia), 62 taxa of lichens and lichenicolous fungi are reported for the first time, including 7 taxa new to Macaronesia: *Acrocordia cavata*, *Amandinea efflorescens*, *Diplolaeviopsis ranula*, *Lecanora albellula* var. *macroconidiata*, *Lecanora sarcopidooides*, *Scoliciosporum gallurae*, and *Thelidium minutulum*. A new species, *Gyalidea subminuta*, is described from Madeira, and a key for the genus *Gyalidea* in Macaronesia is added.

Keywords: Azores, Canary Islands, lichenized and lichenicolous fungi, new species

INTRODUCTION

Madeira is an island situated in the Atlantic ocean, c. 600 km from the African coast. Together with the Selvagens, the Azores, the Canary Islands and the Cape Verde Islands, it is taken together phytogeographically as Macaronesia. The main island of Madeira has an area of c. 740 km², with a length of 58 km and a width of 23 km. Information about geology, climate etc. can be found in Sziemer (2000). The island consists of one big mountain range with (small) deep valleys and steep slopes. Steep cliffs dominate along the coasts, and the highest point is Pico Ruivo, 1862 m. The dominant rocks are basalt and tuff. The climate is equal and favourable throughout the year. North-easterly trade winds ensure an ample supply of moist sea air, mainly at higher altitudes. Due to the east-west orientation of the mountains, there is a marked climatic difference between the north side and the south side. On the north side, annual precipitation values are 1500–2500(–3000) mm (Tavares, 1965; Sziemer, 2000) and most precipitation falls between 700 and 1200 m. The south side of the island is drier and in coastal areas the annual precipitation is less than 600 mm. A sophisticated system of irrigation channels (levadas) crosses the island and transports water from the rainy inside of the island into the arid coastal regions. These levadas extend over 1,350 miles (2,170 km) and provide a remarkable network of walking paths.

The mean temperature of the coldest and warmest months are 15 °C and 22 °C in Funchal on the south coast and 8 °C and 16 °C at Encumeada in the central highlands (Tavares,

1965). In the summit region temperatures below the freezing point occur, so that snowfall is possible. At a smaller scale there are considerable microclimatic differences due to the high structural diversity of the landscape.

Madeira is well known for its high endemism in flowering plants and for the evergreen subtropical cloud forest, known as the laurisilva (Kunkel, 1980). An overview of the Madeiran flora is presented by Sziemer (2000). The island was once extensively forested (the name Madeira means wood). Nowadays forests cover just 20% of the land surface, but the island still hosts the largest expanse of laurel forest in the world, which is best developed at 700–1200 m on the south flank of the island and between 300–1300 m on the north flank. At sites of deforestation heathland evolved, which is also of considerable ecological value. At higher altitudes, tree heath (*Erica arborea* and *E. scoparia*) and shrubs or trees of *Myrica faya* dominate. The coastal zone consists of thickets composed of various shrubs, annuals and succulents and has a Mediterranean character. Due to the widespread urbanisation, only small areas are accessible.

The first checklist for Macaronesian lichens and lichenicolous fungi, including Madeira, was published by Tavares (1952). A new version and several updates were published by Hafellner (1995, 1999, 2002, 2005, 2008). The most recent checklist is by Carvalho et al. (2008). Foliicolous lichens from Madeira were treated by Sérusiaux (1996). Further information on lichens and lichenicolous fungi of Madeira was provided by

Pišút (2009), Sérusiaux et al. (2007), Flakus & Kukwa (2011), Breuss (2012), Lücking & Breuss (2012), Aptroot & Schumm (2012) and van den Boom & Ertz (2014). Schumm (2008) and Schumm & Aptroot (2013) published two attractive colour guides of selected lichens of Madeira, the Canaries and the Azores. Altogether about 800 lichen species are known from Madeira.

Based on the materials collected in 2012, one species is described here as new to science and another 61 taxa are recorded new to the island.

