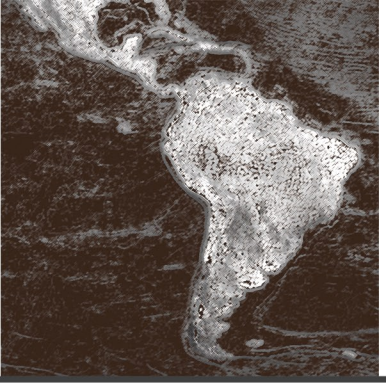

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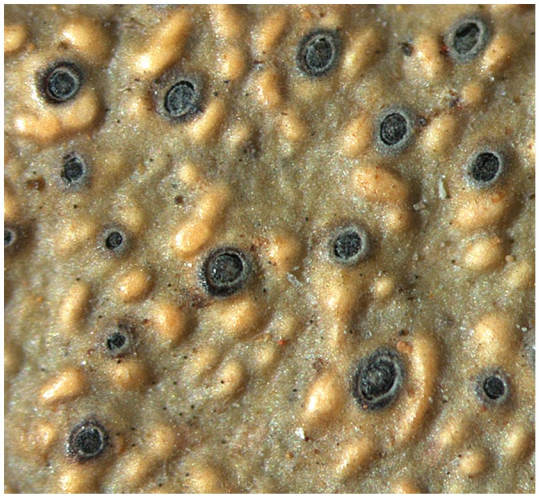
A key to species of the Ocellularia papillata, perforata and terebrata morphodemes



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A key to species of the *Ocellularia papillata*, *perforata* and *terebrata* morphodemes (Ascomycota: Graphidaceae)

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Resumen — Lücking, R. (2014) Una clave para las especies del morfodema de *Ocellularia papillata*, *perforata* y *terebrata* (Ascomycota: Graphidaceae). *Glalia* **6(3):** 1–35. — Se presenta una clave para 69 especies semejantes a o relacionados con *Ocellularia papillata*, *O. perforata* y *O. terebrata*, es decir especies con ascomas con columela, ascosporas pequeñas, hialinas y transversalmente septadas, y sin sustancias secundarias o con sustancias del quimiosindroma de ácido protocetrarico o psoromico. Además se menciona seis especies sorediadas, para un total de 75 taxones. Se propone cuatro nuevas combinaciones: *Ocellularia erodens* (R. C. Harris) Lücking, *O. khaoyaiana* (Homchant. & Coppins) Lücking, *O. rongklaensis* (Homchant. & Coppins) Lücking, and *O. subminuta* (Homchant. & Coppins) Lücking. Además, se reestablece los siguientes once taxones: *Ocellularia cinereoglaucescens* (Vain.) Zahlbr., *O. collativa* (Kremp.) Zahlbr., *O. comparabilis* (Kremp.) Müll. Arg., *O. excavata* (Vain.) Zahlbr., *O. gymnocarpa* (Nyl.) Zahlbr., *O. protocetrarica* Hale, *O. rufocincta* Müll. Arg., *O. violacea* Räsänen, *O. viridipallens* Müll. Arg., and *O. zamboangensis* (Vain.) Zahlbr.

Palabras clave — Carbonización, columela, concepto de especies, Ocellularieae, variación morfológica.

Abstract — Lücking, R. (2014) A key to species of the *Ocellularia papillata*, *perforata* and *terebrata* morphodemes (Ascomycota: Graphidaceae). *Glalia* **6(3):** 1–35. — A key is presented to 69 species similar or related to *Ocellularia papillata*, *O. perforata*, and *O. terebrata*, that is species with columellate ascomata, small, hyaline, transversely septate ascospores, and either lacking secondary substances or with the protocetraric or psoromic acid chemosyndrome. Six sorediate species are also mentioned, for a total of 75 taxa. Four new combinations are proposed: *Ocellularia erodens* (R. C. Harris) Lücking, *O. khaoyaiana* (Homchant. & Coppins) Lücking, *O. rongklaensis* (Homchant. & Coppins) Lücking, and *O. subminuta* (Homchant. & Coppins) Lücking. The following eleven previously synonymized names are reinstated: *Ocellularia cinereoglaucescens* (Vain.) Zahlbr., *O. collativa* (Kremp.) Zahlbr., *O. comparabilis* (Kremp.) Müll. Arg., *O. excavata* (Vain.) Zahlbr., *O. gymnocarpa* (Nyl.) Zahlbr., *O. protocetrarica* Hale, *O. rufocincta* Müll. Arg., *O. violacea* Räsänen, *O. viridipallens* Müll. Arg., and *O. zamboangensis* (Vain.) Zahlbr.

Key words — Carbonization, columella, morphological variation, Ocellularieae, species concept.

Introducción

The genus *Ocellularia* G. Mey. has been variously delimited and classified in the past. Following MÜLLER (1882, 1887) and ZAHLBRUCKNER (1923), for a long time this name was used for species with more or less rounded ascomata and transversely septate, hyaline ascospores. More recently, SALISBURY (1971) and HALE (1980, 1981) redefined *Ocellularia* as having a carbonized excipulum and lacking periphysoids, but with ascospores varying from transversely septate to muriform and from hyaline to grey-brown. Until then and up to the recent past, *Ocellularia* was assigned to the family Thelotremataceae (FRISCH et al. 2006). Molecular sequence data, however, demonstrated that Thelotremataceae formed part of Graphidaceae

(STAIGER et al. 2006; MANGOLD et al. 2008; RIVAS PLATA et al. 2013) and that *Ocellularia* sensu Hale comprises a larger number of separate, in part not even closely related genera, resulting in newly recognized or reinstated segregates such as *Clandestinotrema* in subfamily Fissurinoideae, as well as *Melanotrema*, *Redingeria*, and *Rhabdodiscus* (FRISCH et al. 2006; RIVAS PLATA et al. 2012a, b). The alternative proposal by HODKINSON (2012) to recognize four families within Graphidaceae, and hence maintain the family names Gomphillaceae, Graphidaceae, and Thelotremataceae separate, is not followed, since Graphidaceae sensu Hodkinson would exclude the *Acanthothecis* clade and the genus *Phaeographopsis*, and Thelotremataceae sensu Hodkinson is not a supported clade and would exclude the genus *Diploschistes*, but include instead lirellate lineages such as *Carbacanthographis* and *Heiomasia* (LUMBSCH et al. 2014).

In its current, natural circumscription, *Ocellularia* is the largest genus with rounded ascomata in Graphidaceae and the second largest genus overall, after *Graphis* Adans., with nearly 300 species currently recognized (RIVAS PLATA et al. 2012a; LÜCKING 2014, 2015; LÜCKING et al. 2014; WEERAKOON et al. 2014). Considering the size of the genus, available sequence data are still limited, currently covering approximately 140 species and 290 individuals (RIVAS PLATA et al. 2012a, 2013; KRAICHAK et al. 2014). Nevertheless, these data demonstrate that the rather broadly applied species concepts in this genus, often including forms with variable thallus morphology, ascoma carbonization, columella shape, and ascospore size and septation within a single species, are ill-defined. Rather, it appears that those species supported and resolved as monophyletic are rather uniform morphologically and that forms included within the broad concept of a single species are often not even closely related (RIVAS PLATA et al. 2012a, 2013; KRAICHAK et al. 2014).

With many species of *Ocellularia* having small, transversely septate, hyaline ascospores and with the predominance of species with the psoromic or protocetraric acid chemosyndrome or no secondary substances, three species complexes have been particular stumbling blocks: the *O. papillata* complex (no substances), the *O. perforata* complex (protocetraric acid), and the *O. terebrata* complex (psoromic acid). In addition, revision of herbarium material showed that often species with quite different morphologies and clearly not belonging into these complexes have been identified with these names. Molecular data demonstrate that species traditionally identified as *O. papillata*, *O. perforata*, and *O. terebrata*, belong in several, well-defined, monophyletic clades, including the *O. perforata* clade, the *O. terebrata* clade, the *O. bahiana* clade, and the *O. cavata* clade (RIVAS PLATA et al. 2012a). They can therefore not even be considered species complexes, but should correctly be addressed as morphodemes, i.e. morphologically similar but often unrelated taxa.

In this paper, an attempt is made to summarize the current knowledge on these morphodemes in form of a world key including all currently recognized species. The key includes all species of *Ocellularia* that share the following characters and in a broad concept would have been identified as either *O. papillata*, *O. perforata*, or *O. terebrata*: (1) small, transversely septate, hyaline ascospores; (2) a clear hymenium; (3) presence of a columella; (4) absence of medullary or ascoma pigments; and (5) a chemistry conforming to one of the three morphodemes, i.e. either the psoromic or the protocetraric acid chemosyndrome or no secondary substances. This definition includes a surprising total of 69 species, i.e. nearly 25% of

the entire genus as currently circumscribed, plus six additional taxa that differ in producing soralia. For all species, their inferred distribution and the origin of the type material is given, as well as currently accepted synonyms. Almost all species are also illustrated with color plates showing morphological features. A few species that fit these criteria but differ in producing soralia are not included but instead are mentioned in the key couplets where they would key out based on their ascoma morphology.

Material and Methods

Herbarium specimens, ranging from historic type gatherings to freshly collected material, were studied at The Field Museum or at various international herbaria in situ (B, BM, FH, G, H, NY, S, TUR, US, W), using standard optical equipment and standard preparative methods. Hand sections of thalli and ascomata were studied in tap water to obtain measurements of anatomical details. Lugols' iodine solution (I) was used to test for ascospore amyloidity. Spot tests on exposed medulla using paraphenyl-diamine crystals dissolved in 95% ethanol (P) were applied to all specimens excluding type material and thin-layer chromatography (TLC) was used to confirm the presence or absence of the chemosyndromes. The psoromic acid chemosyndrome can be distinguished from all other chemosyndromes occurring in *Ocellularia* by the P+ yellow reaction of the medulla. The P+ orange-red reaction of the protocetraric acid chemosyndrome is similar to the P+ red reaction of the cinchonarum unknown chemosyndrome occurring in *O. cavata* (Ach.) Müll. Arg. and many other species and in these cases, TLC is often indispensable to clarify the secondary chemistry. The following morphological and anatomical characters were assessed for each specimen including types, as far as possible:

Surface relief – The thallus surface may appear smooth (Fig. 1A) to uneven, distinctly verrucose, with the verrucae small (Fig. 1B) to large (Fig. 1C), of same color as the thallus, or papillose, with small, whitish verrucae (Fig. 1D), or bumpy (verrucae very large, shallow) to bullate (verrucae very large, protrudent and contiguous; Fig. 1E). Some species produce elongate ridges (Fig. 1F, or the thallus may appear folded. This often overlooked character is here considered to have taxonomic importance.

Surface color – Surface color may vary within a species depending on light exposure and preservation. Therefore, colors of herbarium specimens ranging between brownish yellow and olive-green (Fig. 1A, 1C, 1F) were not given any taxonomic importance. However, whitish color in living specimens (Fig. 1E), sometimes becoming pale yellowish in the herbarium, were considered a specific feature, often correlated with the position of calcium oxalate crystals relative to the photobiont layer.

Cortex type – Most species have a dense cortex of either proso- (cells elongate) or paraplectenchymatous (cells isodiametric) cell arrangement; seen from above, the thallus surface appears compact and shiny (Fig. 1A, 1C, 1E). The difference between the two types is difficult to discern and also depends on the angle of the thallus section. Therefore, the only states used in the key were presence of a dense versus a loose cortex, found in a few species only. In these species, the surface appears roughened (Fig. 2A).

