

# *Fellhanera scottii* sp. nov. (*Pilocarpaceae*), a new corticolous lichen from Bermuda

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**Abstract.** *Fellhanera scottii* is described as a new corticolous lichen from Bermuda. This new species is characterized by its aeruginose excipulum and curious substrate, growing on stilt roots of *Rhizophora mangle*.

**Key words:** mangroves, *Rhizophora*

## Introduction

The genus *Fellhanera* comprises at least 113 species of discocarpous lichens in the *Pilocarpaceae* (<http://www.indexfungorum.org/names/Names.asp>, last consultation 31.7.2021). These lichens mostly occur in tropical and subtropical latitudes, where they are mostly found growing on evergreen leaves. Species of temperate regions are more likely to grow on bark or rock. The genus was introduced by Vězda (1986) with major revisions done by Sérusiaux (1996), Lücking (2008) and Harris & Lendemer (2009). Additionally, single species were described as new to science or recombined into *Fellhanera* by (in chronological order) Sérusiaux (1990), Vězda & Kalb (1991), Vězda & Hafellner (1991), Vězda (1994), Ekman (1996), Aptroot et al. (1998), Sparrius & Aptroot (2000), Lücking & Santesson (2001), Lücking et al. (2001), Sérusiaux et al. (2001), Aptroot (2002), Lücking et al. (2004), van den Boom (2004, 2021), Seaward & Aptroot (2004), Llop (2007), Elix (2008), Harris & Lendemer (2009), Sérusiaux & Brand in Lumbsch et al. (2011), Kondratyuk et al. (2013), Morse & Ladd (2013), Aptroot & Cáceres (2014), van den Boom & Sipman (2014), Kalb (2016), Weerakon et al. (2016), Cacéres & Aptroot (2017), Elix & McCarthy (2017), Etayo (2017) and van den Boom (2021).

*Fellhanera* is characterized by a crustose thallus with a chlorococcoid photobiont and apothecia that are mostly sessile, biatorine, and of variable color. The excipulum is mostly paraplectenchymatous; the paraphyses are sparingly branched; the asci have a KI+ tholus of the *Bys-soloma*-type (Hafellner 1984); and the ascospores are

hyaline and transversely septate, rarely aseptate or even muriform. The pycnidia usually produce tiny, bacilliform to pyriform conidia.

As part of an ongoing study of Bermudian lichens by Scott LaGreca and the author, an unknown lichen was collected in 2005 and recognized as an undescribed species of *Fellhanera*.

Bermuda is a group of ~130 islands (the ‘Bermuda Archipelago’) at 32°20’N and 64°45’W, covers ~53.5 km<sup>2</sup> and is situated 960 km offshore from the nearest landmass, North Carolina, USA. The islands are roughly 900,000 years old. Unlike North Carolina, Bermuda is dominated by a subtropical biota due to the effects of the passing Gulf Stream combined with the ‘Bermuda High’, a semi-permanent area of high atmospheric pressure (Thomas 2004). With ~1200 inhabitants/km<sup>2</sup>, the Bermudas are hyper-urbanized, their biota under constant threat from development and tourism. In addition, devastating hurricanes periodically ravage the islands, adding further stress to the islands’ fragile biodiversity.

The new species was encountered in Paget Marsh Nature Reserve (Paget Parish), one of Bermuda’s last remaining undisturbed natural areas, now a protected RAMSAR wetland. Paget Marsh is a pristine acidic peatland of ~10 hectares that gets flooded only during extreme high tides. The area has escaped the strong development of the surrounding area due to early protection (Thomas 2004). The vegetation contains stands of ancient primeval forest (Bermuda cedar, *Juniperus bermudiana*; Bermuda palmetto, *Sabal bermudana*; red mangrove, *Rhizophora mangle*; wax myrtle, *Myrica cerifera*; savannah saw-grass, *Cladium jamaicense*; Bermuda sedge, *Carex bermudiana*; giant fern, *Acrostichum danaeifolium*; and others). With

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75 species of lichens (Berger and LaGreca, unpublished data), Paget Marsh is one of the hot spots of diversity in the archipelago, which contains 208 total lichen species (LaGreca & Berger 2021).

