

# New species of *Enterographa* and *Fulvophyton* from Malaysia and Mexico

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**Abstract.** A new species of *Enterographa* (*Arthoniales: Roccellaceae*) is described. *E. kinabaluensis* from Kota Kinabalu is characterized by the presence of punctiform soralia and norstictic acid. The saxicolous *Fulvophyton serusiauxii* is described from coastal Mexico and differs from the corticolous *F. klementii* in having much smaller ascospores.

**Key words:** taxonomy, *Roccellaceae*, *Opegraphaceae*, *Roccellographaceae*, *Arthoniales*

## Introduction

The genus *Enterographa* (*Arthoniales: Roccellaceae*) was monographed by Sparrius (2004) and now contains 68 species in its current circumscription with additional taxa described in the genus (Sparrius 2004; Sparrius et al. 2006; Aptroot et al. 2007, 2013; Cáceres 2007; Sparrius & Aptroot 2007; Singh & Pinokiyo 2008; Sparrius & Björk 2008; Seaward & Aptroot 2009; Yeshitela et al. 2009; Gao et al. 2009; Ertz 2009; Sipman 2011; Morse 2013; Seavey & Seavey 2014; Ertz et al. 2014, 2015; Jagadeesh Ram 2016; McCarthy & Elix 2016; van den Boom & Sipman 2016; Weerakoon et al. 2016; Seavey et al. 2017; Cáceres & Aptroot 2017; Etayo 2017; Aptroot & Cáceres 2018; Van den Broeck & Ertz 2018; Gupta et al. 2019). *Enterographa* remains polyphyletic, with two or three distinct groups (Ertz & Tehler 2011; Aptroot & Cáceres 2017). The first is *Enterographa* s.str., placed in the *Roccellaceae* which includes the type *E. crassa*. The second group belongs to the *Opegraphaceae* and contains at least *E. anguinella* (Ertz et al. 2009) and probably many other corticolous, saxicolous and lichenocolous species currently placed in *Enterographa*. Aptroot & Cáceres (2017) placed *E. anguinella* in the genus *Nyungwea*; however, the affinity to this genus was based on a very limited number of taxa, and the relations between genera in the *Opegraphaceae* therefore differ slightly between studies (Ertz et al. 2009; Aptroot & Cáceres 2017). A third

group may comprise foliicolous species, which differ in having ellipsoid instead of clavate asci and a *Phycopeltis* photobiont, similar to the foliicolous *Opegrapha* species now placed in *Fouragea* (Frisch et al. 2014).

*Enterographa subserialis* and many other *Sclerophyton* species were transferred to *Fulvophyton*, which forms a strongly supported group. *Fulvophyton* is characterized by the usually white-pruinose, grouped punctiform ascomata, hyaline hypothecium and macrocephalic ascospores (Ertz & Tehler 2011). In this paper we describe further species in both genera, following the current classification.

## Materials and methods

Specimens were collected during collection trips by the second author in Mexico (2016) and by the third author in Kinabalu Park (2014). Microscopic characters were studied in tap water using an Olympus BH2 microscope at 1000×. Thin-layer chromatography (TLC) was performed in solvent A (Orange et al. 2001). UV fluorescence was tested with a 365 nm LED source.

## Results

### Taxonomy

*Enterographa kinabaluensis* Sparrius & Kalb, sp. nov.  
(Fig. 1)