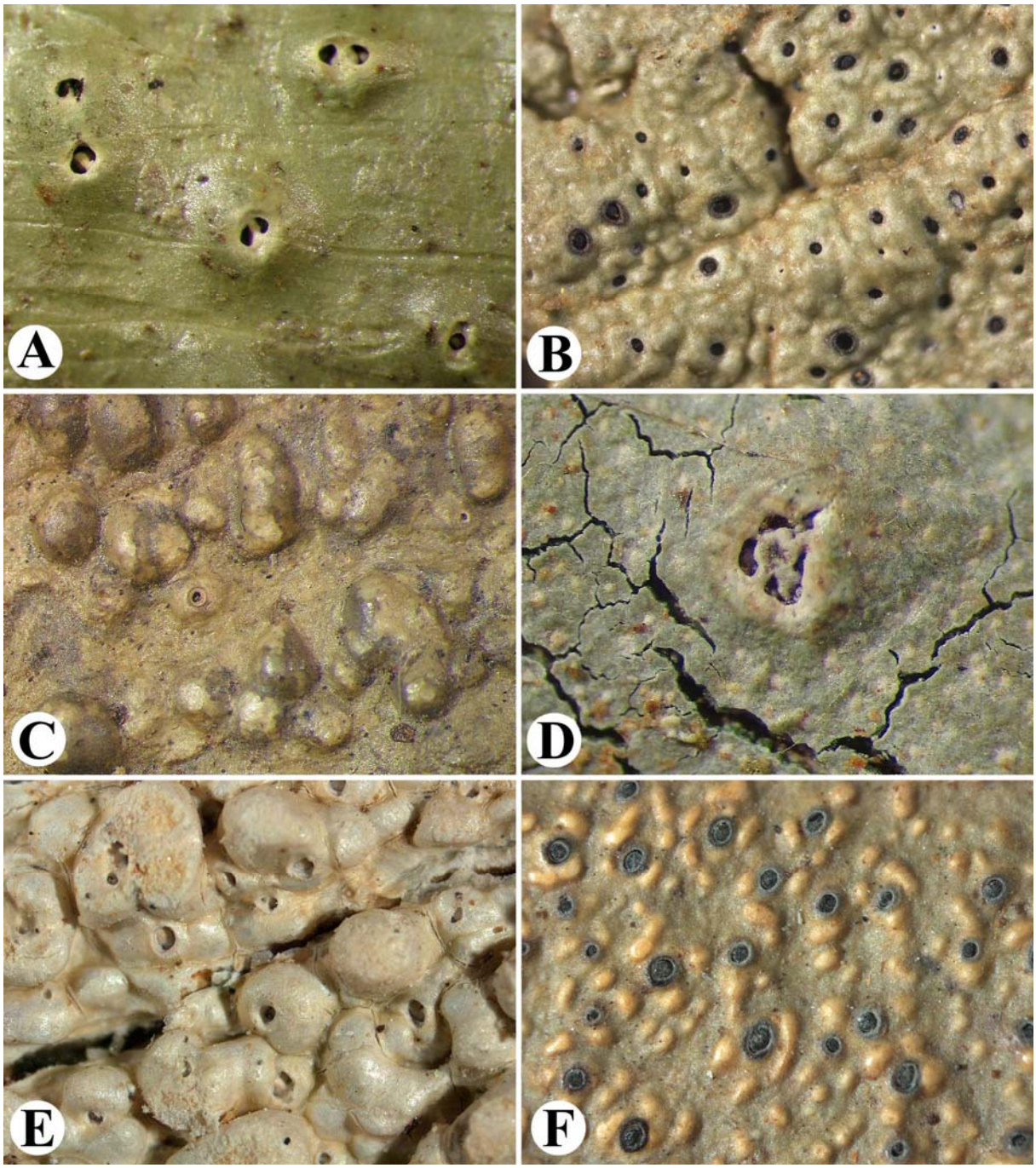

Figure 1 — Characters in *Ocellularia* species. A, smooth thallus (*O. barroensis*). B. verrucose thallus (*O. buckii*). C, coarsely verrucose thallus (*O. grantii*). D, papillose thallus (*O. papillifera*). E, bullate thallus (*O. albobullata*). F, rugose thallus (*O. subperforata*).

Nature and morphology of thallus crystals – Clusters of calcium oxalate crystals are common in Graphidaceae; in *Ocellularia* they are mostly scattered and small to medium-sized, but in some species they can be large and arranged in columnar fashion, then giving the thallus a minutely grainy appearance when seen from above (Fig. 2A). Phylogenetic evi-

dence suggests that this is a very important specific feature of particular clades or taxa (RIVAS PLATA et al. 2012a).

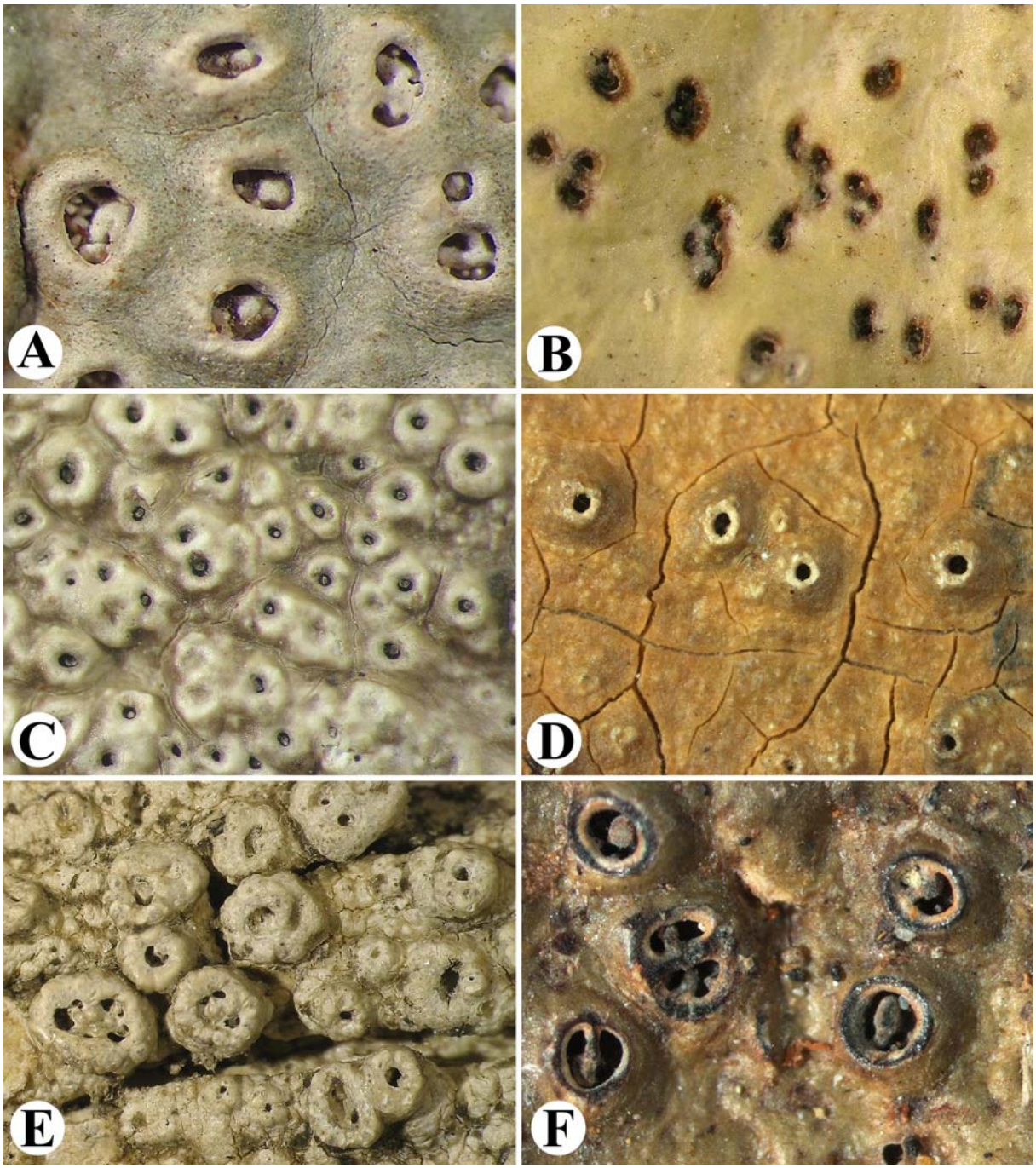

Figure 2 — Characters in *Ocellularia* species. A, minutely grainy thallus (*O. auberianoides*). B, immersed ascomata (*O. papillata*). C, erumpent ascomata (*O. pauciseptata*). D, prominent ascomata (*O. conformalis*). E, sessile ascomata (*O. mauretiana*). F, ascomata with black margin around pore (*O. wandoorensis*).

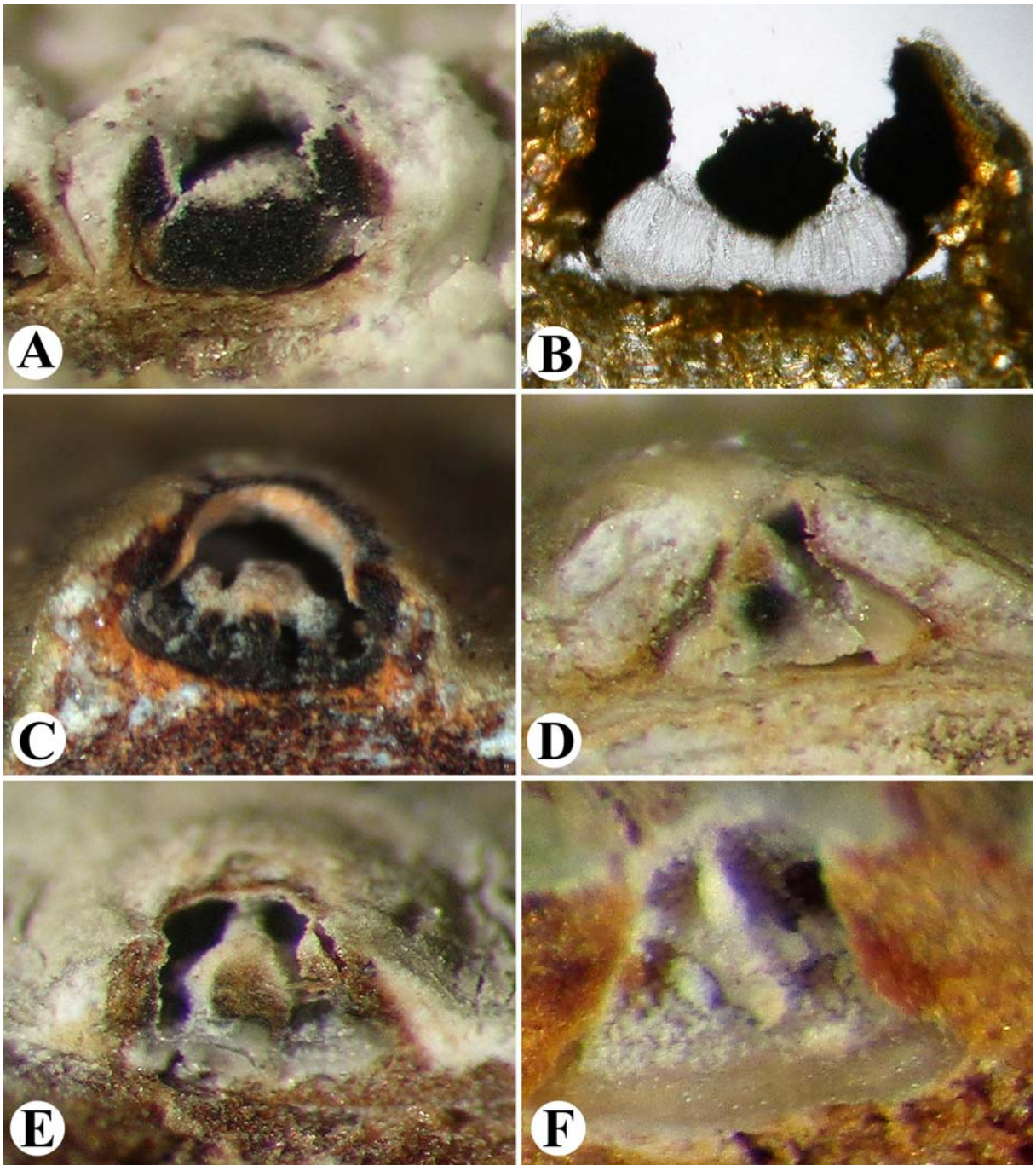

Figure 3 — Characters in *Ocellularia* species. A–C, carbonized excipulum and columella (A–B, *O. antillensis*; C, *O. wandoorensis*). D, brown excipulum and carbonized columella (*O. pluripora*). E, dark brown excipulum and columella (*O. comparabilis*). F. orange excipulum and colorless columella (*O. immersocarpa*). Photograph in B by Armin Mangold.

Ascoma shape and emergence – Ascoma shape was distinguished as regularly rounded (Fig. 1B, 1F, 2D), irregular to lobate (1D, 2A–B) and elongate to lirellate. Following the concept of LÜCKING (2009) for the genus *Graphis*, ascoma emergence was defined as immersed

(upper part flush with thallus; Fig. 2B), erumpent (protruding through thallus surface but at least half-immersed; Fig. 2C), prominent (more than half to completely above thallus surface; Fig. 2D), and sessile (with constricted base; Fig. 2E).

Ascoma size and pore diameter relative to ascoma size – While these characters obviously depend on the age of the ascomata, phylogenetic evidence suggests that within a given species, maximum ascoma size and relative pore size exhibit only limited variability and hence can be used as supporting characters for species delimitation.

Color of ascoma margin – This character depends on how far the ascomata are covered with a thalline layer and the thickness of that layer. In many cases, the thalline layer extends up to the ostiole and the ascoma margin is then of thallus color (Fig. 1E, 2A, 2E). However, the upper portion of the excipulum can be exposed and in addition be covered by pruina or a compact whitish layer, similar to the situation in *Graphis* (LÜCKING 2009), in which case the ostiole is bordered by a whitish to brown or black rim, or often a combination of two colors (Fig. 1F, 2B, 2D, 2F).

Presence and nature of a columella – The presence of a columella is one of the most important features of *Ocellularia* and related genera. Most species of the genus feature a columella, but it might be consistently absent in others or sometimes present in a portion of the ascomata only. The shape ranges from finger-like (narrow; Fig. 2C) to plug-shaped (slightly broader than high; Fig. 1F) to broad-stump-shaped (two or more times as broad as high), or it can disintegrate to form triangular teeth or become irregular with radiating strands and bridges towards the lateral excipulum (Fig. 1A, 2A, 2E–F). To reliably assess columella shape, only mature ascomata should be observed, since columella ontogeny goes through several stages and young ascomata of species with complex columella often have a simple, plug-shaped columella.

Excipulum and columella carbonization – The often dark pigmentation of excipulum and columella is presumably caused by melanin pigments. In high concentration, this pigmentation appears black. In the literature there is no clear consensus as to what defines "carbonization", and authors include here often (dark) brown pigmentation as well, especially based on thick hand sections inspected under the compound microscope. Here, carbonization is defined as jet-black color in surface view of a section observed under the dissecting microscope (Fig. 3A–D). If no black color is present, then carbonization is absent, even if the excipulum and columella appear dark brown (Fig. 3E–F). Often, the columella is carbonized whereas the excipulum is not (Fig. 3D). One has to be careful when determining excipulum pigmentation, since the excipulum is usually bordered by a thick, orange-brown to dark brown layer of bark periderm. The true excipulum is only the layer composed of fungal hyphae between the lateral hymenium and the periderm.