## Material and methods

This paper is based on specimens collected in 2005 by the author, which are deposited in BM as well as the private herbarium of the author (hb Berger). The material was examined with an Olympus VMZ stereomicroscope and an Olympus BH2 compound microscope with interference contrast connected to a Leica DFC290 digital camera. Microscope sections were cut by hand, mounted in tap water and stained with 10% KOH and Lugol's solution.

## Taxonomy

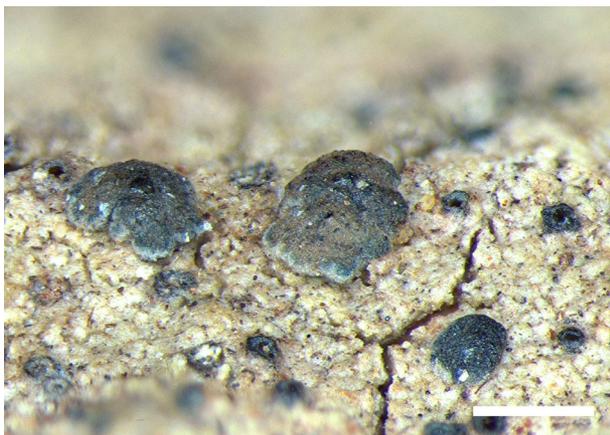
*Fellhanera scottii* F. Berger sp. nov. (Figs 1–6)

Mycobank MB 840991

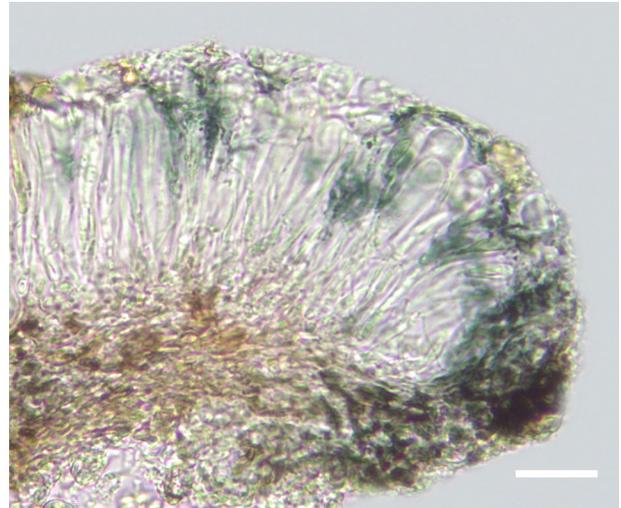
Diagnosis: The main difference between *Fellhanera scottii* and the most similar species *F. azorica* (van den Boom 2021) is the apothecia, which in the new species are larger, round or slightly lobate, possess a brown hypothecium and an olive tinged blue inner excipulum, and produce longer ascospores [(12–)13–16(–18) × 3–3.5 μm]. This new lichen species grows on the bark of stilt roots of *Rhizophora mangle*.

Type: [Bermuda] Paget Parish, Paget Marsh, on stilt roots of *Rhizophora mangle*, 1 m, 32°17.1'N, 64°46.5'W, F. Berger 20036, 5.5.2005, (DUKE 0383973 – holotype; hb. Berger 20010 – isotype).

**Description.** Thallus crustose, irregularly delimited, epiphloeodal, continuous, with a scurfy, farinose or finely gyrate surface (ecorticate), thin (up to 40 μm), pale greenish-grey, with an effuse margin; no distinct layers; chlorococcoid algae occupying most of the thallus, algae cells globose, 6–8 μm diam.; prothallus not apparent (Fig. 1). Apothecia sessile, numerous, round, shallowly lobate when older, 0.2–0.3(–0.5) mm, young disks seemingly blue-black (due to the color of the bluish-black inner rim), at first concave, later becoming slightly convex and light greyish-brown, margin persistent, slightly prominent, paler than disk, with a fine dark blue line

