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New additions to the lichen genus *Enterographa* (*Roccellaceae*) from Everglades National Park including an updated world key

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Abstract: During 2010–12 collecting seasons, we visited 27 islands, locally called keys, in Florida Bay within the boundaries of Everglades National Park for the purpose of investigating their lichen flora. A disproportionate number of the resultant collections belong to *Enterographa* Fée, a genus mostly tropical in distribution. Currently, 11 species are known from Everglades National Park, of which *Enterographa bradleyana*, *E. caudata*, *E. murrayana* and *E. nitidula* are described here as new to science. *Enterographa bradleyana* is superificially similar to *Enterographa divergens* but has smaller ascospores, a wider perispore and contains gyrophoric acid. *Enterographa candata* is easily identified by an unusual chemistry of lichexanthone and schizopeltic acid and its extremely long tailed ascospores. *Enterographa murrayana* resembles *E. anguinella* in the field but has a different chemistry, wider ascospores with more septation and a wider perispore. *Enterographa nitidula* has an unusual fine powdery and glossy thallus, small 4-celled ascospores and contains an unidentified substance. Because a large number of *Enterographa* have been described (20 including those newly described here) since Sparrius monographed the genus in 2004, an updated world key to the genus is provided.

Key words: Florida, Florida Bay, lichenicolous

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Introduction

The boundary of Everglades National Park extends into Florida Bay, which comprises *c.* 162 000 hectares of the Park (Hallac *et al.* 2008). Most of the Bay is shallow, averaging about a metre in depth, and navigational charts plus local knowledge are necessary to avoid running aground on mudflats. During the Wisconsin Glaciation, when sea level was nearly 100 m lower than at present, all of the Bay was exposed and subject to erosional forces (Petuch & Roberts 2007). Thus a person could have walked over dry ground from today's southern tip of mainland Florida in a direct line to Key West. Over the last 5000 years, as sea levels rose, the whole area became inundated except for *c.* 200 marl outcroppings called keys (or cays) in the local vernacular (Robertson 1955; Petuch & Roberts 2007). The origin of these is still a subject of debate and no one theory is universally accepted. They range in size from one to over 50 hectares and are ringed by mangrove with interior prairies dominated by grasses, halophytic plants or mudflats. Scattered buttonwood (*Conocarpus erectus*) and trees of West Indian origin (Tomlinson 1980) often inhabit the interior portions. Many keys are ringed by extensive shallow mudflats and are accessible only by canoe, kayak or by wading ashore.

The corticolous and lignicolous lichen flora of the keys is abundant, frequently with a 30 cm^2 area harbouring 15 or more species, often with no interspaces. Botanically and meteorologically most of Everglades National Park can be considered tropical or subtropical, and lichen genera such as *Enterographa* Fée, which are largely restricted to the tropics, are well represented here. Sparrius (2004) monographed the genus, accepting 35 species. As often happens after a generic monograph, a large number of additional species (16 exclusive of this paper) have rapidly been described. Therefore, building upon the previous work of Sparrius, an updated world key is provided that now includes 55 species. Twenty-one of these are known only from either the type specimen or the type locality. However, many species of *Enterographa* form only small thalli and are

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somewhat cryptic. It is quite possible that species are frequently overlooked by collectors and are more widespread than believed. During the years 2010–2012, we made lichen inventories at 27 of the keys. Eight species of *Enterographa* were identified from these collections, the four described as new below plus *Enterographa anguinella* (Nyl.) Redinger, *E. pallidella* (Nyl.) Redinger, *E. subserialis* (Nyl.) Redinger, and *E. tropica* Sparrius. Of the 11 species currently known from Everglades National Park, six are restricted to the keys, two to the mainland with three inhabiting both areas. A discussion of the Everglades mainland, including topography, plant communities capable of harbouring lichens and difficulties of collecting, was provided in a previous work (Seavey & Seavey 2011).

Materials and Methods

All collections were examined using standard stereoscopic and light microscope techniques. A Leica DFC295 compound microscope and a Leica S8APO inspection microscope were used to examine hand-cut sections and thalline superficial structures, respectively. All macroscopic and microscopic images were captured via computer using Leica Application Suite V4.2.0 28 software. Water mounts of sections were observed in a 10% aqueous solution of potassium hydroxide, Lugol's solution (1% iodine in 10% potassium iodide) and phloxine (1% aqueous solution). Measurements of internal structures were computer-generated and obtained from water mounts. The software's automatic setting was employed and may have enhanced some of the images. No additional enhancement was used unless noted. Spot test abbreviations used are C (sodium hypochlorite), I (iodine), K (potassium hydroxide) and P (*para*-phenylenediamine). Thin-layer chromatography (TLC) was carried out in accordance with Orange *et al.* (2001), using systems A and C. All collections are corticolous from Everglades National Park and were made by the authors unless otherwise noted. They will be curated at the South Florida Collection Management Center (FNPS) except for isotypes as indicated.

The New Species

Enterographa bradleyana F. Seavey & J. Seavey sp. nov.