Ascospore septation and size – By definition, the assembly treated here only includes species with small, transversely septate ascospores. Ascospore size ranges between 10 and 50 µm and septation between 3 and 11 septa. While most species have ascospores ranging from 20 to 30 µm and with 5 to 9 septa, in some cases particularly small (10–20 µm) ascospores or ascospores in the upper range of this size class (30–50 µm) are present. These

have been used as supporting characters for species delimitation, but quantitative analysis of a larger number of specimens is required to confirm such differences.

Secondary chemistry – Within each of the three chemically defined groups, there is very little variation in the composition of secondary compounds. The group containing psoromic acid as major compound invariably features subpsoromic and 2'-*O*-demethylpsoromic acids as accessory substances in variable concentrations (major to trace). Most species with protocetraric acid have virensic acid as accessory substance; however, a few species also contain fumarprotocetraric acid, which in one instance (*Ocellularia subminuta*) is the major component. *Ocellularia vezdana* contains the *vezdana* unknown in addition to protocetraric and virensic acids. This chemical variation in the protocetraric acid group needs further study in terms of its taxonomic importance.

Potential infraspecific variation as opposed to diagnostic species-level differences regarding the above characters were assessed by analyzing phylogenetically well-supported and well-resolved species in *Ocellularia* and related genera, such as *Myriotrema*, *Rhabdodiscus*, and *Stegobolus* (RIVAS PLATA et al. 2012a, 2013). These findings suggest that there is a very low degree of infraspecific variation and such variation is chiefly correlated with age (ontogenetic variation), substrate features (relieve), and light exposure (surface color), as well as the quality of preservation of herbarium specimens (surface color). However, characters such as thallus surface structure, nature and arrangement of calcium oxalate crystal clusters, ascoma morphology, nature of the columella, excipulum and columella carbonization, and ascospore septation and size, appear to be rather uniform in those species for which molecular data are available for several specimens. As a consequence, a rather narrow species concept was applied here, following these findings. Whether this concept holds in all cases distinguished here remains to be tested by a much more expanded set of molecular data. However, in many cases of quite disparate morphologies, it seems highly unlikely that these should represent infraspecific variation, even if molecular data are not yet available in these instances.

Results and Discussion

The following keys are separated into three groups: species lacking secondary substances (exposed medulla P– but TLC required to distinguish from P– chemosyndromes such as hypoprotocetraric acid or several unknown substances), species with the psoromic acid chemosyndrome (exposed medulla P+ yellow), and species with the protocetraric acid chemosyndrome (exposed medulla P+ orange-red; TLC required to distinguish with certainty from the cinchonarum unknown chemosyndrome).

For each keyed species, synonyms are given if applicable. For recently established or reinstated names not included in HALE (1974, 1978, 1980, 1981), FRISCH et al. (2006) and MANGOLD et al. (2009), the corresponding references are cited. Notes on species taxonomy and nomenclature are given in selected cases. Sorediate species with columella and psoromic or protocetraric acid chemistry or no substances are not specifically keyed out or illustrated but are mentioned under the corresponding key couplets.

Key 1: Secondary substances absent (*Ocellularia papillata* morphodeme)

1a Excipulum and columella lacking distinctly carbonized portions (not black in section view under the stereomicroscope) 2

1b Excipulum and/or columella with carbonized portions or entirely carbonized (black in section view under the stereomicroscope) 5

2a Thallus uneven to coarsely verrucose; ascoma pore 0.05–0.1 mm wide; ascospores 15–20 µm long; eastern Paleotropics (Philippines) ..... ***Ocellularia cinereoglaucescens* (Vain.) Zahlbr.** (Fig. 4A)

Notes – This species was long considered a synonym of *Ocellularia papillata* but differs in thallus and ascoma morphology. If thallus sorediate, see *Ocellularia sorediata* Hale.

2b Thallus smooth to uneven; ascoma pore 0.1–0.5 mm wide; ascospores (15–)20–30 µm long 3

3a Ascomata prominent, pore up to 0.5 mm diam., surrounded by white rim; columella irregular, pale; ascospores 15–20 µm long; Neotropics (Panama) ..... ***Ocellularia barroensis* Hale** (Fig. 4B–C)

3b Ascomata immersed to erumpent, pore up to 0.2 mm diam., surrounded by white to brown rim; columella finger-like to plug-shaped or becoming irregular, dark brown; ascospores 20–35 µm long 4

4a Ascoma pore surrounded by brown rim and indistinct thalline margin flush with surrounding thallus, filled with (dark) brown-tipped columella that may become irregular; pantropical (Sri Lanka) .... ***Ocellularia papillata* (Leight.) Zahlbr.** (Fig. 4D)

Notes – This species is here very narrowly defined as having a non-carbonized, brown excipulum and columella and nearly immersed ascomata; it remains to be studied whether this taxon is in fact pantropical.

4b Ascoma pore surrounded by white to pale brown rim and distinct, thickened thalline margin, filled with white-pruinose columella that remains finger-like to plug-shaped; eastern Paleotropics (Thailand) ..... ***Ocellularia rongklaensis* (Homchant. & Coppins) Lücking** (Fig. 4E–F)

Notes – *Ocellularia rongklaensis* (Homchant. & Coppins) Lücking **comb. nov.** [Mycobank #811144]; basionym: *Myriotrema rongklaense* Homchant. & Coppins, *Lichenologist* **34:** 116 (2002). This taxon was considered a synonym of *Ocellularia papillata* by PAPONG et al. (2010), but the refined species concept in this morphodeme suggests that it represents a separate species.

5a Excipulum pale to dark brown but lacking distinctly carbonized portions (not black in section view under the stereomicroscope); columella with carbonized portions or entirely carbonized (black in section view under the stereomicroscope) 6

5b Both excipulum and columella with carbonized portions or entirely carbonized (black in section view under the stereomicroscope) 12

6a Excipulum apically carbonized; columella dark brown but not carbonized; ascoma margin white-pruinose; ascospores 3-septate, 8–12 µm long; eastern Paleotropics (India; NAGARKAR et al. 1986) ..... ***Ocellularia wandoorensis* Nagarkar, Sethy & Patw.** (Fig. 5A–B)

6b Excipulum pale to dark brown but not carbonized; columella completely carbonized; ascoma margin non-pruinose; ascospores 5–9-septate, (15–)20–30 µm long 7

7a Thallus papillose, in section with columnar clusters of calcium oxalate crystals; ascoma pore 0.3–0.5 mm wide, with slightly fissured proper margin and irregular columella; Neotropics (Argentina; FERRARO et al. 2014) ..... ***Ocellularia papillifera* L. I. Ferraro, Lücking, Aptroot & M. Cáceres** (Fig. 5C)

7b Thallus smooth to uneven or verrucose, in section with irregular clusters of calcium oxalate crystals; ascoma pore (0.05–)0.1–0.2(–0.4) mm wide, with entire proper margin and finger-like to plug-shaped columella..... 8

8a Thallus verrucose; ascomata 0.3–0.4 mm diam., pore minute (0.05–0.1 mm) and slightly fissured thalline margin; eastern Paleotropics (Thailand; PAPONG et al. 2014a) ..... ***Ocellularia pseudopapillata* Papong, Mangold & Lücking** (Fig. 5D)

8b Thallus smooth to uneven; ascomata (0.3–)0.4–1.0 mm diam., with larger pore (0.1–0.4 mm) and entire thalline margin 9

9a Ascomata blackened including thalline margin; excipulum dark brown; Neotropics (Costa Rica; SIPMAN et al. 2012).... ***Ocellularia subpyrenuloides* Lücking** (Fig. 5E–F)

9b Ascomata not blackened; excipulum yellowish to pale brown to brown.....10

10a Ascomata erumpent to prominent, (0.6–)0.8–1.0 mm diam., with broad whitish rim around the pore; excipulum orange-brown; ascospores 5-septate, 15–20 µm long; eastern Paleotropics (New Caledonia; PAPONG et al. 2014b)..... ***Ocellularia neocaledonica* Lücking, Lumbsch & Parnmen** (Fig. 6A)

10b Ascomata immersed to erumpent, 0.3–0.8 mm diam., with narrow, brownish to olive-grey rim around the pore; excipulum yellowish to pale brown; ascospores 7–9-septate, 20–30 µm long.....11

11a Ascomata erumpent, 0.3–0.6 mm diam., with wide pore (0.2–0.4 mm); Neotropics (Costa Rica; SIPMAN et al. 2012) ..... ***Ocellularia laeviusculoides* Sipman & Lücking** (Fig. 6B)

11b Ascomata immersed-erumpent, 0.6–0.8 mm diam., with narrow pore (0.1 mm); eastern Paleotropics (Philippines; RIVAS PLATA et al. 2014) ..... ***Ocellularia sublaeviusculoides* Rivas Plata, Sipman & Lücking** (Fig. 6C)

12a Excipulum apically carbonized, yellowish to orange-brown in lower parts; columella apically to rarely fully carbonized.....13

12b Excipulum fully carbonized down to the base; columella fully carbonized.....16

13a Ascomata with wider pore (0.2–0.5 mm); columella irregular; ascospores 5–9(–11)-septate; thallus smooth to uneven or minutely grainy 14

13b Ascomata with narrow pore (0.05–0.15 mm); columella finger-like to plug-shaped; ascospores 3–5-septate; thallus verrucose 15

14a Ascomata 0.6–1.0 mm diam., with wide pore (0.3–0.5 mm) and slightly fissured proper margin; thallus minutely grainy, in section with columnar clusters of calcium oxalate crystals; ascospores 5–7-septate; Neotropics (Argentina; FERRARO et al. 2014) .... ***Ocellularia marmorata*** **L. I. Ferraro, Lücking, Aptroot & M. Cáceres** (Fig. 6D)

14b Ascomata 0.3–0.5 mm diam., with narrower pore (0.2–0.3 mm) and entire proper margin; thallus smooth to uneven, in section with irregular clusters of calcium oxalate crystals; ascospores 7–9(–11)-septate; eastern Paleotropics (Thailand; HOMCHANTARA & COPPINS 2002)..... .....***Ocellularia krathingensis*** **Homchant. & Coppins**

15a Ascomata immersed-erumpent, 0.3–0.4 mm diam., with minute pore (0.05–0.1 mm) filled with black-tipped columella; Neotropics (Brazil; LÜCKING 2015)..... .....***Ocellularia buckii*** **Lücking** (Fig. 6E)

15b Ascomata erumpent, 0.4–0.7 mm diam., with narrow pore (0.1–0.15 mm) filled with white-pruinose columella; pantropical (Australia)..... ..... ***Ocellularia viridipallens*** **Müll. Arg.** (Fig. 6F)
Notes – This species was long considered a synonym of *Ocellularia papillata* but differs in the larger, carbonized ascomata, among other characters.

16a Columella broad-stump-shaped; eastern Paleotropics (Philippines)..... .....***Ocellularia zamboangensis*** **(Vain.) Zahlbr.** (Fig. 7A)
Notes – This species was long considered a synonym of *Ocellularia papillata* but differs in the carbonized excipulum and columella, the latter being broad-stump-shaped (thus resembling a species of *Melanotrema* Frisch; the species of that genus differ in having a rudimentary cortex and in the distinctly larger ascomata).

16b Columella finger-like to plug-shaped.....17

17a Ascomata 0.3–0.6 mm diam., with narrow pore (0.1–0.2 mm); eastern Paleotropics (Malaysia: Borneo) ..... ***Ocellularia collativa*** **(Kremp.) Zahlbr.** (Fig. 7F)
Notes – This species was long considered a synonym of *Ocellularia papillata* but differs in the carbonized ascomata, among other characters.

17b Ascomata 0.8–1.0 mm diam., with wider pore (0.2–0.6 mm).....18

18a Ascomata prominent, with narrower pore (0.2–0.3 mm) filled with black-tipped columella and with entire, whitish margin; ascospores 5–7-septate, 20–30 µm long; pantropical (Sri Lanka)..... ***Ocellularia ascidioidea*** **Hale** (Fig. 7B)

18b Ascomata erumpent, with wide pore (0.3–0.6 mm) partially filled with white-pruinose columella and with slightly fissured, brown-black, white-pruinose margin; ascospores 3–5-septate, 15–20 µm long; Neotropics (Panama)..... ..... ***Ocellularia landronii*** **Hale** (Fig. 7C)

Key 2: Protocetraric acid chemosyndrome (*Ocellularia perforata* morphodeme)

1a Excipulum and columella lacking distinctly carbonized portions (not black in section view under the stereomicroscope); columella mostly irregular 2
1b Excipulum and/or columella with carbonized portions or entirely carbonized (black in section view under the stereomicroscope); columella mostly finger-like to plug-shaped or broad-stump-shaped 15

2a Thallus minutely grainy, in section with columnar clusters of calcium oxalate crystals 3
2b Thallus smooth to uneven or verrucose but not minutely grainy, in section with irregular clusters of calcium oxalate crystals 5

3a Ascoma pore narrow (0.1–0.2 mm); columella finger-like to plug-shaped; Neotropics (Lesser Antilles: St. Vincent) ..... ***Ocellularia excavata* (Vain.) Zahlbr.** (Fig. 8A)
Synonym – *Thelotrema excavatum* var. *impressulum* Vain. (Lesser Antilles: Dominica)
Notes – This species was considered a synonym of *Ocellularia perforata* (HALE 1978) but differs in the columnar clusters of crystals and the overall morphology and anatomy of the ascomata.
3b Ascoma pore wide (0.3–0.8 mm); columella becoming irregular..... 4

4a Ascomata rounded, with entire margin; columella slightly irregular; pantropical (America) ..... ***Ocellularia bonplandii* (Fée) Müll. Arg.** (Fig. 8B–D)
Notes – This species is very close to *Ocellularia auberianoides* and it is presently unclear whether it represents a separate taxon. Paleotropical material is constantly distinct from the neotropical *O. auberianoides* in the regularly round ascomata with finger-like columella, and the type of *O. bonplandii* agrees with this morphology but only bears young ascomata.
4b Ascomata becoming irregular to elongate, with fissured margin; columella distinctly irregular; Neotropics (Colombia)..... ..... ***Ocellularia auberianoides* (Nyl.) Müll. Arg.** (Fig. 8E–F)
Synonym – *Ocellularia endoleuca* Müll. Arg. (Venezuela)
Notes – If thallus sorediate, see *Ocellularia sorediigera* Kalb and *Ocellularia erodens* (R.C. Harris) Lücking **comb. nov.** [Mycobank #811145]; basionym: *Myriotrema erodens* R. C. Harris, *Some Florida Lichens*: 89 (1990).