MATERIALS AND METHODS

In 2012 the author and his wife, Bern van den Boom, collected about 650 specimens of lichens and lichenicolous fungi on Madeira. All specimens have been studied by conventional macro- and microscopical techniques with hand-cut sections of the material mounted in water. Spore sizes were measured in water. Amyloid reactions were tested using Lugol's iodine solution (K/I). The secondary metabolites of several specimens were analysed by TLC (Orange et al., 2001). Geographical coordinates were obtained from GPS. Voucher specimens are kept in the herbarium of P. van den Boom (B before the herbarium number), some duplicates are in the herbarium of Berlin (B).

Sampling localities on Madeira

1. N of Funchal, Largo da Fonte, near church Igreja Matriz de Nossa Senhora de Monte, 32°40.5'N, 16°54.2'W, 580 m, 26 April 2012.
2. N of Funchal, E of church, Quinta do Monte, botanical garden, 32°40.6'N, 16°54.05'W, 590 m, 26 April 2012.
3. N of Funchal, Jardins do Imperador, botanical garden, 32°40.6'N, 16°54.1'W, 590 m, 26 April 2012.
4. Funchal, centre, Jardim de São Francisco, botanical park, 32°38.85'N, 16°54.4'W, 30 m, 26 April 2012.
5. N of Funchal, entrance of Parque Ecológica do Funchal, 32°41.86'N, 16°54.51'W, 1000 m, 27 April 2012.
6. N of Funchal, 0.5 km S of Ribeiro Frio, roadside picnic area, 32°44.03'N, 16°53.33'W, 910 m, 27 April 2012.
7. N of Funchal, Ribeiro Frio, trail to the west, to mirador Balcões, 32°44.32'N, 16°53.39'W, 900 m, 27 April 2012.
8. NNW of Funchal, W of Ribeiro Frio, Pico do Areeiro, 32°44.17'N, 16°55.71'W, 1820 m, 27 April 2012.
9. N of Funchal, E of Poiso, near João do Prado, 32°43.11'N, 16°51.72'W, 1240 m, 27 April 2012.
10. NE of Funchal, Santo da Serra, centre of village, botanical garden, 32°43.51'N, 16°49.12'W, 700 m, 28 April 2012.
11. NE of Funchal, W of Portela, trail to the west, along levada, 32°44.68'N, 16°49.92'W, 665 m, 28 April 2012.
12. NW of Funchal, c. 1 km N of Boca da Encumeada, small picnic area, 32°45.36'N, 17°1.12'W, 860 m, 30 April 2012.
13. NW of Funchal, c. 1.5 km S of Vargem, 32°45.74'N, 17°1.27'W, 745 m, 30 April 2012.
14. NW of Funchal, c. 1.5 km N of Boca da Encumeada, 32°45.64'N, 17°1.08'W, 820 m, 30 April 2012.
15. NW of Funchal, c. 1 km N of Boca da Encumeada, trail Vereda do Chao dos Louros, 32°45.5'N, 17°1.1'W, 880 m, 30 April 2012.
16. NW of Funchal, near mirador of Boca da Encumeada, trail from Vereda da Encumeada, to Pico Ruivo, 32°45.2'N, 17°1.08'W, 1045 m, 30 April 2012.
17. SE of Santana, along road ER103, S of Faial, c. 1 km S of village, 32°47.08'N, 16°51.13'W, 100 m, 1 May 2012.
18. SSW of Santana, Casa das Quemadas, trail from big picnic area to the southwest, 32°4.7'N, 16°54.4'W, 900 m, 1 May 2012.
19. N of Funchal, Ribeiro Frio, Posto Florestal, small botanical garden, 32°44.01'N, 16°53.23'W, 925 m, 1 May 2012.
20. N of Funchal, Ribeiro Frio, trail (PR10) to Portelo, Levada do Furado, 32°44.24'N, 16°53.19'W, 950 m, 1 May 2012.
21. W side of island, road (ER110) from Rabaçal to Porto Moniz, trail to the east, NW of Pico da Fonte do Bispo, in area Ribeira da Janela, 32°47.81'N, 17°11.07'W, 1230 m, 2 May 2012.
22. W side of island, road (ER110) from Rabaçal to Porto Moniz, trail to the east, NW of Pico da Fonte do Bispo, in area Ribeira da Janela, 32°47.84'N, 17°10.88'W, 1110 m, 2 May 2012.
23. W side of island, road (ER209) from Paul da Serra to Ribeira da Janela, Fanal, 32°48.58'N, 17°8.58'W, 1150 m, 2 May 2012.