MycoBank No.: MB804776

Similar to *Enterographa divergens* but ascospores smaller, perispore wider, differing also by containing gyrophoric acid.

Type: USA, Florida, Monroe County, Everglades National Park, Bradley Key, 25°08′ N, 80°57′ W, corticolous on *Avicennia germinans* in upland zone with halophytic understorey, 4 April 2010, *F. Seavey & J. Seavey*, 8153E (FNPS—holotype; FLAS—isotype).

(Fig. 1A–C)

Thallus ecorticate, 1–5 cm diam., continuous, verrucose, pale greyish white, 60–150 μm thick, medulla white, inspersed with small oxalate crystals, prothallus absent. *Photobiont Trentepohlia.*

Ascomata black, encrusted with large white crystals, broadly open, round, ellipsoid, or linear and often short-branched, 0·30–0·60 × 0·15–0·50 mm, immersed in thalline verrucae, 0·4–0·7 mm wide, not in pseudostromata; thalline margin present, 0·05–0·10 mm wide. *Exciple* pale brown, 15–25 μm wide. *Hypothecium* pale brown, lightly oil inspersed, 40–65 μm tall. *Hymenium* hyaline, 80–110 μm tall, paraphysoids 0·95–1·05 μm wide, branched and anastomosing. *Epithecium c.* 15 μm tall, brown, K−. *Asci* 70–80 × 16–18 μm, cylindrical, 8-spored. *Ascospores* ellipsoid/fusiform (17–)19–23 (–25) × 4·5–5·5 μm, 5–7-celled, perispore 1·5–1·7 μm wide.

Pycnidia brown to dark brown, walls orange-brown in section, 65–75 μm, often found inside the carbonized margin between two lichens; *conidia* hyaline, simple, 4–6 × 1 μm.

Chemistry. Thallus K−, C+ pink-red (gyrophoric acid), P−; amyloidy: epihymenium and hypothecium I+ blue, KI+ blue, exciple I+ weakly blue, KI+ blue, hymenium and asci I+ red, KI+ blue.

Etymology. The name commemorates Guy Bradley, an Audubon warden, murdered in Florida Bay by plume hunters in the first decade of the 20th century.

Ecology and distribution. Enterographa bradleyana is common in the interior of most keys visited, usually in full sun. It inhabits both bark and lignum but apparently avoids the peripheral red mangrove tidal zone of the islands.

Discussion. The thin-walled ascospores of this species are more diagnostic of *Chiodecton*