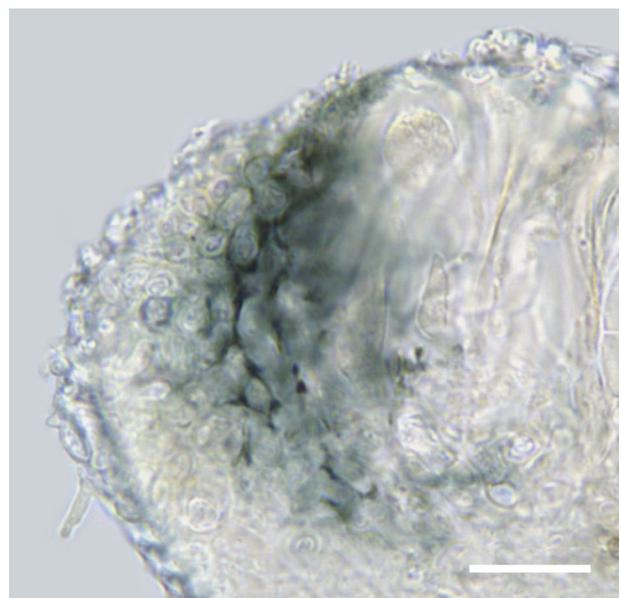


**Figure 1.** *Fellhanera scottii*. Thallus with mature apothecia and conidiomata. Scale = 0.3 mm.



**Figure 2.** *Fellhanera scottii*. Cross-section of hymenium in H<sub>2</sub>O. Scale = 20 μm.

persisting (visible stereo-microscopically) at the inner margin (Fig. 1); excipulum biatorine, without algae, without crystals, paraplectenchymatous, inner layer 15 μm thick, distinctly blue with slight olive tinge, occasionally mixed with hues of brown at the base (Figs 2–3), outer part of excipulum also 15 μm thick, hyaline, paraplectenchymatous, cells thick-walled, 3–7 μm diam., I–, continuing below hypothecium; epihymenium indistinct; hymenium 40–45(–48) μm high, hyaline or with aeruginose-blue streaks, I+ blue; hypothecium prosoplectenchymatous, ~30–50 μm high, light brown, I+ blue; paraphyses branched, ~1.5 μm, tips hyaline, slightly clavate; asci fissitunicate, clavate, 32–40 × 8–10 μm, with 8 bi- to triseriately arranged ascospores (Fig. 4); tholus KI+ blue, *Byssoloma*-type, exoascus KI+ blue; ascospores narrowly ellipsoid to fusiform (Fig. 5), apices rounded, hyaline, smooth, 8 per ascus, when mature, 3-septate, rarely with 5 septa (<5%); ascospores not constricted at the septa, with a thin halo, (12–)13–16(–18) × 3–3.5 μm, length/



**Figure 3.** *Fellhanera scottii*. Cross-section of excipulum, showing the distribution of aeruginous pigments, in H<sub>2</sub>O. Scale = 5 μm.



**Figure 4.** *Fellhanera scottii*. Ascus with 8 hyaline ascospores in H<sub>2</sub>O. Scale = 5  $\mu$ m.

width ratio = (2.6–)4–5(–5.4), n = 35; conidiomata scattered, superficial, pyriform, bluish black, up to 0.1 mm wide, conidia bacilliform to fusiform, non-septate,  $4 \times 1.3$ – $1.7 \mu$ m (Fig. 6).

**Chemistry.** Thallus: K–, C–, KC–, PD–, UV–. Apothecia: Bluish pigments in excipulum and epihymenium darkening, then turning slowly dark olive in K, brown pigment in hypothecium and basal excipulum K– and N–; hymenium KI+blue; hypothecium I+ blue, KI–.