24. W side of island, road (ER209) from Paul da Serra to Ribeira da Janela, NW of Fanal, 32°49.38'N, 17°9.38'W, 1080 m, 2 May 2012.
25. W side of island, road (ER209) from Paul da Serra to Ribeira da Janela, W of Fanal, 32°49.11'N, 17°9.34'W, 1100 m, 2 May 2012.
26. NNW of Funchal, Curral das Freiras, NE side of village, near entrance of tunnel, 32°43.43'N, 16°57.83'W, 760 m, 3 May 2012.
27. Funchal, west side of city, Santa Catarina park, 32°38.7'N, 16°54.86'W, 35 m, 3 May 2012.

NOTES ON THE GENUS *GYALIDEA* IN MACARONESIA

Gyalidea subminuta van den Boom sp. nov. (Fig. 1)

Mycobank No.: MB 811456

Thallus of densely aggregated, vertically proliferating goniocysts of 20–40 µm diameter. Apothecia sessile, pale to dark greyish, translucent when wet, 0.2–0.5 mm diameter, disc plane. Ascospores ellipsoid, submuriform with 3–4 transverse septa and mostly one longitudinal septum or occasionally 1–2 oblique septa, mostly constricted at the median septum, 15–18 × 6–9 µm.

Type: Portugal. Madeira, NW of Funchal, road (ER228) from Ribeira Brava to São Vicente, c. 1.5 km N of Boca da Encumeada, large picnic area with open laurisilva, including very small young trees of 2 cm diameter, 820 m, 30 April 2012, P. & B. van den Boom 47757 (holotype B!, isotype hb. v.d. Boom!).

Description: Thallus corticolous, pale grey green to light green, of scattered to often densely aggregated, globose, mostly vertically proliferating goniocysts of 20–40 µm diam., which often form elongate clusters up to 200 µm length, outer hyphae of coniocysts hyaline. Prothallus absent. Photobiont *Cystococcus*-like. Apothecia numerous, sessile, pale to dark greyish, translucent when wet, 0.2–0.5 mm diam., inconspicuous. Disc persistently plane to slightly concave. Excipulum well developed, hyaline, radiating hyphae of c. 2 µm wide, bound in a

gelatinous matrix. Hymenium 100–150 µm high, colourless. Hamathecium of abundant, simple paraphyses, c. 1 µm wide, not thickened at the apices, bounded with the asci by a gelatinous matrix. Asci 8-spored, broadly clavate to subspherical, thin-walled, with a slightly thickened apical tholus, K/I-. Ascospores ellipsoid, with rounded ends, submuriform, with 3–4 transverse septa and mostly one longitudinal septum, or occasionally one or two oblique septa, mostly constricted at the median septum, 15–18 × 6–9 µm. Pycnidia not observed.

Chemistry: Thallus K-, C-, KC-, Pd-, no compounds detected.

Etymology: The epithet refers to the similarity of the habitus to *Gyalidea minuta*.

Distribution and ecology: Known from the type collection on a trunk of a medium size *Laurus* tree, on a clearing at the edge of a small laurisilva area. Accompanying species were scarce, only one crustose species, *Coenogonium* sp., and two macrolichens, *Heterodermia* sp. and *Leptogium* sp., have been found.

