

New and interesting lichens from the Caxiuanã National Forest in the Brazilian Amazon

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Abstract: As part of an ongoing inventory of the lichenized mycota of the Caxiuanã National Forest, at Ferreira Penna Research Station in the Brazilian Amazon, two species of lichenized fungi are described as new and four new combinations are introduced: *Ampliotrema megalostoma* (Müll. Arg.) M. Cáceres & Lücking comb. nov., *Graphis brachylirellata* M. Cáceres & Lücking sp. nov., *Malmidea leucogranifera* M. Cáceres & Lücking sp. nov., *Ocellularia conformalis* (Kremp.) M. Cáceres & Lücking comb. nov., *Redingeria microspora* (Zahlbr.) M. Cáceres & Lücking comb. nov., and *Sarcographa megistocarpa* (Leight.) M. Cáceres & Lücking comb. nov.

Key words: Belém, *Graphidaceae*, *Malmidiaceae*, Museo Goeldi, taxonomy

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Introduction

Brazil, the fifth largest country in the world, is also considered one of the most diverse countries on the planet. Two of the three major tropical rainforest blocks in the Neotropics are located in Brazil: the Atlantic rainforest and the Amazon (Whitmore 1998). They are both regarded as biodiversity hotspots (Myers *et al.* 2000), the Amazon being the largest in surface area. In Brazil, the Amazon covers *c.* 4 100 000 km², of which around 3–4 million km² remain forested.

The three major forest ecosystems of Brazil, the Amazonian ‘terra firme’ forest, the Atlantic forest and the ‘planalto’ forests (Cerrado), in spite of their geographical proximity, exhibit considerable diversity and marked floristic differences (Leitão Filho 1987; Whitmore 1998). Thus, it is also expected that differences in the lichen biota between these vege-

tation types will be found (Cáceres 2007; Cáceres *et al.* 2008), which emphasizes the need for specific lichen diversity studies in each region. In contrast to the Atlantic rainforest and the ‘planalto’ forests, a good estimate of the lichen diversity in the Brazilian Amazon is still unavailable, although some recent efforts have been made to increase the knowledge of the lichenized mycota of this vast region (Kalb 2004, 2009; Frisch *et al.* 2006; Frisch & Kalb 2009). Therefore, a larger inventory work is currently being undertaken in two areas of Amazonian Brazil in the states of Pará and Rondônia. The present paper presents results from the study undertaken at the Ferreira Penna Research Station [<http://www.museu-goeldi.br/ecfpn>], which covers an area of 33 000 ha within the Caxiuanã National Forest (330 000 ha) in the state of Pará and is under the administration of the Museu Paraense Emílio Goeldi (MPEG; Lisboa 1997, 2002). The foliicolous lichens at Ferreira Penna Research Station were treated in an earlier paper (Lücking & Cáceres 2002), and a first list of corticolous species focusing on *Graphidaceae* is being published separately (Cáceres *et al.* 2012). Here we formally introduce two new species and four new combinations.

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Material and Methods

The material used for this study was collected by the first author during a one-week field trip in January 2009, to the Ferreira Penna Research Station. The Caxiuanã National Forest (Floresta Nacional or FloNa) is situated in the municipalities of Melgaço and Portel (1°37' S, 51°19' W and 1°54' S, 51°58' W and limits south of 2°15' S, 51°15' W and 2°15' S, 51°56' W) in the administrative micro-region of Furos de Breves, in the bay of Caxiuanã between the Xingu and Tocantins rivers, occupying an area of c. 300 000 ha. The area includes several vegetation types, including non-flooded (*terra firme* forest with islands of savanna-like and secondary forest) and flooded forest (*várzea* and *igapó*), as well as abundant aquatic vegetation, the *terra firme* forest being the predominant type (Lisboa 1997, 2002).

Thallus morphology of the collected lichens was examined using LEICA EZ4 and LEICA MS5 dissecting microscopes. Sections of thalli and ascomata were cut by hand with a razor blade and examined with squash preparations in water, KOH and Lugol's solution, using a ZEISS Axioskop 2 compound microscope. TLC was performed using standard techniques with solvent C. Type material and duplicates are deposited at ISE, MPEG, and F.

The Taxa

Ampliotrema megalostoma (Müll. Arg.) M. Cáceres & Lüicking comb. nov.