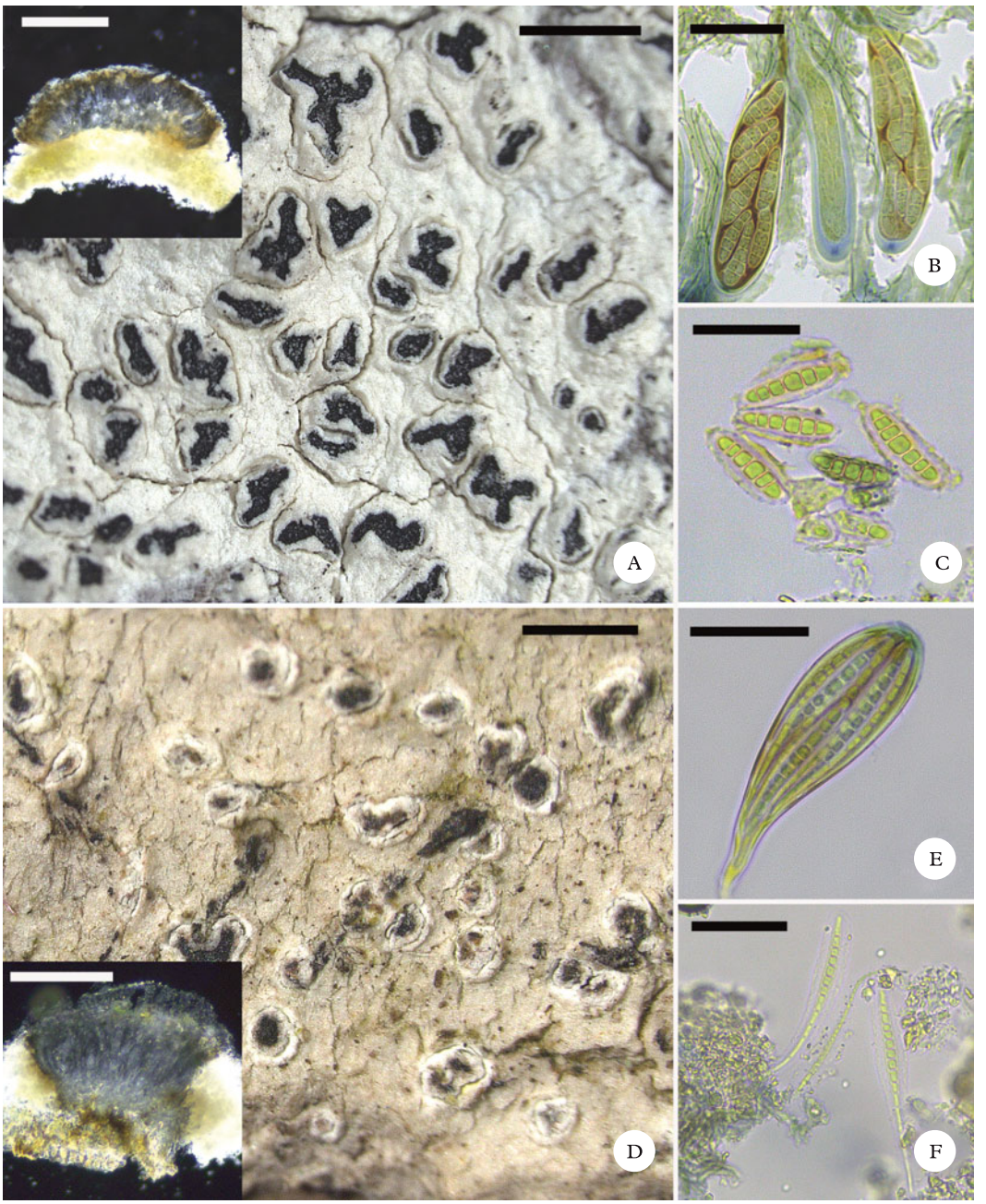

FIG. 1. A–C, *Enterographa bradleyana*; A, thallus and ascomata in thalline verrucae (insert: ascoma section showing crystalline encrusted epithecium); B, asci at 3 stages of development; C, mature ascospores with distinct perispore. D–F, *E. caudata*; D, thallus and ascomata in thalline verrucae (insert: ascoma section with thalline margin); E, ascus; F, ascospores with long acicular tail. Scales: A & D inserts = 200 μm; A & D = 1 mm; B, C, E & F = 20 μm.

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than *Enterographa*. However, *Chiodecton* is described as having a carbonaceous hypothecium, perithecioid ascomata and normally roccellic acid, all absent from *E. bradleyana*. Furthermore, ascospores of *Chiodecton* are not known to possess perispores which are quite pronounced in *E. bradleyana* (Fig. 1C). Visually, *E. bradleyana* is somewhat similar to *E. caudata*, *E. divergens*, *E. elixii* and *E. mesomela*. However, *E. divergens* contains no substances, has larger ascospores and a considerably narrower perispore. *Enterographa elixii* also has larger ascospores and a narrower perispore, while containing psoromic acid and an I+ blue reacting hymenium. *Enterographa caudata*, described below, has a different chemistry and dramatically larger, differently shaped ascospores with greater septation. *Enterographa mesomela* differs by having confluentic acid, an I+ blue hymenium and smaller ascospores without a long acicular tail.

Additional specimens examined. **USA:** *Florida*: Monroe Co., Buoy Key, on *Avicennia germinans*, 2011, *Hernandez* 9011E; Rankin Key, on *Avicennia germinans*, 2011, 6611E; Clive Key, on *Cocos nucifera*, 2010, 3481E; Johnson Key, on *Avicennia germinans*, 2011, 5214E; Big Key, on *Avicennia germinans*, 2011, 8067E; End Key, on *Avicennia germinans*, 2011, 6541E; Dump Key, on *Avicennia germinans*, 2011, 6915E.

Enterographa caudata F. Seavey & J. Seavey sp. nov.

MycoBank No.: MB804777

Thallus grey, continuous, with effuse margins. Apothecia open, round to angular, 0·09–0·23 × 0·08–0·17 mm, not in pseudostromata. Hymenium I+ red. Ascospores (37–)45–60(–67) × 3–4 µm, 9–14 septate, with long acicular tails, perispore 2·5–3·5 µm wide. Containing schizopeltic acid and lichexanthone.

Type: USA, Florida, Miami-Dade County, Everglades National Park, 2 miles west of abandoned missile base, 25°22′N, 80°43′W, corticolous on *Ilex cassine* in hardwood scrub zone, 3 March 2012, *F. Seavey & J. Seavey*, 12931E (FNPS—holotype; FLAS—isotype).

(Fig. 1D–F)

Thallus ecorticate, 1·0–2·5 cm diam., pale grey, continuous, smooth, margins effuse, 130–180 µm thick, medulla white, prothallus absent. *Photobiont Trentepohlia.*

Ascomata black, open, round to more commonly angular, epruinose, with or without large white crystals, immersed in low thalline verrucae, these often ringed by white powdery/granular thalline material; disc 0·09–0·23 × 0·08–0·17 mm, not in pseudostromata, thalline margin present 0·01–0·02 mm wide. *Exciple* pale brown, *c.* 15 µm wide. *Hypothecium* hyaline or pale yellow, 45–55 µm tall. *Hymenium* hyaline, 95–120 µm tall, paraphysoids 1·4–1·9 µm wide, branched and anastomosing. *Epithecium c.* 20 µm tall, brown, K+ olive-green. *Asci* 60–75 × 17–25 µm, clavate, 8-spored. *Ascospores* fusiform (37–)45–60(–67) × 3–4 µm, 10–15-celled usually with a long acicular often hook-shaped tail, perispore 2·5–3·5 µm wide.