Remarks: The new species is most similar to *Gyalidea minuta* van den Boom & Vězda, but this species differs in having an inconspicuous, thin thallus without goniocysts and smaller apothecia of 0.15–0.2 mm, and the ascospores are more clearly constricted at all septa (van den Boom & Vězda, 1995). The new species also resembles *Gyalidea cylindrica* Etayo & Vězda, but that species differs in its muscicolous life habit, much smaller apothecia, and larger, transversely 5–7-septate ascospores measuring ca. 20–30 × 6–7 µm (Etayo & Vězda, 1994). In a survey of the genus *Gyalidea*, Vězda & Poelt (1991) treated 24 species, but only one of them, *G. parvula* Kalb & Vězda, is corticolous. This species, so far known from Ecuador, has smaller apothecia of 0.12–0.2 mm diam. and pauciseptate ascospores measuring 16–22 × 8–12 µm.

In the most recent paper about *Gyalidea* (Aptroot & Lücking, 2003), a phylogenetic analysis about the family Asterothyriaceae is given and no further new species described. The most important conclusion is, that a phenotype-based phylogenetic analysis does not support the generic separation of *Solorinella* from *Gyalidea*. The conservation of *Gyalidea* over *Solorinella* is recommended.

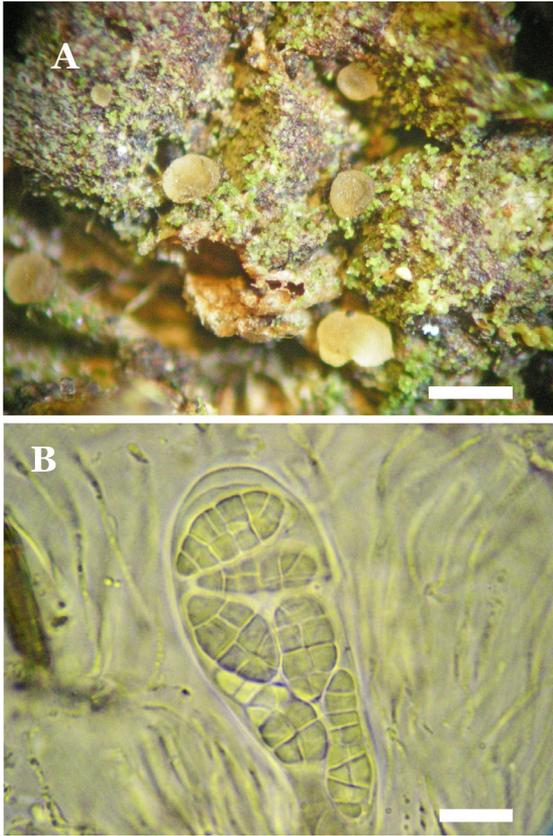


Fig. 1. *Gyalidea subminuta*, holotype.
 A – Thallus and apothecia. Scale: 0.5 mm;
 B – Ascospores in an ascus. Scale: 10 µm.

Key to the *Gyalidea* species in Macaronesia
 (A = Azores, C = Canary Islands, M = Madeira)

1. Apothecia conspicuous, 0.5–1 mm diam., orange to brown (A) *G. hyalinescens*
 – Apothecia not conspicuous, 0.15–0.6 mm diam., of different colour 2
2. Apothecia whitish to grey-brown, not translucent when wet; ascospores 10–12(–15) µm wide (C) *G. lecideopsis*
 – Apothecia greyish or dark brown black, translucent when wet or not; ascospores 5–9 µm wide 3
3. Apothecia dark brown black, not translucent when wet; ascospores 3–5-septate (M) *G. madeirensis*
 – Apothecia greyish, translucent when wet; ascospores submuriform (M) *G. subminuta*

SPECIES NEW TO MADEIRA

Lichenicolous fungi are marked with #.

ACROCORDIA CAVATA (Ach.) R.C. Harris – Loc. 11, on *Laurus* trunk, B47704. This species is known from Europe, including British Islands and N. America (Smith et al., 2009). It was not reported from Macaronesia so far.

ACAROSPORA VERONENSIS A. Massal. – Loc. 9, on volcanic rock, B47602.

AMANDINEA EFFLORESCENS (Müll. Arg.) Marbach – Loc. 3, on mature *Quercus* trunk, B47467. This species is widely distributed in the tropics and was previously not reported from Macaronesia.

ANISOMERIDIUM POLYPORI (Ellis & Everh.) M.E. Barr – Loc. 10, on rather sheltered, unidentified tree, B47600.