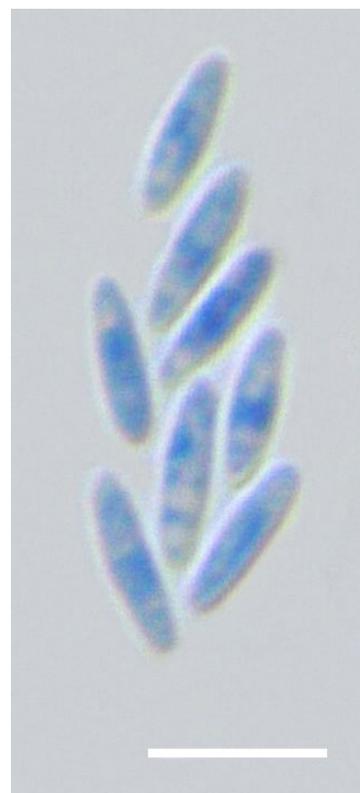
**Etymology.** Named in honour of Dr. Scott LaGreca, lichenologist and collections manager of the W.L. and C.F. Culberson Lichen Herbarium at Duke University, Durham, NC, USA; specifically in recognition of his many taxonomic and floristic contributions to the lichen biota of the Bermudas.

**Discussion.** According to the last worldwide conspectus of the genus by Sérusiaux (1996), as well as the study of foliicolous species of the Neotropics (Lücking 2008) – and also taking into account new species and new combinations since those works (see chapter ‘Introduction’) – most species of *Fellhanera* are foliicolous and thrive in subtropical or tropical habitats. *Fellhanera scottii*, however, is corticolous and occupies a very special microenvironment – healthy, lower parts of unimmersed stilt roots of red mangroves, just above the humid soil in this inland freshwater swamp. Using the publications of Sérusiaux and Lücking (q.v.), *F. scottii* keys to foliicolous



**Figure 5.** *Fellhanera scottii*. Ascospores (mainly 3-septate). Scale = 5  $\mu$ m.

*F. rhapidothyli*, a species of the *F. fuscatula* group. *Fellhanera rhapidothyli* is characterized by a similar thallus structure, but possesses dark greyish- or reddish-brown apothecia and differs in narrower conidia (0.7–1 vs. 1.3–1.7  $\mu$ m), as well as a dark rather than a light brown hypothecium. Furthermore, the inner exciple of *F. scottii*



**Figure 6.** *Fellhanera scottii*. Conidia in BCR. Scale = 5  $\mu$ m.

is always colored significantly blue with a slight olive tinge, while it is hyaline in *F. rhapsidophylli* (if aeruginous color is observed, it is only present in the marginal exciple (Santesson 1952). The exciple is colored differently in all other species of the genus except the very recently described *F. azorica*, which grows on leaves of *Camelia* in the Azores. *Fellhanera azorica* shares the similarly pigmented exciple of *F. scottii*, but differs in its foliicolous lifestyle, its slightly smaller and always round apothecia, its shorter ascospores (10–)11–12(–14) (2.5–)3.2–4  $\mu\text{m}$  with a lower length/ width ratio (2.5–3 vs. 4–5), and most obviously in its dark blue lower hypothecium, which is light brown in *F. scottii*. *Fellhanera silicis*, a species known from chert in North America, is another species with similarly colored epihymenium and outer excipulum, but differs by its thicker, sometimes darker thallus, and its larger (up to 0.5 mm), dark brown to black apothecia with concolorous margins, brown inner exciple, and colored paraphyses tips (Harris & Lendemer 2009).

There is a second *Fellhanera* on mangroves, *F. incolorata*, which occurs on the twigs of *Avicenna marina* in Australia; it cannot, however, be confused with *F. scottii*, as there are no pigments in *F. incolorata*, and its conidia are drop-like rather than bacilliform (McCarthy & Elix 2019).

**Distribution and ecology.** Presumably endemic to the Bermuda Isles and known only from the type location where it occurs on shady parts of the stilt roots of *Rhizophora mangle* up to one handspan over the humid ground. In this place, *Rhizophora mangle* does not grow in open salt water, but on the shore of a little pond in a permanent inland freshwater marsh with only underground connections to Bermuda's more typical, tidally-influenced, coastal environment (Thomas 2004). Associated species include *Byssoloma leucoblepharum*, *Bacidina brittoniana* and *Enterographa multilocularis*.

**Other specimens examined.** Comparative material of *Fellhanera azorica*: Azores, São Miguel, Ponta Delgada, botanical garden 'Jardim José Canto', 37°44'52"N, 25°40'26"W, 60 m, 24.10.2011, leg. P. & B. van den Boom (Hb Boom 46510).