Pycnidia not detected.

Chemistry. Thallus K–, C–, P–, UV+ yellow (schizopeltic acid, lichexanthone); amyloidy: epihymenium, hypothecium, hymenium and asci I+ red, KI+ blue.

Etymology. Name referring to long tails of the ascospores.

Ecology and distribution. Enterographa caudata is currently known from hardwood scrub zones in well-lit areas and widely distributed, at least in the eastern half of the Park.

Discussion. *Enterographa caudata* is characterized by its unique chemistry within the genus, long ascospores with acicular tails and its I+ red hymenium. For a comparison of similar species, see discussion at *E. bradleyana* above. Also similar is a synonym of *E. anguinella*, formerly known as *E. lecanoroides*, which contains psoromic acid and lacks a prominent ascospore acicular tail.

Additional specimens examined. **USA:** *Florida*: Miami-Dade Co., south of Tamiami Trail near Blue Shanty canal, on *Salix caroliniana*, 2005, 12927E; 2 km west of abandoned missile base, on *Ilex cassine*, 2012, 12928E; glade trail west of Long Pine Key, on bark of dead tree, 2013, 12929E.

Enterographa murrayana F. Seavey & J. Seavey sp. nov.

MycoBank No.: MB804778

Similar to *Enterographa anguinella* but ascospores wider with more septa, perispore wider and containing gyrophoric acid.

Type: USA, Florida, Monroe County, Everglades National Park, Murray Key, 25°06′N, 80°56′W, corticolous on *Rhizophora mangle* in tidal zone of mixed mangrove species, 24 February 2010, *F. Seavey & J. Seavey*, 4949E (FNPS—holotype).

(Fig. 2A–C)

Thallus ecorticate, 2–3 cm diam., continuous, smooth, pale grey, 120–260 µm thick, medulla white, prothallus absent. *Photobiont Trentepohlia.*

Ascomata brown to brown-black, epruinose, closed to tardily open, immersed, lirelliform following bark fissures, unbranched, 0·4–0·6 × 0·08–0·14 mm, not in pseudostromata, thalline margin absent. *Exciple* thin, hyaline to pale brown, 12–15 µm wide. *Hypothecium* hyaline to pale brown, 30–44 µm tall. *Hymenium* hyaline, 100–125 µm tall, paraphysoids 1·0–1·2 µm wide, branched and anastomosing. *Epithecium c.* 12 µm tall, hyaline to pale brown, K−. *Asci* 55–65 × 15–18 µm, narrowly clavate, 8-spored. *Ascospores* fusiform (37–)40–49(–58) × 4·5–5·5 µm, 10–15-celled, perispore 4·0–4·5 (–5·0) µm wide.

Pycnidia not detected.

Chemistry. Thallus K−, C+ pink-red (gyrophoric acid), P−; amyloidy: epihymenium, hymenium and asci I+ red, KI+ blue. Hypothecium I+ blue, KI+ blue.

Etymology. The name commemorates a Mrs Murray who resided on the Key as a squatter for many years in the early part of the 20th century and raised five fatherless children there. Her full name does not appear in any historical documents of the time.

Ecology and distribution. Currently known only from the one collection. However, superficially *E. murrayana* closely resembles *E. anguinella* and several species of *Arthonia*, all of which are common at the collection site. Thus, it seems eminently possible that subsequent investigation will show *E. murrayana* to be more common than currently indicated.

Discussion. Enterographa murrayana is distinguished by its long ascospores, extremely wide perispore and the presence of gyrophoric acid. Among other corticolous *Enterographa* lacking pseudostroma with an I+ red hymenium, only *E. bradleyana* (this paper) and *E. pallidella*, recently reported for North America (Seavey & Seavey 2012), have a similar chemistry. However, the former has black apothecia immersed in thalline verrucae, smaller ascospores and a narrower perispore, while the latter has paler apothecia and smaller ascospores with a perispore rarely exceeding 1 µm wide.

Enterographa nitidula F. Seavey & J. Seavey sp. nov.

MycoBank No.: 804779

Similar to *Enterographa inthanonensis* but differing by its smaller ascospores, lack of true pseudostromatic tissue and a different chemistry.

Type: USA, Florida, Everglades National Park, Monroe County, Rankin Key, 25°07′N, 80°47′W, lignicolous on lignum of *Conocarpus erectus* in open prairie with halophytic herbaceous layer, 11 May 2012, *F. Seavey & J. Seavey* 12970E (FNPS—holotype).