#*ARTHONIA VARIANS* (Davis) Nyl. – Loc. 8, on *Lecanora rupicola* on basalt, B47578.

BACIDIA CANARIENSIS Erichsen – Loc. 11, on *Acer* tree at edge of laurisilva, B47701.

BACIDIA NEOSQUAMULOSA Aptroot & van Herk – Loc. 13, on stones on soil along trail, B47726.

BACIDIA aff. *PARAMEDIALIS* M. Brand, Coppins, van den Boom & Sérus. – Loc. 19, on branch of *Clethra* tree, B47866. The ascospores are 8–10-septate, 25–37 x 5 µm. Brand et al. (2009) give the ascospores as (5–)7–9-septate, (19–)22–31(–34) x 4–5 µm.

BACIDIA SIPMANII M. Brand, Coppins, van den Boom & Sérus. – Loc. 7, on rather shaded, steep, volcanic outcrop, B47547.

BACIDINA ARNOLDIANA (Körb.) V. Wirth & Vězda – Loc. 7, on very shaded, steep, volcanic outcrop, B47546.

BIATORA BRITANNICA Printzen, Lumbsch & Orange – Loc. 11, on *Acer* tree at edge of laurisilva, B47665.

BOTRYOLEPRARIA LESDAINI (Hue) Canals, Hernández-Mariné, Gómez-Bolea & Llimona – Loc. 7, on shaded surface of wall, B47564.

BRYOBILIMBIA HYPNORUM (Lib.) Fryday, Printzen & Ekman – Loc. 26, on volcanic rock, B48076.

BUELLIA ERUBESCENS Arnold – Loc. 6, on wood of bench, B47524.

BUELLIA OCELLATA (Flot.) Körber – Loc. 9, on basalt outcrops, B47604.

BUELLIA SEQUAX (Nyl.) Zahlbr. – Loc. 21, on low volcanic rock in meadow, B47913.

CALICIUM HYPERELLOIDES Nyl. – Loc. 24, on *Erica* trunk, B48013.

CALOPLACA FLAVOCITRINA (Nyl.) H. Olivier – Loc. 1, on horizontal surface of wall, B47443.