Mycobank No: MB 800583

Ocellularia megalostoma Müll. Arg., *Hedwigia* 31: 283 (1892); type: Brazil, *Trail* s. n. (BM!—holotype)

(Fig. 1A)

Notes. *Ampliotrema megalostoma* is a very typical *Ampliotrema*, closely resembling *A. auratum* (Tuck.) Kalb in the large apothecia with yellow-pruinose disc, but differing in the larger, transversely septate ascospores (40–80 × 9–15 µm and 11–17-septate in *A. megalostoma* versus 14–22 × 8–10 µm and submuriform in *A. auratum*). The ascospores are similar to those of *A. lepadinoides* (Leight.) Kalb, but that species has smaller apothecia with orange-pruinose discs, and the ascospores are usually larger (up to 150 µm in *A. lepadinoides*).

Specimens examined. **Brazil:** *Pará:* Municipality of Melgaço, Estação Científica Ferreira Penna, 400 km west of Belém, on trail behind the station, 2009, *Cáceres* 6012 (F, ISE), 9716, 9724, 9737, 9747 (ISE).

Graphis brachylirellata M. Cáceres & Lüicking sp. nov.

Mycobank No: MB 800584

Differing from *G. mexicana* in the striate lirellae, thicker excipulum, septate ascospores, and stictic acid chemistry.

Type: Brazil, *Pará,* Municipality of Melgaço, Estação Científica Ferreira Penna, 400 km west of Belém, on trail behind the station, 31 January 2009, *Cáceres* 6015 (ISE—holotype; F—iso-type).

(Fig. 1B)

Thallus corticolous, up to 5 cm diam., 50–100 µm thick, continuous; surface smooth to uneven, matt, pale yellowish grey; prothallus absent. Thallus in section with thin, cartilaginous upper cortex and irregular algal layer and medulla encrusted with large clusters of calcium oxalate crystals.

Apothecia rounded to very shortly lirelliform, straight, unbranched, prominent, with thin to thick complete thalline margin, 0.7–1.0 mm long and broad, 0.3–0.4 mm high; *disc* concealed; *proper margin* thick, labia striate; *thalline margin* thin to thick, usually completely covering the labia, yellowish white, but sometimes abraded to expose black labia. *Excipulum* apically crenulate, completely carbonized, 100–200 µm wide, black; laterally covered by corticate algiferous thallus including large clusters of calcium oxalate crystals, laterally above the hymenium with short, thick periphysoids; *hypothecium* prosoplectenchymatous, 20–30 µm high, yellowish; *hymenium* 250–300 µm high, colourless, clear; *epithecium* indistinct. *Paraphyses* unbranched; *asci* fusiform, 150–200 × 30–40 µm. *Ascospores* 1 per ascus, fusiform, 19–25-septate, 120–150 × 25–30 µm, 4–5 times as long as wide, colourless, I+ violet-blue.

Secondary chemistry. Stictic and constictic acids, traces of cryptostictic acid.

Notes. This species is characterized by the unusual combination of short, almost rounded, massively carbonized ascomata with striate labia, large, transversely septate ascospores, and stictic acid. It resembles *Graphis mexicana* (Hale) Lumbsch *et al.* and

related species (Mangold *et al.* 2008), but these differ by the lack of chemical substances, entire labia, muriform ascospores, and the comparatively thin excipulum. The new species also resembles a *Carbacanthographis*, particularly due to the periphysoids (Staiger 2002), but the ascospores are distinctly amyloid and we could not see wart-like ornamentation in the periphysoids covering the inner part of the labia. We therefore place the new species in *Graphis*, pending molecular studies. The most similar species in *Carbacanthographis* is *C. crassa* (Müll. Arg.) Staiger & Kalb, which is comparable in the massive lirellae and chemistry, but has warty periphysoids and muriform, non-amyloid ascospores (Staiger 2002).

Malmidea leucogranifera M. Cáceres & Lüicking sp. nov.

Mycobank No: MB 800585

Differing from *M. granifera* in the light brown apothecial disc and hypothecium.

Type: Brazil, Pará, Municipality of Melgaço, Estação Científica Ferreira Penna, 400 km west of Belém, on trail behind the station, 31 January 2009, Cáceres 9740 (ISE—holotype; F—isotype); same locality and date, Cáceres 9706, 9708, 9715 (ISE—paratype).

(Fig. 1C)

Thallus crustose, corticolous, continuous, 20–50 mm across and 30–70 µm thick, densely verrucose, green-grey; medulla pale yellow, K+ dark yellow. *Photobiont* chlorococcoid; cells 4–7 µm diam.

Apothecia sessile, rounded to irregular, 0.5–1.0 mm diam. and 250–350 µm high; *disc* plane, orange-brown; *margin* thin but distinct, not prominent, cream-coloured. *Excipulum* externally paraplectenchymatous with small cells and loose hyphal ends, 20–50 µm broad, hyaline, internally with medullary layer composed of loosely arranged, periclinal hyphae with constricted septa, 40–60 µm broad, encrusted with hydrophobic granules, nubilous but dissolving in KOH (without visible colour reaction). *Hypothecium* 20–30 µm high, orange-brown, K-. *Epithecium* indistinct. *Hymenium* 80–100 µm high, colourless. *Asci* 70–90 × 15–20 µm. *Ascospores* 8 per ascus, non-septate, broadly ellipsoid, 12–

16 × 7–10 µm, 1.6–2.0 times as long as broad.