(Fig. 2D–F)

Thallus ecorticate, 3–4 cm diam., continuous, smooth, white, with a somewhat glossy sheen, 200–300 µm thick, medulla white, prothallus absent. *Photobiont Trentepohlia.*

Ascomata black, epruinose, open, punctiform, immersed, 0·04–0·12 mm wide, randomly arranged in unraised bright white parts of the thallus, not in pseudostromata, thalline margin absent or occasionally present, 0·015–0·020 mm wide. *Exciple* thin, hyaline to pale brown, 8–16 µm wide. *Hypothecium* hyaline, 20–30 µm tall. *Hymenium* hyaline, 80–100 µm tall, paraphysoids 1·5–1·8 µm wide, branched and anastomosing. *Epithecium* 12–18 µm tall, pale brown, K+ olive-green. *Asci* 65–78 × 13–14 µm, narrowly clavate, 8-spored. *Ascospores* fusiform 16–19 × 4·0–4·5 µm, 4-celled, perispore *c.* 2·0 µm wide.

Pycnidia not detected.

Chemistry. Thallus K+ yellow (unknown substance: see below), C−, P−; amyloidy: epihymenium, hypothecium, hymenium and asci I+ red, KI+ blue.

Etymology. Name refers to the thallus sheen.

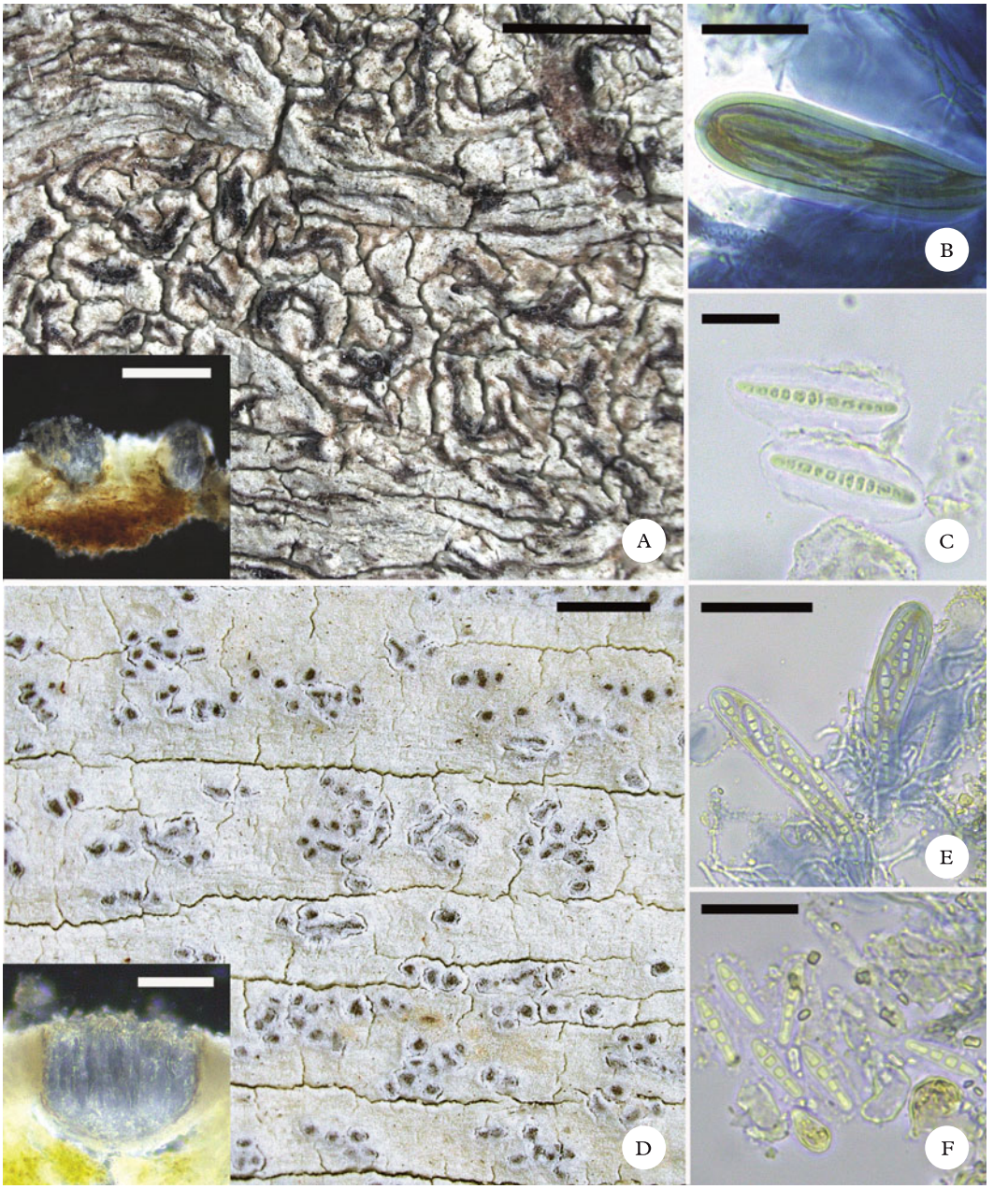

FIG. 2. A–C, *Enterographa murrayana*; A, thallus with lirelliform ascomata (insert: ascoma section); B, ascus with well-developed ocular chamber; C, ascospores with characteristic broad perispore. D–F, *E. nitidula*; D, smooth, shiny thallus with punctate ascomata (insert: ascoma section); E, asci; F, consistently 4-celled ascospores. Scales: A & D inserts = 200 μm; A & D = 1 mm; B, C, E & F = 20 μm.