- CALOPLACA SCOTOPLACA (Nyl.) H. Magn. – Loc. 26, on volcanic outcrops, B48109.
- CLADONIA CILIATA Stirt. – Loc. 24, on soil, B48017, B.
- CLADONIA CYATHOMORPHA Stirt. ex Walt. Watson – Loc. 9, on *Pinus* trunk, B47591, B.
- CLADONIA DIDYMA (Fée) Vainio – Loc. 9, on *Pinus* trunk at edge of *Pinus* forest, B47590, B. This species is common and widely distributed in tropical areas, and previously reported from the Azores as *Cladonia vulcanica* Zoll. (Aptroot, 1989).
- CLADONIA HUMILIS (With.) J.R. Laundon – Loc. 22, on exposed soil, B47936.
- COENOGONIUM TAVARESIANUM (Vězda) Lücking, Aptroot & Sipman – Loc. 3, on mature *Cupressus*, B47459; on mature *Quercus* (1 m diam.), B47468. This species was previously known from south-western and Mediterranean Europe and from the Azores (Aptroot et al., 2009).
- COLLEMA POLYCARPON Hoffm. – Loc. 17, on vertical, exposed, volcanic rock, B47919.
- #CORTICIFRAGA FUCKELII (Rehm) D. Hawksw. & R. Sant. – Loc. 22, on *Peltigera* on soil, B47946.
- #DIPLOLAEVIOPSIS RANULA Giralt & D. Hawksw. – Loc. 10, on *Lecanora strobilina* on *Picea* trunk, B47635.
- #HAWKSWORTHIANA PELTIGERICOLA (D. Hawksw.) U. Braun – Loc. 22, on *Peltigera* on soil along trail, B47954.
- HYPOTRACHYNA AFROREVOLUTA (Krog & Swinscow) Krog & Swinscow – Loc. 23, on *Laurus* trunk in meadow, B47974.
- LECANIA HUTCHINSIAE (Nyl.) A.L. Sm. – Loc. 1, on vertical surface of wall, B47438, 47440.
- LECANIA NAEGELII (Hepp) Diederich & van den Boom – Loc. 2, on trunk of unidentified tree, B48102.
- LECANORA ALBELLULA Nyl. var. MACROCONIDIATA M. Brand & van den Boom – Loc. 6, on wood of bench, B47527. This variety was described by van den Boom & Brand (2008) and recorded from The Netherlands, Sweden, France and Spain, but not from Macaronesia.
- LECANORA CENISIA Ach. – Loc. 26, on volcanic rock, B48077.
- LECANORA SARCOPIDOIDES (A. Massal.) A.L. Sm. – Loc. 3, on mature *Quercus* trunk (1 m diam.), B47471. In van den Boom & Brand (2008) this species is mentioned from central and western Europe, but not from Macaronesia.
- LECANORA SYMMICTA (Ach.) Ach. (s.l.) – Loc. 6, on wood of bench, B47511.
- LECIDELLA CARPATHICA Körb. – Loc. 21, on volcanic outcrops in meadow, B47912.
- LECIDELLA SCABRA Körb. – Loc. 17, on vertical surface of volcanic outcrop, B47820; Loc. 26, on volcanic outcrops, B48088.
- LEPTOGIUM TERETIUSCULUM (Wallr.) Arnold – Loc. 5, on aged roadside *Cupressus* tree (1 m diam.), B48104; Loc. 11, on mature *Acer* tree, B47671.
- MEGALARIA GROSSA (Pers. ex Nyl.) Hafellner – Loc. 12, on *Laurus*, B47720; Loc. 18, on *Dombeya* trunk, B47843.
- MEGALOSPORA TUBERCULOSA (Fée) Sipman – Loc. 5, on aged roadside *Cupressus* tree (1 m diam.), B47490.
- MICAREA DOLIIFORMIS (Coppins & P. James) Coppins & Sérus. – Loc. 3, on base of *Cryptomeria* trunk, B47474.
- MICAREA MICROCOCCA (Körb.) Gams ex Coppins – Loc. 18, on branch of *Clethra* tree, B47852.
- MICAREA VIRIDILEPROSA Coppins & van den Boom – Loc. 11, on *Cryptomeria* trunk, B47687; on soil, B47678.
- #MUELLERELLA LICHENICOLA (Sommerf.: Fr.) D. Hawksw. – Loc. 2, on *Schismatomma* sp. on unidentified tree, B48103.
- OCHROLECHIA TURNERI (Sm.) Hasselrot – Loc. 24, on *Erica* shrub, B48034.
- PARMELINOPSIS aff. CRYPTOCHLORA (Vainio) Elix & Hale – Loc. 9, on *Pinus* tree, B47593. Atranorin, 3-methoxy-2,4-di-O-methylgyrophoric acid, 5-O-methylhiascic acid present (TLC).
- PELTIGERA NECKERI Müll. Arg. – Loc. 16, on facing soil, B47810.
- PELTULA OBSCURANS (Ach.) Poelt – Loc. 27, on stones on soil, B48094.
- PORINA AENEA (Wallr.) Zahlbr. – Loc. 3, on *Acer* trunk, B47482.
- PORINA CORALLOIDEA P. James – Loc. 6, on *Laurus* trunk, B47507.
- PORINA LEPTOSPORA (Nyl.) A.L. Sm. – Loc. 3, on *Laurus* trunk, B47462.
- RHIZOCARPON BADIOATRUM (Spreng.) Th. Fr. – Loc. 21, on volcanic rock, B47914.
- RHIZOCARPON REDUCTUM Th. Fr. – Loc. 21, on low, volcanic rock in meadow, B47918.