5a Ascomata immersed to erumpent, 0.2–0.8 mm diam., round, with narrow pore (0.1–0.2 mm); columella finger-like to plug-shaped..... 6
5b Ascomata (erumpent to) prominent, 0.5–2.0 mm diam., round to angular, with wider pore [0.2–0.5(–1.0) mm]; columella becoming irregular to broad-stump-shaped 11
Notes – If thallus sorediate, ascomata erumpent to prominent, with apically dark brown excipulum and finger-like, apically dark brown columella, see *Ocellularia africana* Frisch

6a Thallus verrucose-rugose; ascomata 0.3–0.8 mm diam.; excipulum apically dark brown; pantropical (Brazil) ....***Ocellularia perforata* (Leight.) Müll. Arg.** (Fig. 9A–B)
Synonym – *Ocellularia violacea* var. *glauca* Räsänen (Australia)
Notes – This species is here narrowly defined by the very distinctly verrucose-rugose thallus and the non-carbonized, brown excipulum and columella.
6b Thallus smooth to uneven to shallowly verrucose; ascomata 0.2–0.5 mm diam.; excipulum orange-yellow to pale brown..... 7

7a Thallus shallowly verrucose, cream-white; ascomata immersed, filled with brown-topped columella surrounded by a brown rim; columella apically dark brown; excipulum orange-yellow; ascospores 5–7-septate, 25–35 µm long; eastern Paleotropics (Sri Lanka; WEERAKOON et al. 2014) ..... ***Ocellularia raveniana* Weerak., Lücking & Lumbsch** (Fig. 9C)

7b Thallus smooth to uneven, light greyish olive; ascomata erumpent, filled with white-pruinose columella surrounded by a white to pale brown rim; columella pale to rarely dark brown; excipulum pale brown to orange-brown; ascospores variously septate 8

8a Ascospores 3–5-septate, 15–25 µm long 9

8b Ascospores 7–9-septate, (20–)25–35 µm long 10

9a Thallus smooth to uneven, light olive-grey; ascomata dense, pore with white rim; Macaronesia (Portugal: Azores; APTROOT 2010) ..... ***Ocellularia pauciseptata* (Purvis & P. James) Aptroot** (Fig. 9D)

9b Thallus uneven to verrucose, olive-green; ascomata scattered, pore with brownish rim; pantropical (São Thomé & Principe) .... ***Ocellularia vezdana* Frisch** (Fig. 9E)
Replaced name: *Ocellularia subterebrata* Vězda [nom. illeg., non (Nyl.) Zahlbr. = *Myriotrema microporellum* (Nyl.) Hale

10a Fumarprotocetraric as major secondary substance; eastern Paleotropics (Thailand) ..... ***Ocellularia subminuta* (Homchant. & Coppins) Lücking**
Notes – *Ocellularia subminuta* (Homchant. & Coppins) Lücking **comb. nov.** [Mycobank #811146]; basionym: *Myriotrema subminutum* Homchant. & Coppins, *Lichenologist* **34:** 117 (2002).

10b Protocetraric as major secondary substance; eastern Paleotropics (Thailand) ..... ***Ocellularia khaoyaiana* (Homchant. & Coppins) Lücking** (Fig. 9F)
Notes – *Ocellularia khaoyaiana* (Homchant. & Coppins) Lücking **comb. nov.** [Mycobank #811147]; basionym: *Myriotrema khaoyaianum* Homchant. & Coppins, *Lichenologist* **34:** 114 (2002). These two taxa were considered synonyms of *Ocellularia perforata* by PAPONG et al. (2010), but the refined species concept used here suggests that they represents separate species.

11a Ascomata becoming irregular in shape with lateral bumps; ascospores 7–9-septate, 30–45 µm long; pantropical (Costa Rica; SIPMAN et al. 2012) ..... ***Ocellularia cryptica* Lücking** (Fig. 10A–B)

11b Ascomata more or less rounded; ascospores 3–7-septate, 12–30 µm long 12

12a Ascomata prominent to sessile with vertical sides, up to 2.0 mm diam., pore very wide (0.3–1.0 mm); pantropical (Mauritius) .. ***Ocellularia mauretiana* Hale** (Fig. 10C)

12b Ascomata prominent with sloping sides, up to 1.3 mm diam., pore narrower (0.2–0.5 mm) 13

13a Ascospores 3-septate, 12–16 µm long; Neotropics (Costa Rica) ..... ***Ocellularia rufocincta* Müll. Arg.** (Fig. 10D)
Notes – This taxon was considered a synonym of *Ocellularia perforata* (HALE 1978) but differs in several morphological features including the small, consistently 3-septate ascospores; it is actually more similar to *O. protocetrarica* and here chiefly distinguished by the small, 3-septate ascospores.

13b Ascospores 5–7-septate, 20–30 µm long 14

14a Cortex paraplectenchymatous, lacking internal splitting; Neotropics (Panama) ..... ***Ocellularia protocetrarica* Hale** (Fig. 10E–F)
Notes – Several authors placed this name as synonym under *Ocellularia mauretiana*, but the neotropical species is well-distinguished by its ascoma morphology.

14b Cortex prosoplectenchymatous, with internal splitting; Paleotropics (Cameroon) ..... ***Ocellularia cameroonensis* Frisch**

15a Excipulum pale to dark brown but lacking distinctly carbonized portions (not black in section view under the stereomicroscope); columella with carbonized portions or entirely carbonized (black in section view under the stereomicroscope) 16

15b Both excipulum and columella with carbonized portions or entirely carbonized (black in section view under the stereomicroscope) 20

16a Columella irregular to broad-stump-shaped, apically carbonized; ascoma pore wide (0.3–0.5 mm); thallus papillose to verrucose; eastern Paleotropics (Sri Lanka; WEERAKOON et al. 2014) ..... ***Ocellularia balangoda* Weerak., Lücking & Lumbsch** (Fig. 11A)

16b Columella finger-like to plug-shaped, fully carbonized down to the base; ascoma pore narrow (0.03–0.2 mm); thallus smooth to uneven to (coarsely) verrucose or bullate 17

17a Thallus smooth to uneven; ascomata erumpent to prominent, (0.6–)0.8–1.0 mm diam.; Neotropics (Dominican Republic; LÜCKING 2015) ..... ***Ocellularia baorucensis* Lücking** (Fig. 11B)

17b Thallus uneven to (coarsely) verrucose or bullate; ascomata erumpent, ascomata 0.3–0.8 mm diam. 18

18a Thallus uneven to verrucose; ascoma pore filled with white-pruinose columella, surrounded by brown rim; ascospores 5–9-septate; pantropical (Australia) ..... ***Ocellularia violacea* Räsänen** (Fig. 11C–D)
Synonyms – *Thelotrema cavatum* var. *planius* Nyl. (Colombia); *Thelotrema cavatum* var. *submutatum* Nyl. (Colombia); *Thelotrema terebratum* var. *abbreviatum* Vain. (Brazil)
Notes – This taxon (and its synonyms) was long synonymized with *Ocellularia perforata* but differs in ascoma carbonization and thallus morphology, among other features.

18b Thallus coarsely verrucose to bullate; ascoma pore filled with black-tipped columella or columella concealed, surrounded by white rim; ascospores 5-septate 19

19a Ascoma pore minute (0.03–0.05 mm), completely concealing the columella; excipulum orange-brown; thallus bullate; Neotropics (Puerto Rico; LÜCKING 2015) ..... ***Ocellularia maricaoensis* Lücking** (Fig. 11E)

19b Ascoma pore narrow (0.1–0.15 mm), filled with black-tipped columella; excipulum yellow-orange; thallus verrucose; Neotropics (Cuba; LÜCKING 2015) ..... ***Ocellularia daniana* Lücking** (Fig. 11F)

20a Thallus smooth to uneven 21

20b Thallus distinctly and coarsely verrucose or ridged 22

21a Excipulum and columella apically carbonized; columella finger-like to plug-shaped; ascoma pore narrow (0.1–0.2 mm), with entire margin, filled with white-pruinose columella; ascospores 30–40 µm long; Neotropics (Panama) ..... ***Ocellularia thryptica* Hale** (Fig. 12A)

21b Excipulum and columella fully carbonized down to base; columella broad-stump-shaped; ascoma pore wider (0.3–0.4 mm), with slightly fissured margin, filled with grey-black-tipped columella; ascospores 20–30 µm long; Neotropics (Colombia) ..... ***Ocellularia gymnocarpa* (Nyl.) Zahlbr.** (Fig. 12B)

Notes – This taxon was considered a synonym of *Ocellularia perforata* (MANGOLD et al. 2009) but differs in ascoma carbonization. It is most similar to *O. subperforata*.

22a Ascomata immersed in pseudostromatic warts, 0.7–1.2 mm diam.; ascospores 7–9-septate, 20–30 µm long; Neotropics (Brazil; CÁCERES et al. 2014)..... ***Ocellularia ornata* M. Cáceres, Aptroot & Lücking** (Fig. 12C)

22b Ascomata solitary, erumpent, 0.4–0.6 mm diam.; ascospores 5–7-septate, 15–20 µm long.....23

23a Excipulum apically carbonized; columella finger-like to plug-shaped; ascoma pore narrow (0.1–0.15 mm), surrounded by white rim; thallus ridged; eastern Paleotropics (New Caledonia; PAPONG et al. 2014b) ..... ***Ocellularia rugosothallina* Lücking, Lumbsch & Parnmen** (Fig. 12D)

23b Excipulum fully carbonized down to base; columella broad-stump-shaped; ascoma pore wider (0.3–0.4 mm), surrounded by blackish rim; thallus distinctly and coarsely verrucose; pantropical (India; NAGARKAR et al. 1988)..... ***Ocellularia subperforata* Nagarkar, Sethy & Patw.** (Fig. 12E–F)

Notes – This taxon was considered a synonym of *Ocellularia perforata* (MANGOLD et al. 2009) but differs in ascoma carbonization, the blackish ascoma margin, and the more conspicuous and often distinctly elongate thallus verrucae.

Key 3: Psoromic acid chemosyndrome (*Ocellularia terebrata* morphodeme)

1a Excipulum and columella lacking distinctly carbonized portions (not black in section view under the stereomicroscope) 2
1b Excipulum and/or columella with carbonized portions or entirely carbonized (black in section view under the stereomicroscope) 10

2a Columella finger-like to plug-shaped; ascoma pore narrow (0.05–0.2 mm); ascomata erumpent 3
2b Columella irregular; ascoma pore wider (0.2–0.4 mm); ascomata (immersed to) erumpent to prominent 5

3a Ascomata 0.1–0.3 mm diam., pore surrounded by pale brown rim; columella apically dark brown; ascospores 15–30 µm long; pantropical (Panama) ..... ***Ocellularia minutula* Hale** (Fig. 13A)
3b Ascomata 0.3–0.5 mm diam.; pore surrounded by white rim; columella colorless to light yellow-grey; ascospores 15–20 µm long 4
4a Thallus uneven to shallowly verrucose; ascoma pore 0.05–0.1 mm wide; excipulum light yellow-grey; eastern Paleotropics (New Caledonia; PAPONG et al. 2014b) ..... ***Ocellularia inconspicua* Lücking, Lumbsch & Parnmen** (Fig. 13B)
4b Thallus smooth to uneven; ascomata pore 0.1–0.2 mm wide; excipulum brown; Neotropics (Costa Rica; SIPMAN et al. 2012) ..... ***Ocellularia pseudopyrenuloides* Lücking** (Fig. 13C)

5a Thallus bullate, white; ascomata prominent, round to becoming lobate, pore annulate; ascospores 3–5-septate, 10–20 µm long; Neotropics (Costa Rica; SIPMAN et al. 2014) ..... ***Ocellularia albobullata* Lücking, Sipman & Grube** (Fig. 13D)
5b Thallus smooth to uneven, light grey to greenish grey to olive-green; ascomata immersed to prominent, round to slightly irregular in outline, pore not annulate; ascospores 5–9-septate, 15–30 µm long 6

6a Ascomata immersed; ascospores 7–9-septate, 25–30 µm long; excipulum light orange; Neotropics (Brazil; CÁCERES et al. 2014) ..... ***Ocellularia immersocarpa* M. Cáceres, Aptroot & Lücking** (Fig. 13E–F)
6b Ascomata distinctly erumpent to prominent; ascospores 5–7-septate, 15–25 µm long; excipulum orange-brown to dark brown 7