Pycnidia not observed.

Secondary chemistry. Two unknown substances (xantholepinones?), pale yellow medullary pigment.

Notes. This new species is closely related to *Malmidea badimoides* (Cáceres & Lüicking) Cáceres & Kalb (Kalb *et al.* 2011), but differs in the pale yellow, K+ intensifying instead of white, K- medulla. The apothecial margin is also thinner on average and never pure white as in *M. badimoides*. In addition, the green K+ reaction of the medullary layer in the excipulum of *M. badimoides* was not observed in *M. leucogranifera*. The new species differs from *M. granifera* (Ach.) Kalb *et al.* (Kalb *et al.* 2011) mainly in the light orange-brown, rather than brown-black hypothecium and apothecial disc.

Ocellularia conformalis (Kremp.) M. Cáceres & Lüicking comb. nov.

Mycobank No: MB 800586

Thelotrema conformale Kremp., *Nuovo Giorn. Bot. Ital.* 7: 19 (1875); type: Malaysia (Borneo), Beccari 12 (M!—holotype).

(Fig. 1D)

Notes. This species is placed here in *Ocellularia* because of the carbonized excipulum and columella. Externally it resembles a *Stegobolus* due to the broad, split columella and the psoromic acid chemistry (Frisch *et al.* 2006), but in molecular phylogenetic analysis it clusters close to *Ocellularia pyrenuloides* Zahlbr. and is apparently not closely related to either *Stegobolus* or *Ocellularia* s. str. (Rivas Plata *et al.* 2012).

Specimens examined. **Brazil:** Pará: Municipality of Melgaço, Estação Científica Ferreira Penna, 400 km west of Belém, on trail behind the station, 2009, Cáceres 6004, 6033 (F, ISE).

Redingeria microspora (Zahlbr.) M. Cáceres & Lüicking comb. nov.

Mycobank No: MB 800587

Leptotrema microsporum Zahlbr., *Sitzungsber. Kaiserl. Akad. Wiss. Wien, Math.-Naturwiss. Klasse* 111: 392 (1902).—‘*Thelotrema*’ *microsporum* Zahlbr., *Cat. Lich. Univ.* 2: 625