- RINODINA ALGARVENSIS Giralt, M. Barbero & van den Boom – Loc. 18, on small stones of pavement, B48091; Loc. 26, on worked, volcanic stone, B47837.
- SCOLIOSPORUM GALLURAE Poelt & Vězda – Loc. 2, on *Myrica* trunk, B47451.
- #SKYTTEA CAESII Diederich & Etayo – Loc. 24, on sorediate crust on *Erica* shrub, B48012.
- #SKYTTEA PYRENULAE Diederich, Etayo & Coppins – Loc. 11, on *Pyrenula occidentalis* on *Acer* trunk, B47677.
- THELIDIUM MINUTULUM Körb. – Loc. 13, on stones on soil, B47722.
- TRAPELIA GLEBULOSA (Sm.) J.R. Laundon – Loc. 26, on volcanic outcrops, B48084.
- TREMOLECHIA ATRATA (Ach.) Hertel – Loc. 8, on N exposed basalt, B47579.
- USNEA ESPERANTIANA P. Clerc – Loc. 10, on *Prunus* tree, B47662.

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REFERENCES

- Aptroot, A. 1989. Contribution to the Azores lichen flora. *Lichenologist* 21(1): 59–65. <http://dx.doi.org/10.1017/S0024282989000071>
- Aptroot, A. & Lücking, R. 2003. Phenotype-based phylogenetic analysis does not support generic separation of *Gyalidea* and *Solorinella* (Ostropales: Asterothyriaceae). In: Jensen, M (ed.). *Lichenological Contributions in Honour of G. B. Feige*. *Bibliotheca Lichenologica* 86, J. Cramer, Berlin, Stuttgart, pp. 5–78.
- Aptroot, A. & Schumm, F. 2012. A new terricolous *Trapelia* and a new *Trapeliopsis* (Trapeliaceae, Baeomycetales) from Macronesia. *Lichenologist* 44(4): 449–456. <http://dx.doi.org/10.1017/S0024282912000084>
- Aptroot, A., Schumm, F. & Gabriel, R. 2009. Lichens new to the Azores collected on Terceira. *Herzogia* 22: 147–152.
- Brand, M., Coppins, B., van den Boom, P. P. G. & Sérusiaux, E. 2009. Further data on the lichen genus *Bacidia* s. l. in the Canary Islands and Western Europe, with descriptions of two new species. In: Aptroot, A., Seaward, M. R. D. & Sparrius, L. B. *Biodiversity and Ecology of Lichens. Liber Amicorum Harrie Sipman*. *Bibliotheca Lichenologica* 99. J. Cramer in der Gebrüder Borntraeger Verlagbuchhandlung, Berlin, Stuttgart, pp. 81–92.
- Breuss, O. 2012. Flechtenfunde auf Madeira. *Stapfia* 97: 47–52.
- Carvalho, P., Figueira, R. & Jones, M. P. 2008. Os líquenes e fungos liquenícolas (Fungi) dos arquipélagos da Madeira e das Selvagens. The lichens and lichenicolous fungi (Fungi) of the Madeira and Selvagens archipelagos. In: Borges, P. A. V., Abreu, C., Aguiar, A. M. F., Carvalho, P., Jardim, R., Melo, I., Oliveira, P., Sérgio, C., Serrano, A. R. M. & Vieira, P. *Listagem dos Fungos, Flora e Fauna Terrestres dos Arquipélagos da Madeira e Selvagens. A List of the Terrestrial Fungi, Flora and Fauna of Madeira and Selvagens Archipelagos*. Direcção Regional do Ambiente da Madeira and Universidade dos Açores, Funchal and Angra do Heroísmo, pp. 95–122.
- Etayo, J. & Vězda, A. 1994. Two new species of *Gyalidea* from Europe. *Lichenologist* 26(4): 333–335. <http://dx.doi.org/10.1017/S0024282994000484>
- Flakus, A. & Kukwa, M. 2011. *Lepraria maderensis* Kukwa & Flakus, a new lichen species containing gyrophoric and lecanoric acids. *Nova Hedwigia* 92(1–2): 95–99. <http://dx.doi.org/10.1127/0029-5035/2011/0092-0095>
- Hafellner, J. 1995. A new checklist of lichens and lichenicolous fungi of insular Laurimacaronesia including a lichenological bibliography for the area. *Fritschiana* 5: 1–132.
- Hafellner, J. 1999. Additions and corrections to the checklist and bibliography of lichens and lichenicolous fungi of insular Laurimacaronesia. I. *Fritschiana* 17: 1–26.
- Hafellner, J. 2002. Additions and corrections to the checklist and bibliography of lichens and lichenicolous fungi of Insular Laurimacaronesia. II. *Fritschiana* 36: 1–10.
- Hafellner, J. 2005. Additions and corrections to the checklist and bibliography of lichens and lichenicolous fungi of Insular Laurimacaronesia. III. *Fritschiana* 49: 1–13.
- Hafellner, J. 2008. Additions and corrections to the Checklist and Bibliography of Lichens and Lichenicolous Fungi of Insular Laurimacaronesia. IV. *Fritschiana* 64: 1–28.
- Kunke, G. 1980. *Die Kanarischen Inseln und ihre Pflanzenwelt*. Stuttgart, New York, Gustav Fischer Verlag.