7a Thallus light grey, with loose cortex; ascoma pore 0.3–0.6 mm wide; excipulum and columella dark brown; Neotropics (Brazil) ..... ***Ocellularia comparabilis* (Kremp.) Müll. Arg.** (Fig. 14A–B)
Notes – This taxon does not appear to be closely related to *Ocellularia terebrata*; its general morphology is more reminescent of *O. auberianoides*, which has a different chemistrt.
7b Thallus olive-grey to olive-green, with dense, prosoplectenchymatous cortex; ascoma pore 0.1–0.3(–0.4) mm wide; excipulum and columella colorless to (light) brown 8

8a Ascomata prominent, 0.8–1.2 mm diam.; columella colorless; Neotropics (Costa Rica) ..... ***Ocellularia psorbarroensis*** **Sipman** (Fig. 14C)
8b Ascomata erumpent, 0.4–0.8 mm diam.; columella colorless to brown 9

9a Ascomata 0.6–0.8 mm diam., pore filled with light brown columella and surrounded by brown rim and white thalline margin; columella brown; ascospores 7-septate, 20–25 µm long; eastern Paleotropics (Sri Lanka; WEERAKOON et al. 2014) .... ***Ocellularia aptrootiana*** **Weerak., Lücking & Lumbsch** (Fig. 14D)
9b Ascomata 0.4–0.6 mm diam., pore filled with white-pruinose columella and surrounded by pale brown rim and olive-grey thalline margin; columella colorless; ascospores 5-septate, 15–20 µm long; Neotropics (Peru; RIVAS PLATA & LÜCKING 2013) ..... ***Ocellularia fenestrata*** **Rivas Plata & Lücking** (Fig. 14E)

10a Excipulum pale to dark brown but lacking distinctly carbonized portions (not black in section view under the stereomicroscope); columella with carbonized portions or entirely carbonized (black in section view under the stereomicroscope) 11
10b Both excipulum and columella with carbonized portions or entirely carbonized (black in section view under the stereomicroscope).....16

11a Columella irregular to reticulate, apically carbonized; excipulum pale brown; ascospores 7–13-septate, 30–45 µm long; pantropical (Thailand; HOMCHANTARA & COPPINS 2002)..... ***Ocellularia pluriporoides*** **Homchant. & Coppins** (Fig. 14F)
11b Columella finger-like to plug-shaped to broad-stump-shaped, sometimes breaking into triangular teeth, fully carbonized down to the base; ascospores 5–9-septate, 15–30(–40) µm long 12

12a Columella broad-stump-shaped, sometimes breaking into triangular teeth; thallus greyish to yellowish white, with loose cortex; ascomata (erumpent to) prominent, pore 0.2–0.5 mm wide 13
12b Columella finger-like to plug-shaped; thallus greyish olive to olive-green, with dense, prosoplectenchymatous cortex; ascomata erumpent, pore 0.05–0.25 mm wide.....14

13a Thallus coarsely verrucose; ascoma pore 0.2–0.3 mm wide, filled with black-tipped columella that remains entire; ascospores 5–7-septate, 20–25 µm long; eastern Paleotropics (New Caledonia; PAPONG et al. 2014b) .... ***Ocellularia albothallina*** **Lücking, Lumbsch & Parnmen** (Fig. 15A)
13b Thallus smooth to uneven; ascoma pore 0.3–0.5 mm wide, filled with white-pruinose columella that breaks into triangular teeth; ascospores 7–9-septate, 25–30 µm long; eastern Paleotropics (Australia; MANGOLD et al. 2014)..... ..... ***Ocellularia australiana*** **Mangold, Lücking & Lumbsch** (Fig. 15B)

14a Ascospores 7–9-septate, 30–40 µm long; excipulum orange-yellow; eastern Paleotropics (Sri Lanka; WEERAKOON et al. 2014)..... ..... ***Ocellularia cloonanii*** **Weerak., Lücking & Lumbsch** (Fig. 15C)

14b Ascospores 5–7-septate, 15–25 µm long; excipulum orange-brown.....15

15a Thallus ridged; ascoma pore 0.15–0.25 mm wide; Neotropics (Brazil; CÁCERES et al. 2014) ..... ***Ocellularia rondoniana*** **M. Cáceres, Aptroot & Lücking** (Fig. 15D)
15b Thallus uneven to bumpy; ascoma pore 0.05–0.1 mm wide; pantropical (Sri Lanka).....***Ocellularia pluripora*** **Hale** (Fig. 15E–F)

16a Excipulum and/or columella apically or in upper half carbonized; columella finger-like to plug-shaped.....17
16b Excipulum and columella fully carbonized down to base; columella finger-like to plug-shaped to broad-stump-shaped or fissured or irregular.....18

17a Thallus conspicuously folded; ascoma pore surrounded by brown rim; ascospores 25–35 µm long; Neotropics (Peru; RIVAS PLATA & LÜCKING 2013) .... ***Ocellularia plicata*** **Rivas Plata & Lücking** (Fig. 16A)
17b Thallus smooth to uneven; ascoma pore surrounded by black, white-pruinose rim; ascospores 15–25 µm long; pantropical (India; PATWARDHAN & NAGARKAR 1980).....***Ocellularia garoana*** **Patw. & Nagarkar** (Fig. 16B–C)
Notes – If thallus and/or ascomata sorediate, see *Ocellularia soredica* Kalb.

18a Columella finger-like to plug-shaped.....19
18b Columella broad-stump-shaped to fissured or irregular.....23

19a Thallus endoperidermal, with loose cortex; ascomata immersed, 0.2–0.3 mm diam.; African Paleotropics (Sierra Leone; LÜCKING 2014) ....***Ocellularia abbayesiana*** **Lücking** (Fig. 16D)
19b Thallus epiperidermal, with dense, prosoplectenchymatous cortex; ascomata immersed to prominent, 0.3–1.0 mm diam.....20

20a Thallus uneven to rugose; ascomata immersed, 0.6–1.0 mm diam., pore minute (0.05–0.1 mm); ascospores 7–9-septate, 30–35 µm long; Neotropics (Colombia; PELAEZ et al. 2014) .... ***Ocellularia umbilicatoides*** **Pelaez, Moncada & Lücking** (Fig. 16E)
20b Thallus uneven to verrucose; ascomata erumpent to prominent, 0.3–0.8 mm diam., with narrow pore (0.1–0.2 mm); ascospores 5–7(–9)-septate, 15–30 µm long 21

21a Thallus uneven, light yellowish olive; ascomata erumpent, with gently sloping sides, pore surrounded by yellowish rim; columella indistinct when seen from above; pantropical ("America") .... ***Ocellularia terebrata*** **(Ach.) Müll. Arg.** (Fig. 16F)
Synonyms – *Ocellularia comparabilis* var. *microcarpa* Redinger; *O. comparabilis* var. *plicata* Redinger
Notes – This taxon is here narrowly defined by fully carbonized ascomata and simple columella, lacking any other conspicuous features. Unfortunately, the type material is not well-developed and hence the precise definition of this species is not fully settled.

21b Thallus verrucose, white; ascomata erumpent to prominent, with steeply sloping sides; pore surrounded by white or blackish rim; columella distinct when seen from above 22

22a Ascomata prominent, pore filled with black-tipped columella; Neotropics (Dominica) ..... ***Ocellularia antillensis* Hale** (Fig. 17A–B)
22b Ascomata erumpent, pore filled with white-pruinose columella; eastern Paleotropics (Australia)..... ***Ocellularia wirthii* Mangold, Elix & Lumbsch** (Fig. 17C)

23a Thallus with loose cortex; ascomata 0.4–0.6 mm diam., pore surrounded by blackish, white-pruinose rim; columella broad-stump-shaped, remaining entire; African Paleotropics (Mozambique)..... ***Ocellularia mozambica* (Vain.) Zahlbr.**
Notes – If thallus sorediate, see *Ocellularia discoidea* (Ach.) Müll. Arg.
23b Thallus with dense, prosoplectenchymatous cortex; ascomata 0.5–1.2 mm diam., pore surrounded by white to dark brown rim; columella fissured or irregular 24

24a Columella fissured, split into triangular teeth; ascospores 7–15-septate, 25–45 µm long; thallus verrucose; ascomata prominent; pantropical (Malaysia: Borneo; CÁCERES et al. 2012) .... ***Ocellularia conformalis* (Kremp.) M. Cáceres & Lücking** (Fig. 17D)
24b Columella irregular; ascospores 5–9-septate, 15–30 µm long; thallus smooth to uneven or with scattered, very large verrucae; ascomata erumpent to prominent 25

25a Thallus olive-brown, with scattered, very large verrucae filled with calcium oxalate crystals; ascomata erumpent; ascospores 15–20 µm long; African Paleotropics (Nigeria; LÜCKING 2014) ..... ***Ocellularia grantii* Lücking** (Fig. 17E)
25b Thallus mottled white and light yellowish green, smooth to uneven, in section lacking clusters of calcium oxalate crystals; ascomata erumpent to prominent; ascospores 20–30 µm long; Neotropics (Colombia; PELAEZ et al. 2014)..... ..... ***Ocellularia usnicolor* Pelaez, Moncada & Lücking** (Fig. 17F)

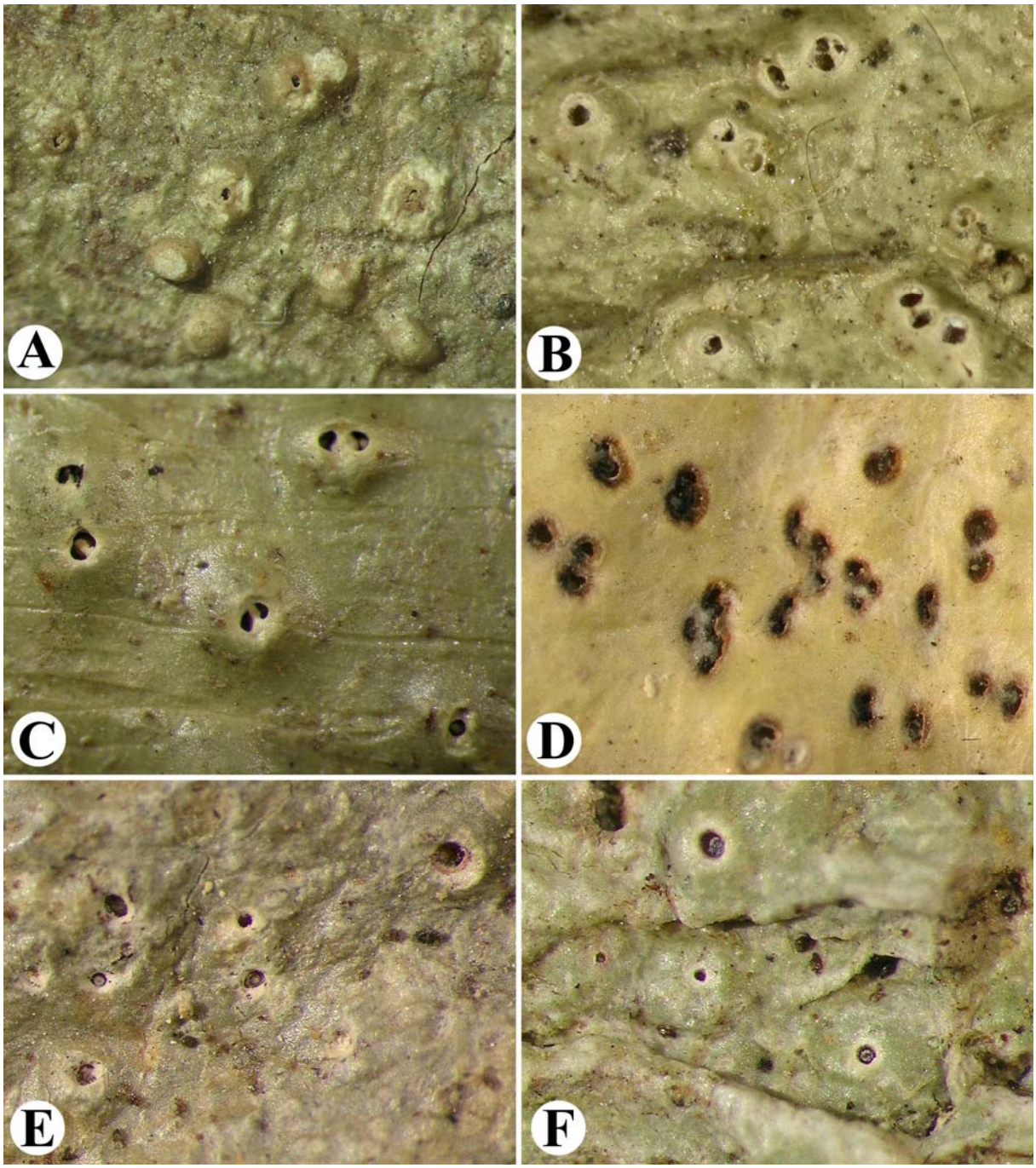

Figure 4 — Morphology of *Ocellularia* species. A, *O. cinereoglaucescens* (holotype). B–C, *O. barroensis* (B, holotype; C, Costa Rica, *Lücking 97-250*). D, *O. papillata* (isolectotype). E–F, *O. rongklaensis* (E, isotype; F, Fiji, *Lumbsch 19849d*).