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## References

Aptroot, A. 2002. New and interesting lichens and lichenicolous fungi in Brazil. *Fungal Diversity* 9: 15–45.

Aptroot, A. & Cáceres, M. E. 2014. New lichen species from termite nests in rainforest in Brazilian Rondônia and adjacent

Amazonas. *The Lichenologist* 46: 365–372. <https://doi.org/10.1017/s0024282913000340>

Aptroot, A., Brand, M. & Spier, L. 1998. *Fellhanera viridisorediata*, a new sorediate species of sheltered trees and shrubs in western Europe. *The Lichenologist* 30: 21–26. <https://doi.org/10.1006/lich.1997.0119>

Cáceres, M. E. & Aptroot, A. 2017. Lichens from the Brazilian Amazon, with special reference to the genus *Astrothelium*. *The Bryologist* 120: 165–181.

Ekman, S. 1996. The corticolous and lignicolous species of *Bacidia* and *Bacidina* in North America. *Opera Botanica* 127: 1–148.

Elix, J. A. 2008. Four new lichens from tropical and subtropical Australia. *Australasian Lichenology* 62: 35–40.

Elix, J. A. & McCarthy, P. M. 2017. Six new lichen species (Ascomycota) from Australia. *Telopea* 20: 147–163. <https://doi.org/10.7751/telopea11598>

Etayo, J. 2017. Hongos liquenícolas de Ecuador. *Opera Lilloana* 50: 1–535.

Hafellner, J. 1984. Studien in Richtung einer natürlichen Gliederung der Sammelfamilien *Lecanoraceae* und *Lecideaceae*. *Beiheft zur Nova Hedwigia* 79: 241–371.

Harris, R. C. & Lendemer, J. C. 2009. The *Fellhanera silicis* group in eastern North America. *Opuscula Philolichenum* 6: 157–174.

Kalb, K. 2016. Lichenes Neotropici XV. *Archive for Lichenology* 11: 1–12.

Kondratyuk, S., Lőkös, L., Tchabanenko, S., Haji Moniri, M., Farkas, E., Wang, X. Y., Oh, S. O. & Hur, J. S. 2013. New and noteworthy lichens and lichenicolous fungi. *Acta Botanica Hungarica* 55(3–4): 275–349. <https://doi.org/10.1556/abot.55.2013.3-4.9>

LaGreca, S. & Berger, F. 2021. Checklist of Bermuda lichens & lichenicolous fungi (under construction). <http://bermudalichens.myspecies.info/content/checklist-bermuda-lichens-lichenicolous-fungi-under-construction> [accessed 21 January 2021]

Llop, E. 2007. *Fellhanera colchica*, relocating a forgotten taxon, and *Byssoloma llimonae* new for Italy. *The Lichenologist* 39: 393–396. <https://doi.org/10.1017/s0024282907007037>

Lücking, R. 2008. Foliicolous Lichenized Fungi. *Flora Neotropica Monograph* 103, The New York Botanical Garden Press, 899 pp.

Lücking, R. & Santesson, R. 2001. New species or interesting records of foliicolous lichens. VIII. Two new taxa from tropical Africa, with a key to sorediate *Fellhanera* species. *The Lichenologist* 33: 111–116. <https://doi.org/10.1006/lich.2001.0312>

Lücking, R., Cáceres M. E., Kalb, K. & Sérusiaux, E. 2001. Studies in *Bacidia* sensu lato (Lichenized Ascomycetes: Lecanorales). II. Six new combinations in *Fellhanera* Vězda. *The Lichenologist* 33: 189–194. <https://doi.org/10.1006/lich.2000.0318>

Lücking, R., Streimann, H. & Elix, J. A. 2004. Further records of foliicolous lichens and lichenicolous fungi from Australasia, with an updated checklist for continental Australia. *The Lichenologist* 33: 195–210. <https://doi.org/10.1006/lich.2000.0316>

Lumbsch, T., Ahti, T., Altermann, S., Arup, U., Kärnefelt, I., Thell, A., et al. 2011. One hundred new species of lichenized fungi: a signature of undiscovered global diversity. *Phytotaxa* 18: 1–127. <https://doi.org/10.11646/phytotaxa.18.1.1>

McCarthy, P. M. & Elix, J. A. 2019. A new saxicolous species of *Fellhanera* (lichenized Ascomycota, *Pilocarpaceae*) from eastern New South Wales, Australia. *Australasian Lichenology* 85: 3–7.