- Lücking, R. & Breuss, O. 2012. A new species of Thelotrema, a new combination, *Leucodecton isidioides*, and a key to thelotremoid lichens of Macaronesia (lichenised Ascomycota: Graphidaceae). *Österreichische Zeitschrift für Pilzkunde* 21: 127–133.
- Orange, A., James, P. W. & White, F. J. 2001. *Microchemical Methods for the Identification of Lichens*. London, British Lichen Society. 101 pp.
- Pišút, I. 2009. Some lichens from the vicinity of Ribeiro Frio (Madeira, Macaronesia). *Acta Mycologica* 44(2): 179–184. <http://dx.doi.org/10.5586/am.2009.016>
- Schumm, F. 2008. *Flechten Madeiras, der Kanaren und Azoren*. Wangen, Selbstverlag.
- Schumm, F. & Aptroot, A. 2013. *Flechten Madeiras, der Kanaren und Azoren*. Band 2. Wangen, Selbstverlag.
- Sérusiaux, E. 1996. Follicolous lichens from Madeira, with the description of a new genus and two new species and a world-wide key of follicolous *Fellhanera*. *Lichenologist* 28(3): 197–227. <http://dx.doi.org/10.1017/S002428299600028x>
- Sérusiaux, E., Berger, F., Brand, M., van den Boom, P. (2007). The lichen genus *Porina* in Macaronesia, with descriptions of two new species. *Lichenologist* 39(1): 15–33. <http://dx.doi.org/10.1017/S0024282907005993>
- Smith, C. W., Aptroot, A., Coppins, B. J., Fletcher, A., Gilbert, O. L., James, P. W. & Wolseley, P. A. (eds) 2009. *The Lichens of Great Britain and Ireland*. London. 1046 pp.
- Sziemer, P. 2000. *Eine kurze Naturgeschichte Madeiras*. Funchal, Francisco Ribeiro & Filhos.
- Tavares, C. N. 1965. Ilha da Madeira. O meio e a flora. *Revista da Faculdade de Ciências de Lisboa*, 2 Ser. 13C(1): 51–174.
- Van den Boom, P. P. G. & Brand, A. M. 2008. Some new *Lecanora* species from western and central Europe, belonging to the *L. saligna* group, with notes on related species. *Lichenologist* 40(6): 465–497. <http://dx.doi.org/10.1017/S0024282908007299>
- Van den Boom, P. & Ertz, D. 2014. A new species of *Micarea* (Pilocarpaceae) from Madeira growing on *Usnea*. *Lichenologist* 46(3): 295–301. <http://dx.doi.org/10.1017/S0024282913000698>
- Van den Boom, P. P. G. & Vězda, A. 1995. A new species and a new variety of the lichen genus *Gyalidea* from western Europe. *Mycotaxon* 54: 421–426.
- Vězda, A. & Poelt, J. 1991. Die Flechtengattung *Gyalidea* Lett. ex Vězda (Solorinellaceae). Eine Übersicht mit Bestimmungsschlüssel. *Nova Hedwigia* 53(1–2): 99–113.