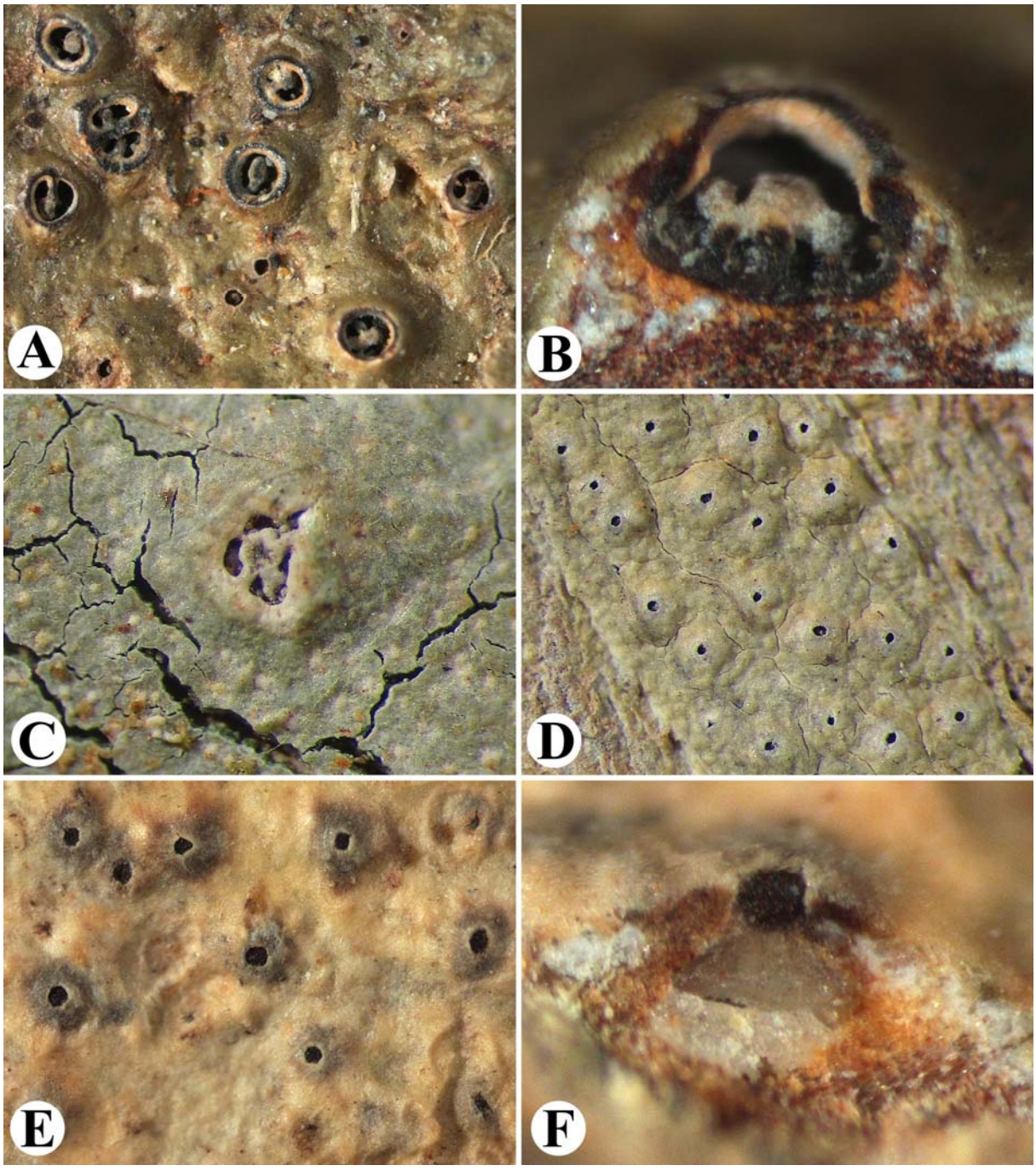

Figure 5 — Morphology of *Ocellularia* species. A–B, *O. wandoorensis* (holotype; B section through ascoma). C, *O. papillifera* (holotype). D, *O. pseudopapillata* (holotype). E–F, *O. subpyrenuloides* (holotype; F, section through ascoma).

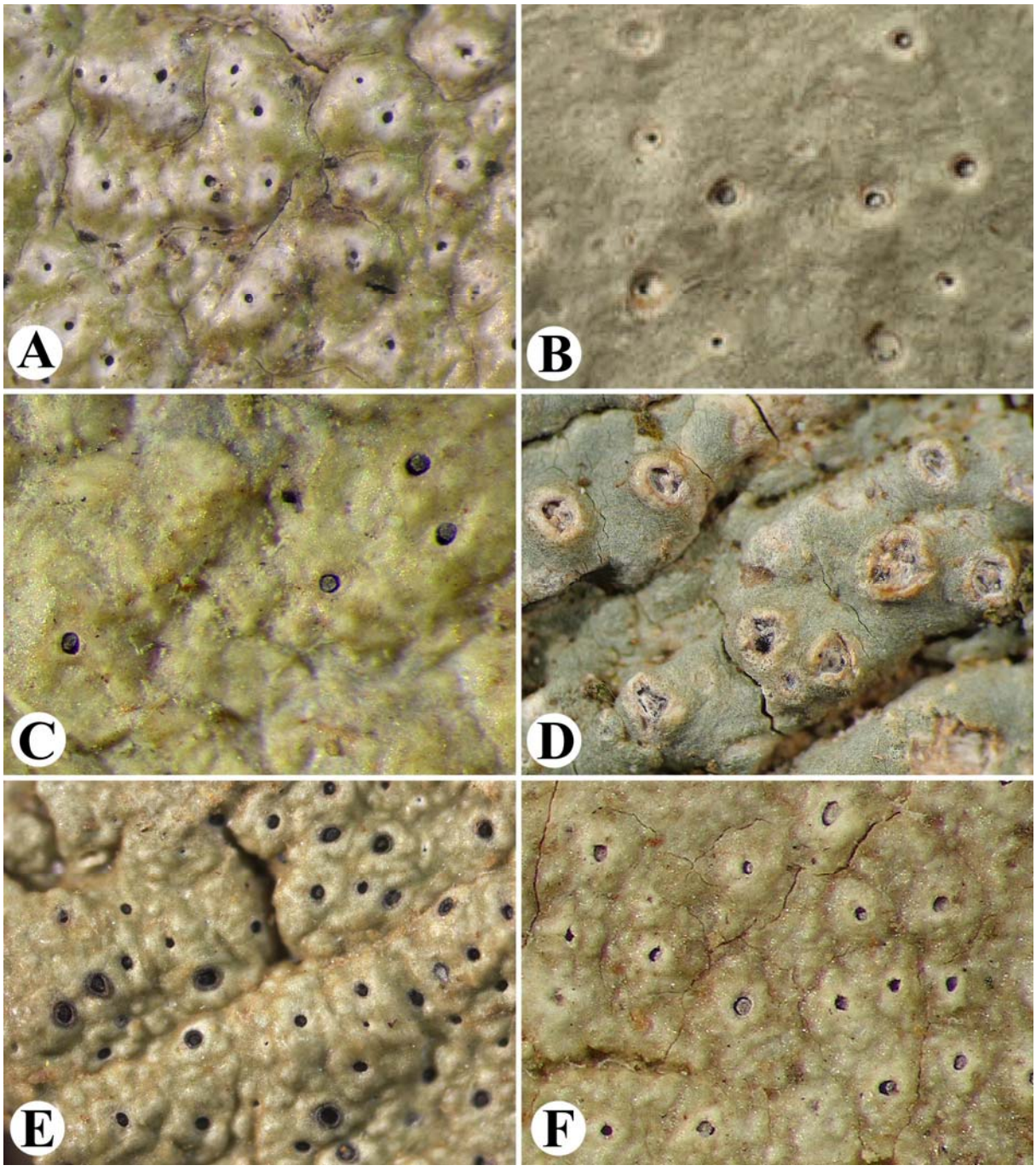

Figure 6 — Morphology of *Ocellularia* species. A, *O. neocaledonica* (holotype). B, *O. laeviusculoides* (holotype). C, *O. sublaeviusculoides* (holotype). D, *O. marmorata* (holotype). E, *O. buckii* (holotype). F, *O. viridipallens* (holotype).

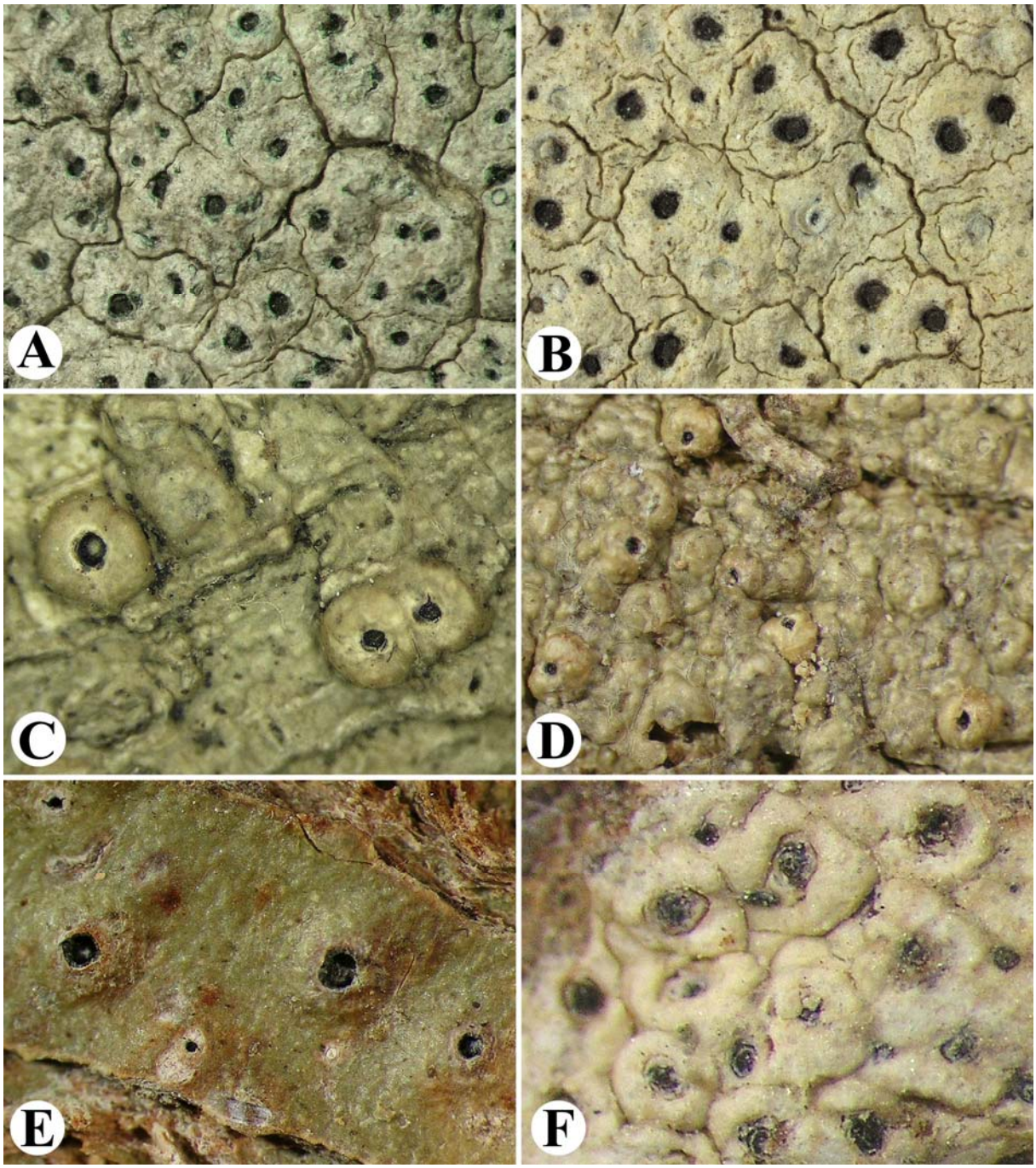

Figure 7 — Morphology of *Ocellularia* species. A–B, *O. zamboangensis* (isotype). C–D, *O. ascidioidea* (C, holotype; D, Sri Lanka, *Hale 47012*). E, *O. landronii* (Brazil, *Cáceres 105*). F, *O. collativa* (holotype).