Morse, A. & Ladd, D. 2013. A new species of *Fellhanera* (lichenized Ascomycota: *Pilocarpaceae*) from central North America. *The Lichenologist* 45: 341–346. <https://doi.org/10.1017/s0024282913000078>

Santesson, R. 1952. Foliicolous lichens I. – A revision of the taxonomy of the obligately foliicolous, lichenized fungi. *Symbolae botanicae Upsalienses* 12(1): 1–590.

- Seaward, M. R. D. & Aptroot, A. 2004. Four Seychelles lichens new to science. *The Lichenologist* 36: 119–124. <https://doi.org/10.1017/S002428290401401x>
- Sérusiaux, E. 1990. Liste préliminaire des lichens et champignons lichénicoles des rochers et éboulis des affleurements du Salmien (Belgique, région de Vielsalm). *Mémoires de la Société Royale de Botanique de Belgique* 12: 142.
- Sérusiaux, E. 1996. Foliicolous lichens from Madeira, with the description of a new genus and two new species and a world-wide key of foliicolous *Fellhanera*. *The Lichenologist* 28: 197–227. <https://doi.org/10.1006/lich.1996.0019>
- Sérusiaux, E., Coppins, B. J., Diederich, P. & Scheidegger, C. 2001. *Fellhanera gyrophorica*, a new European species with conspicuous pycnidia. *The Lichenologist* 33: 285–289. <https://doi.org/10.1006/lich.2001.0328>
- Sparrius, L. & Aptroot, A. 2000. *Fellhanera ochracea*, a new corticolous lichen species from sheltered habitats in western Europe. *The Lichenologist* 32: 515–520. <https://doi.org/10.1006/lich.2000.0292>
- Thomas, M. L. H. 2004. *The Natural History of Bermuda*. Bermuda Zoological Society, 255 pp.
- van den Boom, P. P. G. 2004. *Fellhanera*. In: Nash III, T. H., Ryan, B. D., Diederich, P., Gries, C. & Bungartz, F. (eds), *Lichen Flora of the Greater Sonoran Desert Region*. Vol. 2, pp. 107–108. (Lichens Unlimited, Arizona State University, Tempe).
- van den Boom, P. P. G. 2021. Foliicolous lichens and their lichenicolous fungi in Macaronesia and atlantic Europe. *Bibliotheca Lichenologica* 111: 1–197.
- van den Boom, P. P. G. & Sipman, H. 2014. New or interesting lichen records from Guatemala II – Six new species and records of 80 further taxa. *Sydowia* 66: 143–168. [http://dx.doi.org/10.12905/0380.sydowia66\(1\)2014-0143](http://dx.doi.org/10.12905/0380.sydowia66(1)2014-0143)
- Vězda, A. 1986. Neue Gattungen der Familie *Lecideaceae* s. lat. (Lichenes). *Folia Geobotanica Phytotaxonomica* (Praha) 22: 71–83. <https://doi.org/10.1007/bf02854668>
- Vězda, A. 1994. Neue foliicole Flechten II. *Nova Hedwigia* 58: 123–143.
- Vězda, A. & Hafellner, J. 1991. Beiträge zur Kenntnis der foliikolen Flechten australischer Regenwälder II. *Nova Hedwigia* 52: 73–80.
- Vězda, A. & Kalb, K. 1991. Beiträge zur Kenntnis der foliikolen Flechten australischer Regenwälder III. *Nova Hedwigia* 53: 215–228.
- Weerakoon, G., Wolseley, P. A., Arachchige, O., Da Silva Cáceres, M. E., Jayalal, U. & Aptroot, A. 2016. Eight new lichen species and 88 new records from Sri Lanka. *The Bryologist* 119: 131–142. <https://doi.org/10.1639/0007-2745-119.2.131>