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Ecology and distribution. Enterographa nitidula was collected only once from the lignum of *Concarpus erectus*, fully exposed to sunlight but out of the tidal zone and away from salt spray.

Discussion. Enterographa nitidula is characterized by its punctiform ascomata, small 4-celled spores, hymenium reacting I+ red and an unknown substance similar to 4-*O*-methylcryptochlorophaeic acid (solvent system C = 26–27, solvent system A = 31–32, spot brownish orange after char, green in long wave ultraviolet light). Although the thallus reacts strongly K+ yellow, no yellow effusion or crystal formation was observed in section. Further investigation via TLC may degrade the integrity of the type collection. A definitive metabolite identification will have to await HPLC analysis. Among other consistently 4-celled *Enterographa, E. compunctula* differs in having larger ascospores, a narrower perispore and a different chemistry.

World key to the species within *Enterographa*

The foundation of this key is based upon the work of Sparrius (2004). As stated above, subsequent to that work many new species have been described. Furthermore, recent data suggests that two species (*Enterographa subcervina* and *E. zonata*) with partially carbonized exciples nest within *Enterographa* and two others, *E. anguinella* and *E. subserialis*, are best placed in other genera. For convenience, all four have been included in this key with their *Enterographa* epithets followed by the citation explaining their relocation.

1 Species obligately foliicolous (infrequently corticolous on bamboo with *E. multiseptata*) 2
Species appearing on other substrata. 14

2(1) Ascospores 4-celled; thallus P+ yellow (psoromic acid). 3
Ascospores 6 or more celled; thallus P+ or P− 4

3(2) Thallus pale grey, circular, disjunct or several coalescing; ascospores 23–27 × 2·5–3·0 μm, perispore to 2·5 μm; known only from type locality, Chile . . . . . **E. falcata Lücking & V. Wirth**
Thallus pale grey-green, effuse, not in circular pattern; ascospores 17–23 × 3–4 μm, perispore to 1·5 μm; Central America, eastern Paleotropics . . . . . **E. angustissima (Vain.) R. Sant.**

4(2) Thallus C+ pink to red, (gyrophoric acid) 5
Thallus C−, P+ yellow (psoromic acid) or epithecium K+ yellow-orange,. . . . . (*E. batista*). 6

5(4) Ascospores 18–24 × 2–5 μm, 6-celled; conidia filiform, 20 × 1 μm; . . . . . Christmas Island, Papua New Guinea . . . . . **E. deslooveri Sérus.**
Ascospores 23–30 × 2·5–4·0 μm, 6(8)-celled; conidia bacilliform, 3 × 1 μm; known only from type locality, Oregon, USA. . . . . **E. oregonensis Sparrius & Björk**

6(4) Epithecium K+ yellow-orange, containing pale orange pigment; ascospores 24–33 × 3·5–4·5 μm, 8-celled; known only from the type locality, Brazil . . . . . **E. batistae Lücking & Sérus.**
Epithecium K–, not containing orange pigment 7

7(6) Hypothecium dark brown; ascomatal disc chocolate brown; Costa Rica . . . . . **E. foliicola Matzer & Lücking**
Hypothecium pale; ascomatal disc not chocolate brown 8

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8(7) Thalline margin white, byssoid; disc pale orange; Central America . . . . . **E. byssoidea Lücking**
Thalline margin not byssoid; disc not pale orange 9

9(8) Ascomata black, lirelliform, stellately branched; ascospores 8–12-celled, 22–36 µm long; tropical Asia, East Africa . . . . . **E. multiseptata R. Sant.**
Ascomata not black, not stellately branched 10

10(9) Ascospores > 30 µm long; ascomata pale yellow without brown tint; Seychelles . . . . . **E. seawardii Lücking & Henssen**
Ascospores < 30 µm long; ascomata darker, distinctly brown-tinted 11

11(10) Ascospores < 23 µm long; thallus white; known only from the type collection, New Zealand . . . . . **E. bartlettii Sérus.**
Ascospores > 25 µm long; thallus greyish green to yellowish green 12

12(11) Photobiont (*Phycopeltis*) without cells in radiating plates; ascospores 8–10-celled; known only from the type locality, Mexico . . . . . **E. perez-higaredae Herrera-Campos & Lücking**
Photobiont (*Phycopeltis*) with cells in radiating plates; ascospores 8-celled. 13

13(12) Thalline margin orange-brown, smooth; disc closed; Australia, New Zealand . . . . . **E. bella R. Sant.**
Thalline margin grey-green, crenulate; disc open; Tanzania . . **E. vezdae Sparrius**

14(1) Species obligately lichenicolous 15
Species corticolous, lignicolous or saxicolous 20