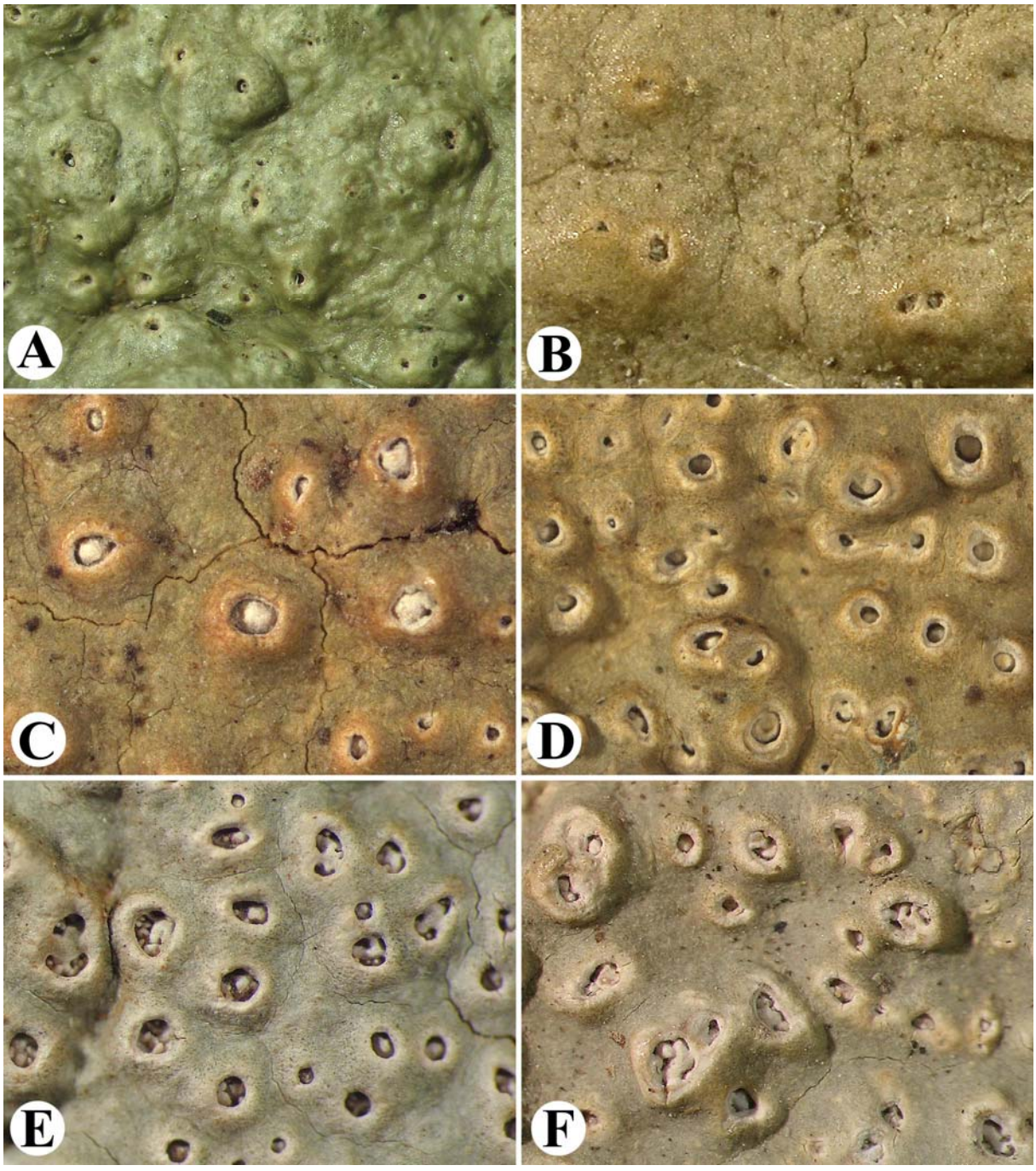

Figure 8 — Morphology of *Ocellularia* species. A, *O. excavata* (holotype), B–D, *O. bonplandii* (B, holotype; C, Australia, *Wilson 26164*; D, Australia, *Degelius s.n.*). E–F, *O. auberianoides* (E, Argentina, Ferraro 10521; F, isotype of *O. endoleuca*).

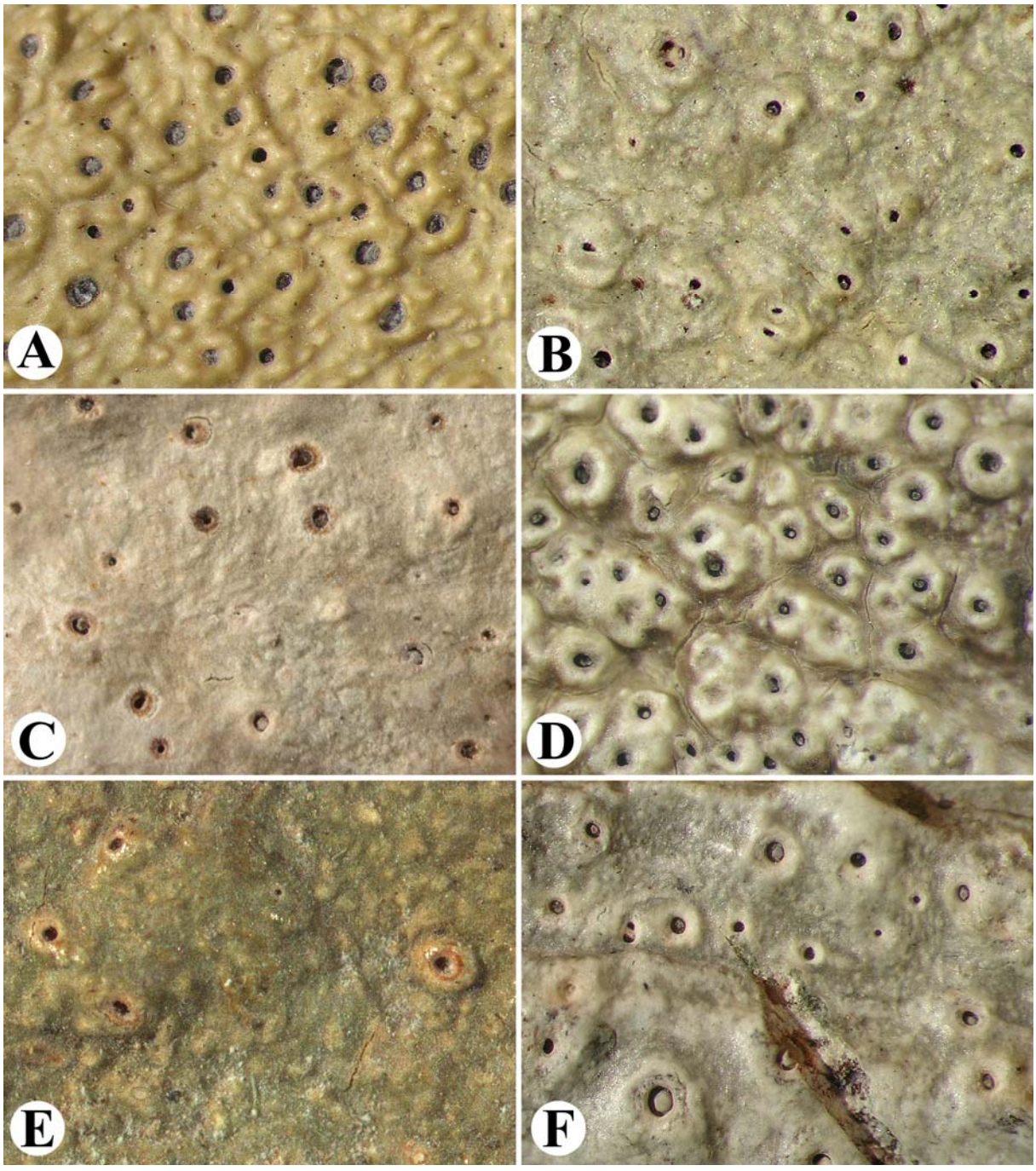

Figure 9 — Morphology of *Ocellularia* species. A–B, *O. perforata* (A, lectotype; B, lectotype of *O. violacea* var. *glauca*). C, *O. raveniana* (holotype). 9D, *O. pauciseptata* (holotype). E, *O. vezdana* (isolectotype). F, *O. khaoyai-ana* (holotype).

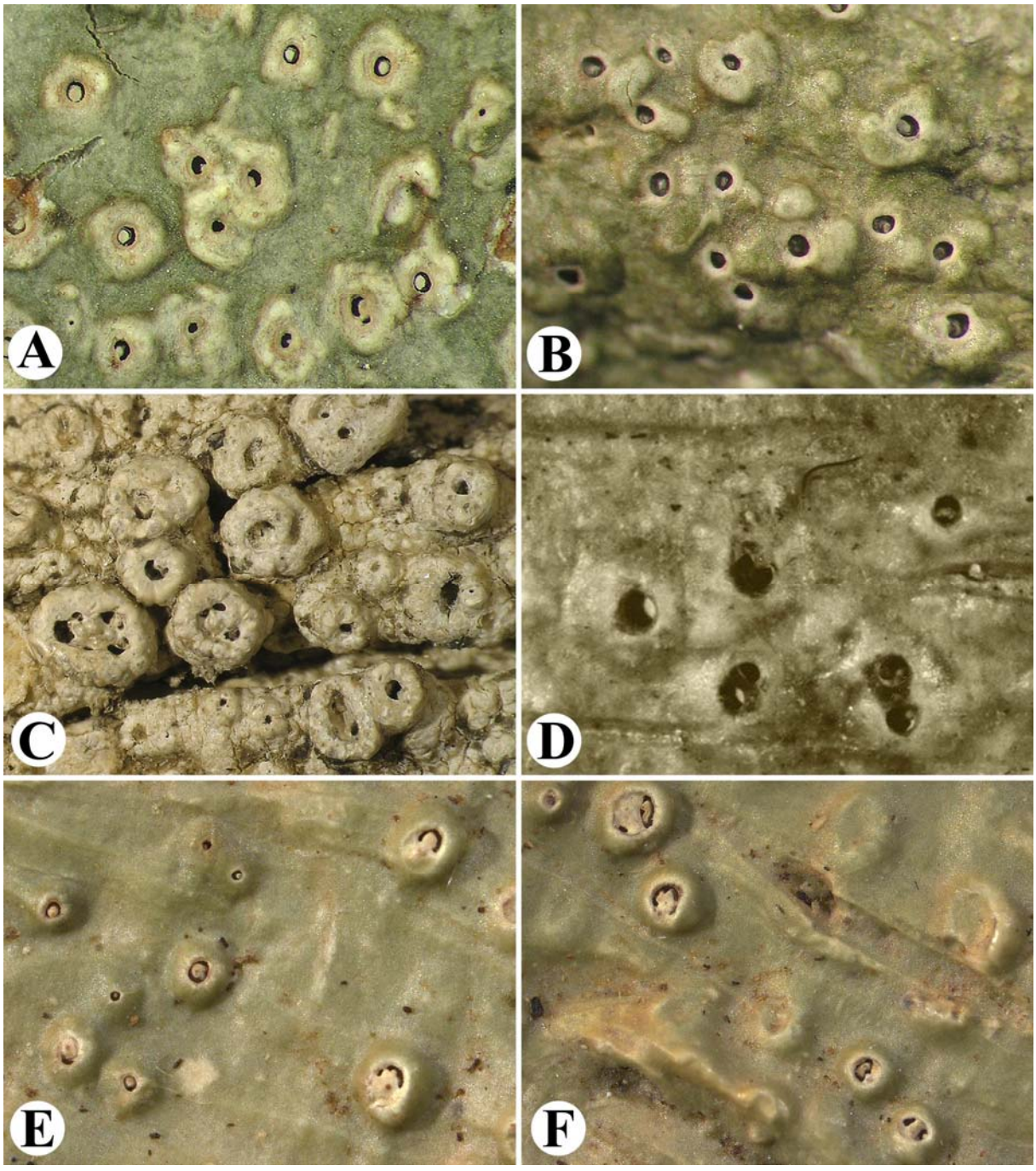

Figure 10 — Morphology of *Ocellularia* species. A–B, *O. cryptica* (A, holotype; B, Costa Rica, Lücking 17261b). C, *O. mauretiana* (holotype). D, *O. rufocincta* (holotype). E–F, *O. protocetrarica* (Brazil, *Buck 2580*).

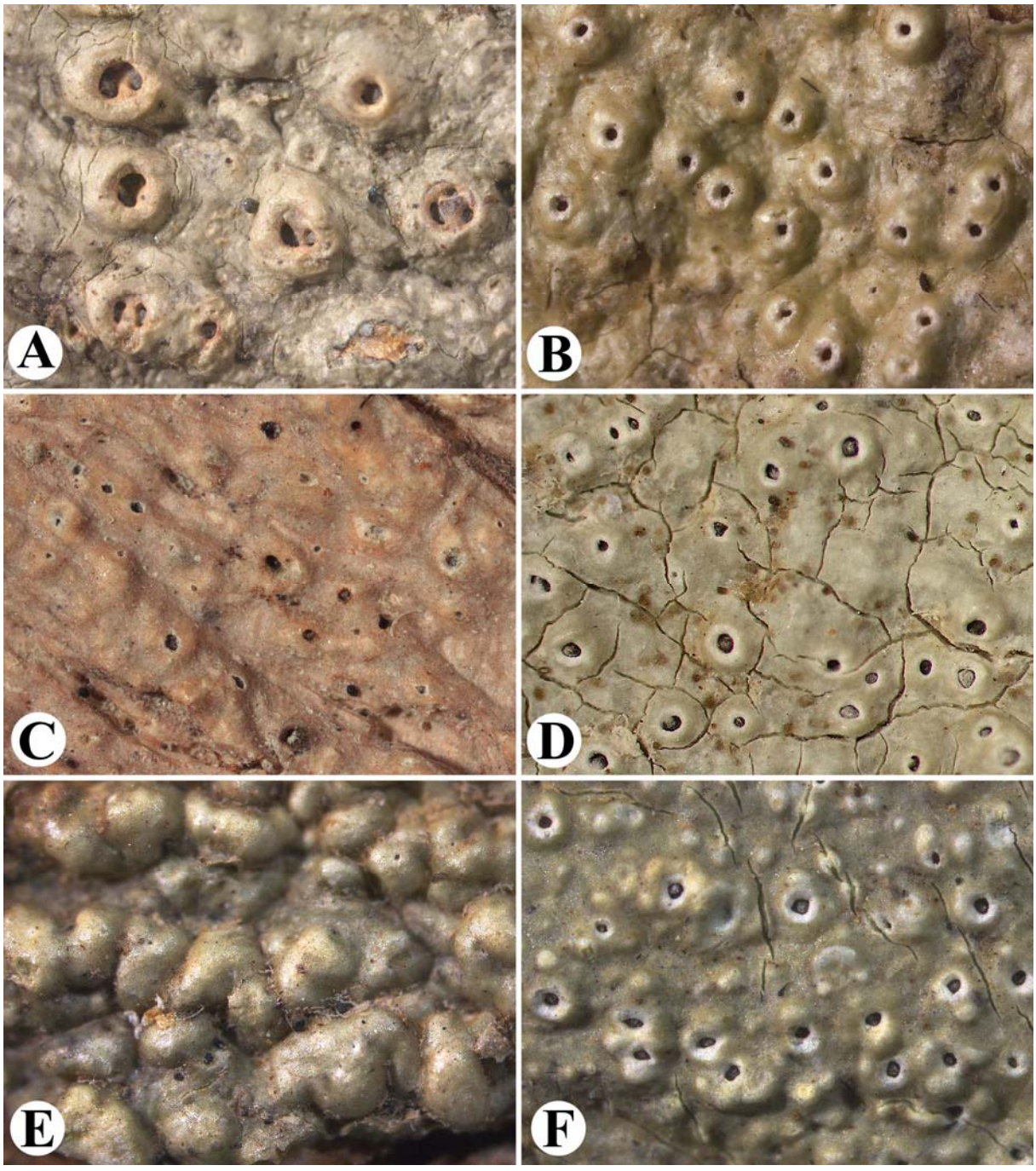

Figure 11 — Morphology of *Ocellularia* species. A, *O. balangoda* (holotype). B, *O. baorucensis* (holotype). C–D, *O. violacea* (holotype). E, *O. maricaoensis* (holotype). 11F, *O. daniana* (holotype).