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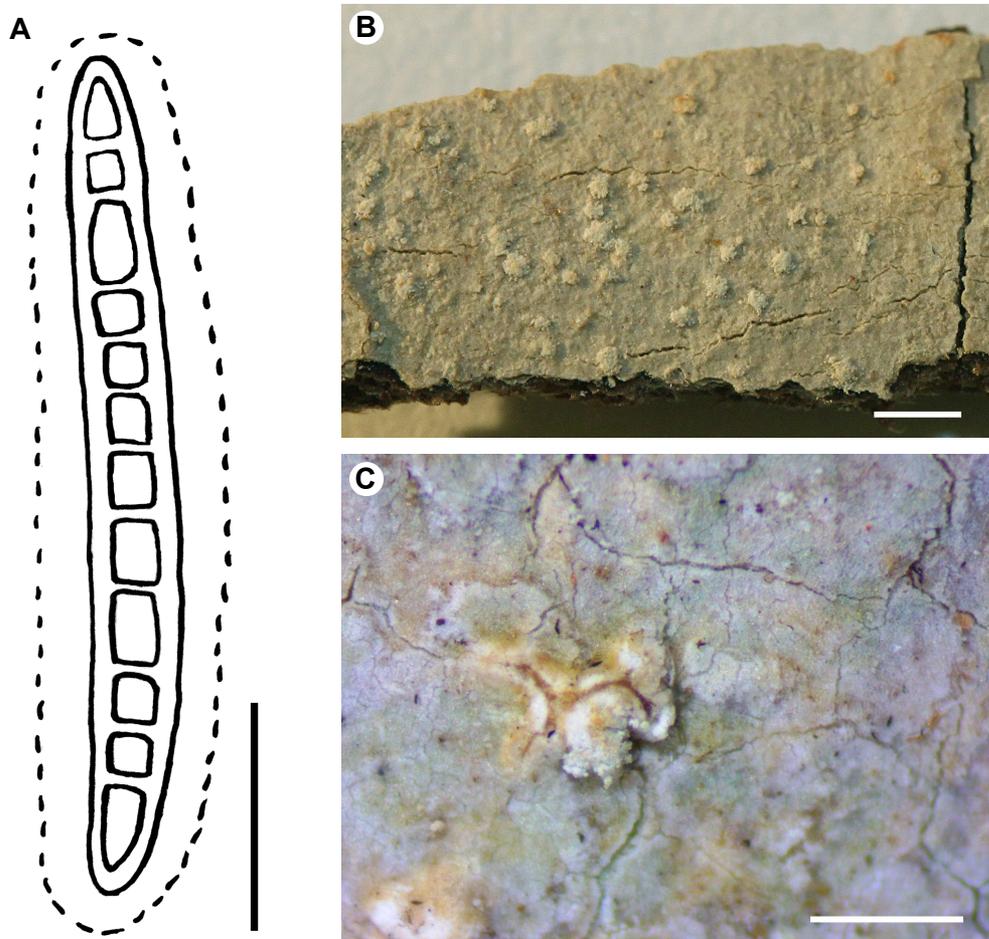
Diagnosis: *Enterographa* with punctiform soralia, from which shortly lirelline ascomata arise. Ascospores 4–5 × 39–52 µm, 11–17 septate. Thallus with norstictic acid.

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**Figure 1.** *Enterographa kinabaluensis*. A – ascospore; B – thallus showing punctiform soralia; C – ascoma arising from a soralium. Scales: A = 10  $\mu\text{m}$ ; B–C = 1 mm.

Type: Malaysia, Borneo, Sabah, Kota Kinabalu, Sapi Island. Coastal rainforest, corticolous, 06°00'14"N, 116°00'57"E, 30–50 m alt., 8 Aug. 2014, leg. K. Kalb & A. Mertens 40346 (B – holotype; TLC!).

**Description.** Thallus smooth, continuous to finely areolate, white, water-absorbing, able to cover a large area of bark surface, thin, 100–150  $\mu\text{m}$  tall. Photobiont trentepohlioid. Prothallus thin and black or absent. Upper algae-free medulla ~10  $\mu\text{m}$  thick, of densely interwoven hyphae. Medulla cream-colored, with abundant crystals of norstictic acid (dissolving in KOH to form a yellow solution, rapidly followed by the formation of clusters of red needle-shaped crystals). Soralia punctiform, 0.3–0.7 mm diam. Soredia farinose, white. Ascomata shortly lirelline, sessile, often arising from soralia, disc pale orange-brown, 0.1–0.2  $\times$  0.1–0.4 mm, aggregated in linear or stellate pseudostromata. Thalline margin indistinct, somewhat paler than thallus, 0.05 mm wide. Excipulum hyaline, very thin, ~5  $\mu\text{m}$  wide. Hypothecium hyaline, ~70  $\mu\text{m}$  tall. Hymenium hyaline, ~100  $\mu\text{m}$  tall. Paraphysoids ~1.0  $\mu\text{m}$  wide, tips widened to 1.5  $\mu\text{m}$ , irregularly branched and anastomosing. Epithecium straw-colored, ~20  $\mu\text{m}$  tall, K–. Asci clavate, ~70–100  $\times$  15  $\mu\text{m}$ , 8-spored. Ascospores fusiform, hyaline, (9–)11(–17)-septate, 4–5  $\times$  39–52  $\mu\text{m}$ , excluding perispore, perispore distinct, 1–3  $\mu\text{m}$  wide in K. Conidiomata not observed.