15(14) Lichenicolous on *Coenogonium* 16
Lichenicolous on other genera. 18

16(15) Ascomata apothecioid, raised, not forming in pseudostromatic tissue; ascospores 15–18 µm long, 8-celled; known only from the type locality, Kenya. . . . . **E. fellhaneroides Yeshitela *et al.***
Ascomata forming in pseudostromatic tissue. 17

17(16) Ascospores averaging > 17 µm long, consistently 8-celled; Papua New Guinea, Costa Rica, Brazil . . . . . **E. epiphylla (Sérus.) Ertz *et al.***
Ascospores averaging < 17 µm long, 5–6-celled; known only from the type locality; Kenya . . . . . **E. meklitiae Yeshitela *et al.***

18(15) Lichenicolous on *Lobaria*; ascomata inducing gall formation; ascospores 17–21 µm long, 4-celled; known only from the type collection; Sri Lanka . . . . . **E. punctata Ertz & Diederich**
Lichenicolous on other genera; ascomata not gall-inducing 19

19(18) Lichenicolous on foliicolous *Mazosia*; ascospores 4–5-celled; South-East Asia, Orient . . . . . **E. mazosiae R. Sant. ex Matzer & R. Sant.**
Lichenicolous on *Porina*; ascospores 5–7-celled; British Isles, France . . . . . **E. brezhonega Sparrius & Aptroot**

20(14) Exciple well developed apically, at least partially carbonized 21
Exciple poorly developed, never carbonized 22

21(20) Thallus K−, sorediate; ascospores < 40 µm long; Pan-temperate . . . . . **E. zonata (Körb.) Källsten ex Torrente & Egea** (Ertz *et al.* 2009)
Thallus K+ red (norstitic acid), esorediate; ascospores > 40 µm long; known only from the type collection, Hawaii . . . . **E. subcervina (Zahlbr.) Ertz** (Ertz 2009)

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22(20) Thallus sorediate 23
Thallus not sorediate 24

23(22) Thallus C+ pink-red, P−; ascospores > 11 μm long, 4-celled; known only from the type locality; French Guiana . . . . . **E. zephyri Sparrius**
Thallus C−, P+ red; ascospores < 11 μm long, 5–6-celled; Great Britain . . . . . **E. sorediata Coppins & P. James**

24(22) Thallus C+ pink-red (gyrophoric acid or erythrin) 25
Thallus C− 30

25(24) Ascospores averaging > 40 μm long, 10–18-celled 26
Ascospores averaging < 40 μm long (usually considerably less), 4–12-celled 27

26(25) Thallus P+ yellow (psoromic acid); thalline margin C+ pink-red; ascospores 2·5–4·0 μm wide; coastal, Black Sea, Mediterranean, Western Europe, Canary Islands . . . . . **E. elaborata (Leight.) Coppins & P. James**
Thallus P−, ascospores 4·5–5·5 μm wide; Florida Keys, USA . . . . . **E. murrayana F. Seavey & J. Seavey**

27(25) Disc pale yellow or pale brown; ascomata lirelliform, not prominent; thalline margin absent 28
Disc brown to black; ascomata rounded, prominent; thalline margin present 29

28(27) Saxicolous on volcanic rock; thallus thick and areolate; ascospores 18–25 μm long, 4–6-celled; Pantropical, coastal. . . . . **E. leucolyta (Nyl.) Redinger**
Corticolous (occasionally on Si rock but then thallus thin, i.e. not as above); ascospores 23–33 μm long, 7–13-celled; Pantropical . . . . . **E. pallidella (Nyl.) Redinger**

29(27) Ascospores 17–23 μm long, 5–7-celled; disc black; Florida Keys, USA. . . . . **E. bradleyana F. Seavey & J. Seavey**
Ascospores 25–40 μm long, 8-celled, disc brown; known only from the type locality, Chile . . . . . **E. lecanoracea Sipman**

30(24) Ascospores 4-celled 31
Ascospores 5–25-celled 37

31(30) Ascomata arranged in pseudostromatic tissue. 32
Ascomata not arranged in pseudostromatic tissue 35

32(31) Thallus P+ yellow (psoromic acid) 33
Thallus P− 34

33(32) Ascospores > 25 μm long; ascomata ellipsoid, dark brown-black; known only from the type locality, Australia . . . . . **E. elixii Sparrius**
Ascospores < 25 μm long; ascomata lirelliform, stellately branched, brown; known only from the type locality, Indonesia . . . . . **E. pertusarioides Groenhart ex Sparrius**

34(32) Ascospores < 30 μm long; thallus K− (or brownish); ascomatal sections K+ yellow-orange precipitating norstictic acid crystals; Hawaii, Australia, Florida, USA. . . . . **E. compunctula (Nyl.) Redinger**
Ascospores > 40 μm long; thallus K+ red (norstictic acid); ascomatal sections K+ green; Thailand . . . . . **E. inthanonensis Sparrius**