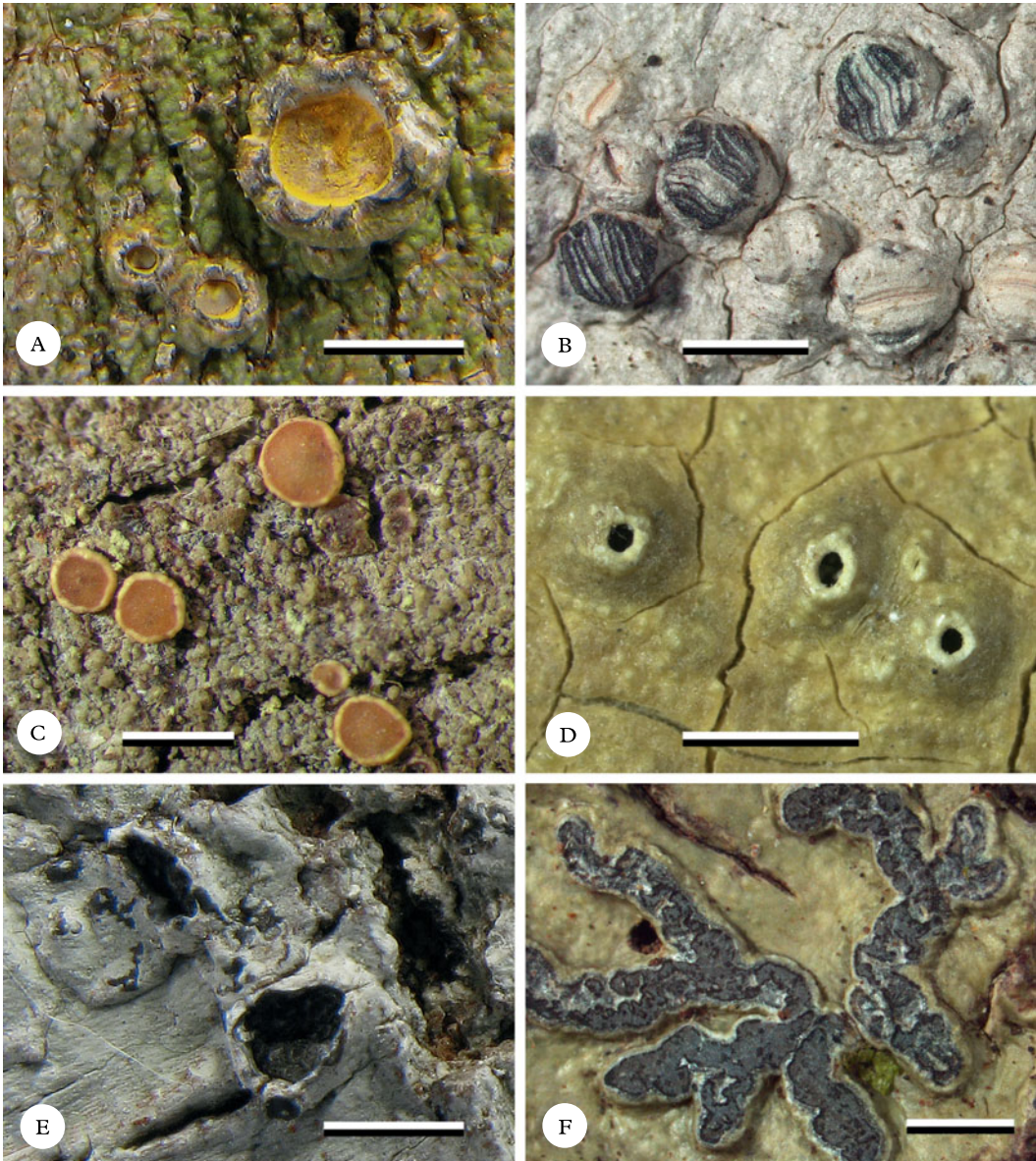


FIG. 1. General habit of the Brazilian lichen species studied. A, *Amphitrema megalostoma*; B, *Graphis brachylirellata*; C, *Malmidea leucogranifera*; D, *Ocellularia conformalis*; E, *Redingeria microspora*; F, *Sarcographa megistocarpa*. Scale = 1 mm. In colour online.

(1923); orth. error; *Thelotrema microsporoides* Zahlbr., *Cat. Lich. Univ.* 2: 625 (1923) [nom. nov., non *T. microsporum* Mont.].

(Fig. 1E)

Notes. *Redingeria microspora* is somewhat intermediate between the genera *Melanotrema* [e.g. *M. astrolucens* (Sipman) Frisch], *Redingeria*, and *Stegobolus* [e.g. *S. metaphoricus* (Nyl.) Frisch], but clusters within *Redingeria*

in molecular phylogenetic analysis (Rivas Plata *et al.* 2012), which is consistent with its *Redingeria*-like thallus and ascospores as defined by Frisch *et al.* (2006). The latter authors placed the species in synonymy with *Stegobolus metaphoricus*, but this is clearly contradicted by the molecular phylogeny. The two species have indeed several characters in common, but differ both in apothecial morphology (lirellate in *S. metaphoricus* versus more rounded in *R. microspora*) and thallus surface colour and structure (yellow-green and uneven in *S. metaphoricus* versus grey and minutely grainy in *R. microspora*).

The name *Thelotrema microsporoides* is apparently based on a mishap. Zahlbruckner (1923) listed his original species, *Leptotrema microsporum*, under *Thelotrema*, indicating *T. microsporum* Mont. as competing homonym, and therefore introduced the superfluous new name, *T. microsporoides*.

Specimens examined. **Brazil:** Pará: Municipality of Melgaço, Estação Científica Ferreira Penna, 400 km west of Belém, on trail behind the station, 2009, Cáceres 6030, 9113 (F, ISE).

***Sarcographa megistocarpa* (Leight.)
M. Cáceres & Lücking comb. nov.**

Mycobank No: MB 800588

Platygrapha megistocarpa Leight., *Trans. Linn. Soc. London* 27: 178 (1869)—*Phaeographis megistocarpa* (Leight.) Müll. Arg., *Flora* 65: 336 (1882); type: Sri Lanka, *Thwaites* s. n. (BM!—holotype; G!—isotype).

(Fig. 1F)

Notes. This species is very closely related to *Sarcographa ramificans* (Kremp.) Staiger (2002), having primarily lirellate ascomata and comparatively long, multiseptate ascospores. However, the species lacks chemistry, contrary to *S. ramificans* which contains the stictic acid chemosyndrome, and the ascomata are usually broader and more prominent and become somewhat stromatic with age.

Specimens examined. **Brazil:** Pará: Municipality of Melgaço, Estação Científica Ferreira Penna, 400 km west of Belém, on trail behind the station, 2009, Cáceres 6008, 6020, 6042 (F, ISE).

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