**Chemistry.** Thallus and ascomata C–, K+ yellow–red, PD+/- yellow, UV–; TLC: norstictic acid; amyloidy: asci and hymenium I–.

**Distribution and ecology.** Only known from the type locality in coastal rainforest. Corticolous.

**Etymology.** Named after the type locality near Kota Kinabalu.

**Remarks.** It is easily recognized when fertile by the white thallus with punctiform soralia, from which the ascomata arise. Other known *Enterographa* species with a sorediate thallus are *E. zephyri*, which has an entirely sorediate green thallus containing erythrin (Sparrus 2004), and *E. incognita* (Ertz et al. 2014), which is also entirely sorediate and contains roccellic acid. The presence of ascomata on the soredia might indicate a parasitic relation. However, we ruled this out because of the identical chemistry of both the thallus and ascomatal margin. The new species would key out as *Enterographa sorediata* in Seavey & Seavey (2014), but that species is now synonymous with *Syncesia myrticola* (Ertz et al. 2018).

*Fulvophyton serusiauxii* Sparrus & Tehler, sp. nov.  
(Fig. 2)

MycoBank MB 833323



**Figure 2.** *Fulvophyton serusiauxii*. A – drawing of an ascospore. B – thallus. C – collecting locality. Scales: A = 10  $\mu\text{m}$ ; B = 5 mm.

**Diagnosis:** Saxicolous *Fulvophyton* with thick, cream-colored, areolate thallus. Ascromata lirelline. Ascospores 5–6  $\times$  20–22  $\mu\text{m}$ , 5-septate. Thallus with norstictic acid.

**Type:** Mexico, Estado de Jalisco, South of Puerto Vallarta along highway 200 north of Mismaloya just opposite to Los Arcos National Underwater Park, saxicolous on granitic boulders on the beach, 20°32'34"N, 105°17'16"W, 1 m alt., 7 Jan. 2016, leg. A. Tehler 10911 (S – holotype; TLC!).

**Description.** Thallus thick, areolate, cream-colored, matte, water-absorbing, 100–1000  $\mu\text{m}$  thick. Photobiont trentepohlioid. Prothallus black-brown. Upper algae-free medulla ~50  $\mu\text{m}$  thick, of densely interwoven hyphae. Medulla cream-colored. Ascromata lirelline, immersed in areoles, disc black, partly white-pruinose, 0.15–0.2  $\times$  0.5–1.2 mm, often branched, not notably aggregated in pseudostromata. Thalline margin indistinct, somewhat paler than thallus, 0.05 mm wide. Excipulum hyaline, very thin, ~10  $\mu\text{m}$  wide. Hypothecium hyaline, ~30  $\mu\text{m}$  tall. Hymenium hyaline, ~100  $\mu\text{m}$  tall. Paraphysoids ~1.0  $\mu\text{m}$  wide, tips widened to 1.5  $\mu\text{m}$ , irregularly branched and anastomosing. Epithecium straw-colored, ~15  $\mu\text{m}$  tall, K–. Asci clavate, ~70–100  $\times$  20  $\mu\text{m}$ , 8-spored. Ascospores ellipsoid, hyaline, 5-septate, 20–22(–25)  $\times$  5–6  $\mu\text{m}$  excluding perispore, perispore indistinct in K. Young

ascospores with enlarged cells on both ends, as typical for this genus. Conidiomata not observed.

**Chemistry.** Thallus and ascromata C–, K+ yellow–red, PD+/- yellow, UV–; TLC: norstictic acid; amyloidy: asci and hymenium I+ red.

**Distribution and ecology.** Only known from the type locality. Saxicolous on granite boulders on the Pacific Ocean shore. The tidal range along the coastline is very low, and contact with saltwater is probably limited to a few days in the hurricane season.

**Etymology.** The name is dedicated to Professor Emmanuël Sérusiaux on the occasion of his retirement from his position at the University of Liège.

**Remarks.** Very similar to the mainly corticolous *Fulvophyton klementii*, which has much larger ascospores (30  $\times$  7.5  $\mu\text{m}$  on average), shorter, ellipsoid ascromata, and ascromata not notably aggregated in pseudostromata. The saxicolous *Enterographa subgelatinosa* is also similar in appearance but it has a faint C+ red and P+ yellow reaction. *Fulvophyton calcicola* is known from the Atlantic coast in Florida; it grows on calcareous rock and contains no secondary compounds.

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