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35(31) Thallus P−; ascomata punctiform; ascospores 16–20 µm long; Florida Keys, USA . . . . . **E. nitidula F. Seavey & J. Seavey**
Thallus P+ yellow (psoromic acid) 36

36(35) Ascospores > 25 µm long; ascomata round to long lirelliform, pale brown; Cuba, Florida, USA . . . . . **E. albopunctata Sparrius**
Ascospores < 18 µm long; ascomata punctiform, dark brown to black; Seychelles . . . . . **E. aldabrensis Sparrius**

37(30) Ascomata arranged in pseudostromatic tissue clearly differentiated in colour and/or structure from the rest of the thallus 38
Ascomata arranged otherwise 43

38(37) Thallus P+ yellow (psoromic acid); ascomatal sections emitting K+ yellow effusion and precipitating norstictic acid crystals; ascospores 25–40 µm long; Pantropical . . . . . **E. subserialis (Nyl.) Redinger** (Ertz & Tehler 2011)
Thallus P− 39

39(38) Thallus UV+ yellow (lichexanthone); Brazil . . . . . **E. kalbii Sparrius**
Thallus UV− 40

40(39) Sections of pseudostroma emitting K+ yellow effusion, precipitating norstictic acid crystals 41
Sections of pseudostroma K−, not precipitating norstictic acid crystals 42

41(40) Averaging 5–15 ascomata per pseudostroma; excipulum dark brown; hymenium I+ blue; known only from the type collection, Brazil. . . . . **E. subquassiicola Cáceres & Lücking**
Averaging 5 or less ascomata per pseudostroma; excipulum pale orange; hymenium I+ red; Central and South America, Florida, USA . . . . . **E. quassiicola Fée**

42(40) Ascomata apothecioid; ascospores averaging > 35 µm long, consistently 8-celled; Brazil. . . . . **E. chiodectonoides Cáceres & Lücking**
Ascomata perithecioid; ascospores averaging < 35 µm long, 4–7-celled; known only from type collection, Zambia . . . . . **E. diederichiana Ertz**

43(37) Thallus P+ yellow (psoromic acid) 44
Thallus P− 47

44(43) Ascospores averaging < 30 µm long, 4–8-celled 45
Ascospores averaging > 30 µm long, 8–17-celled 46

45(44) Thalline margin of ascomata often C+ pink-red; ascospores 20–25 µm long, 6–8-celled; saxicolous; Australia, New Zealand . . . . . **E. subgelatinosa (Stirt.) Redinger**
Thalline margin of ascomata C−; ascospores 15–25 µm long, 4(−6)-celled; corticolous; India, Australia. . . . . **E. micrographa (Nyl.) Redinger**

46(44) Ascomata black, punctiform; ascospores 13–17-celled; known only from type collection, India . . . . . **E. bengalensis Jagadeesh *et al.***
Ascomata pale to dark red-brown, lirelliform; ascospores 6–12-celled; Pantropical . . . . . **E. anguinella (Nyl.) Redinger** (Ertz et al. 2009)

47(43) Thallus UV+ yellow; ascospores 45–60 µm long with acicular tail; Florida, USA . . . . . **E. caudata F. Seavey & J. Seavey**
Thallus UV− or at least not yellow; ascospores without acicular tail. 48

48(47) Ascospores > 50 µm long, 15–20-celled; Brazil, Barbados . . . . . **E. multilocularis (Müll. Arg.) Sparrius**
Ascospores < 40 µm long, 5–12-celled 49

49(48) Ascomata broad, round to irregular. 50
Ascomata punctiform to lirelliform 51

50(49) Ascospores < 30 µm long, 6–8-celled; ascomata red-brown to black; South-East Asia, East Africa . . . . . **E. divergens (Müll. Arg.) Redinger**
Ascospores > 30 µm long, 8–10-celled; ascomata black; Thailand, Vietnam . . . . . **E. mesomela Sparrius *et al.***

51(49) Containing no substances 52
Containing confluentic acid 53

52(51) Conidiomata prominent, black, crater-like; ascomata lirelliform, brown; ascospores 6–12-celled; South-East Asia . . . . . **E. tropica Sparrius**
Conidiomata inconspicuous, immersed; ascomata punctiform; ascospores consistently 8-celled; known only from the type locality, French Guyana . . . . . **E. sipmanii Sparrius**

53(51) Ascomata comma-shaped to lirelliform, often branched; ascospores 25–32 µm long; Europe and eastern North America . . . . . **E. hutchinsiae (Leight.) A. Massal.**
Ascomata punctiform to ellipsoid, not branched. 54

54(53) Thallus lead grey to dark brownish grey; ascospores 27–35 µm long, 6–7-celled; conidia 6–8 × 1 µm; Mediterranean Europe, north-west Africa, Azores. . . . . **E. pitardii (B. de Lesd.) Redinger**
Thallus olive-green; ascospores 30–38 µm, 5–8-celled; conidia 4–6 × 1 µm; western Europe, north-west Africa. . . . . **E. crassa (DC.) Fée**

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