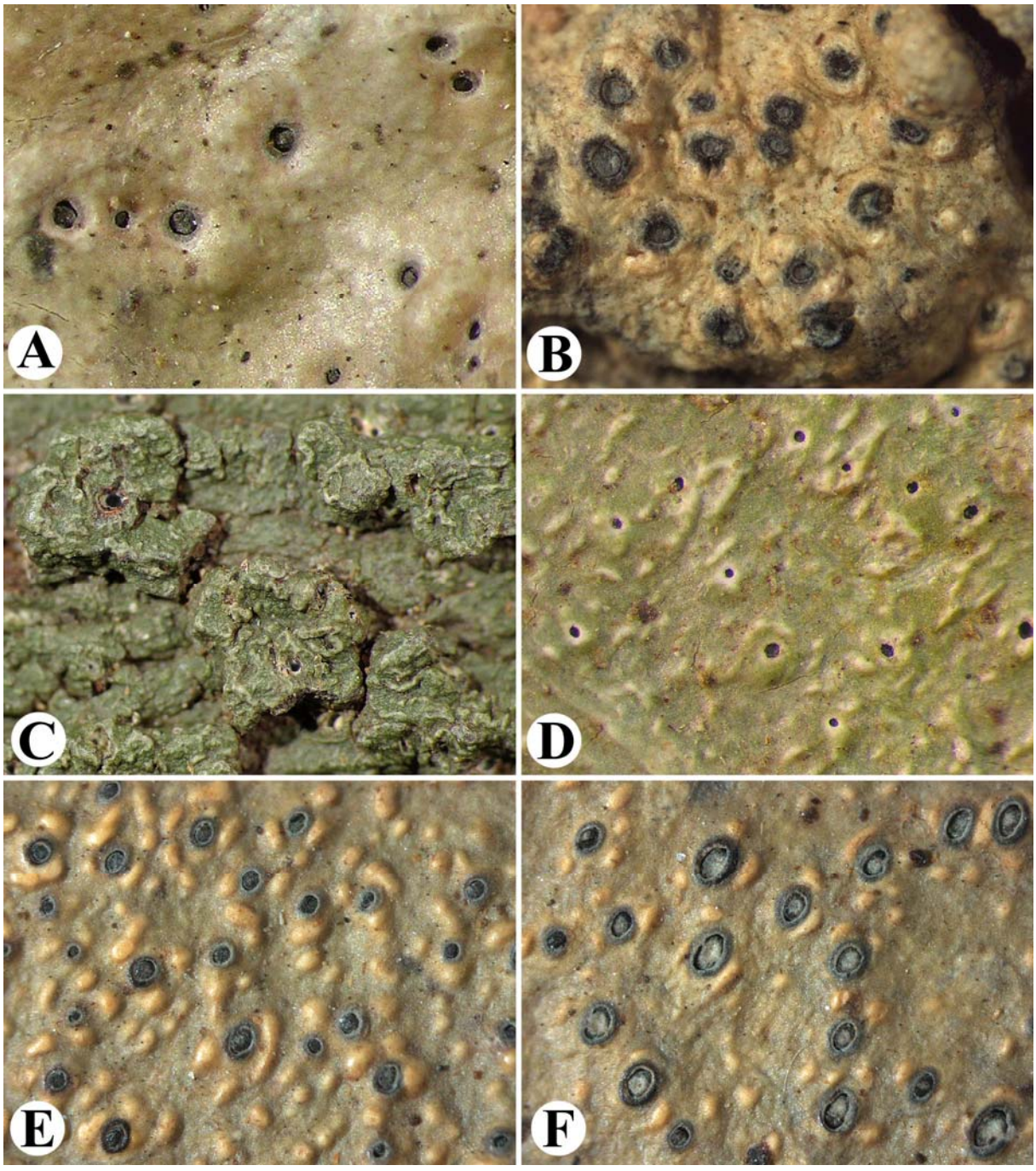

Figure 12 — Morphology of *Ocellularia* species. A, *O. thryptica* (holotype). B, *O. gymnocarpa* (holotype). C, *O. ornata* (holotype). D, *O. rugosothallina* (holotype). E–F, *O. subperforata* (holotype).

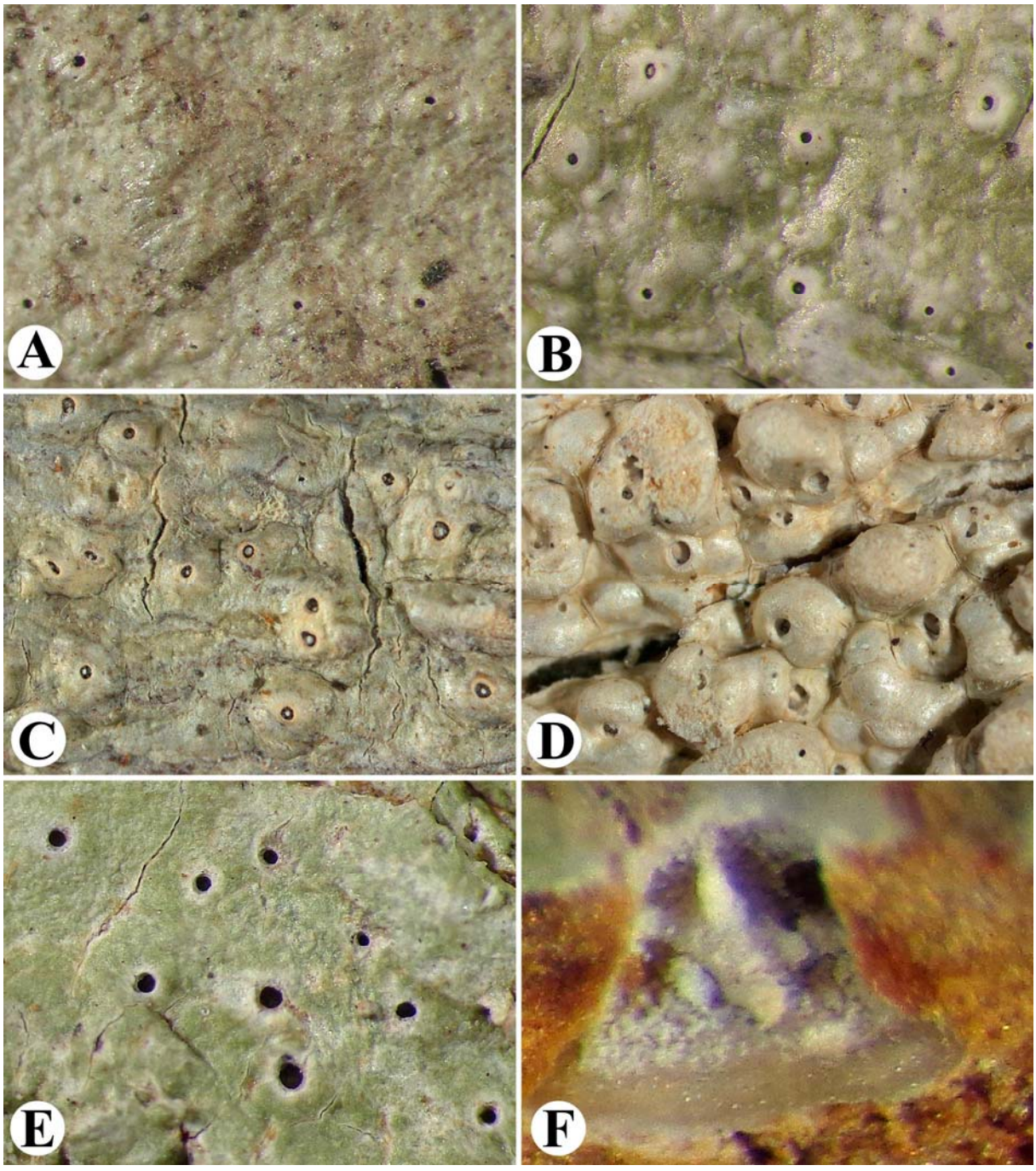

Figure 13 — Morphology of *Ocellularia* species. A, *O. minutula* (holotype). B, *O. inconspicua* (holotype). C, *O. pseudopyrenuloides* (holotype). D, *O. albobullata* (holotype). E–F, *O. immersocarpa* (holotype; F, section through ascoma).

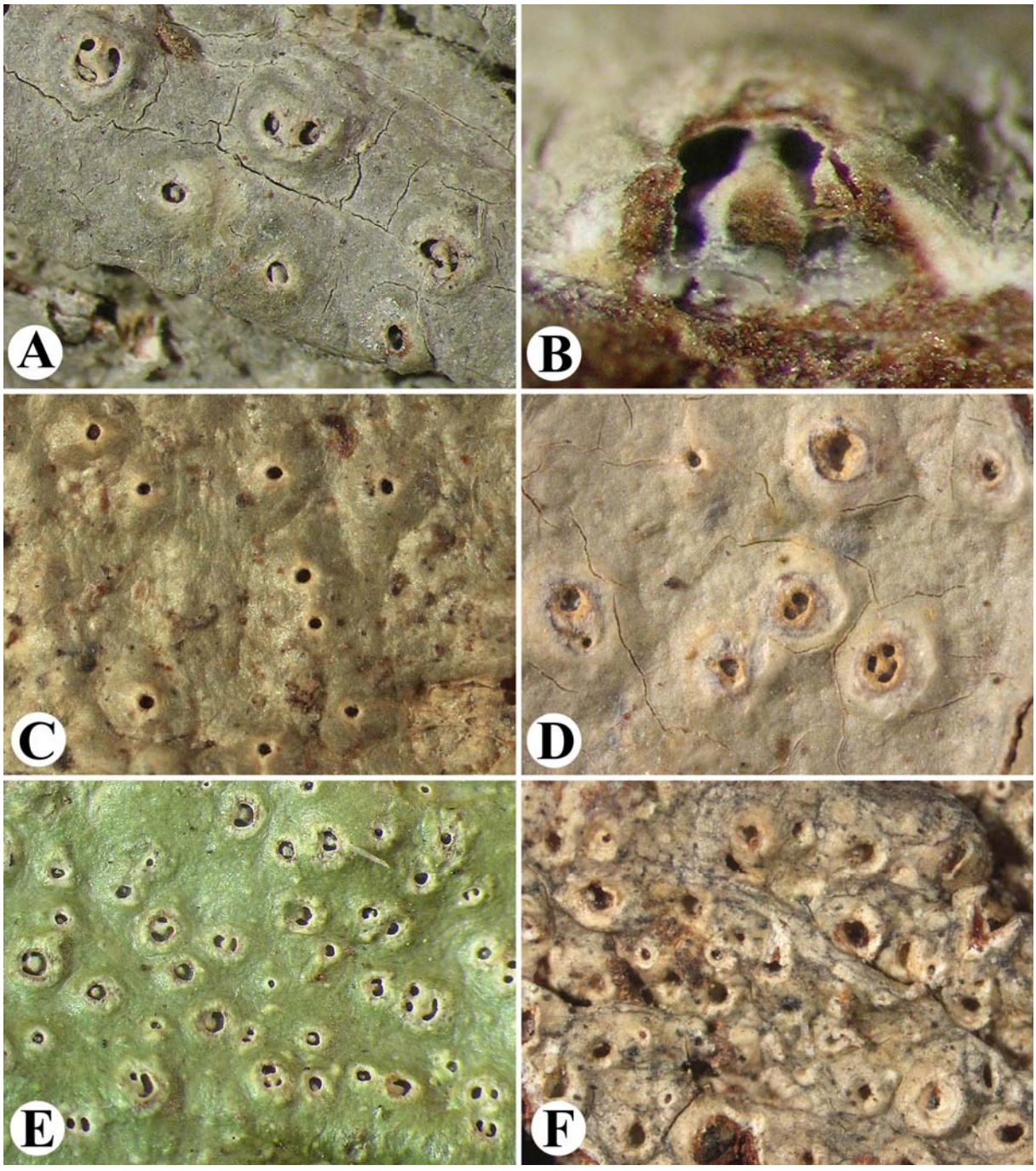

Figure 14 — Morphology of *Ocellularia* species. A–B, *O. comparabilis* (isotype; B, section through ascoma). C, *O. psorbarroensis* (holotype). D, *O. aptrootiana* (holotype). E, *O. fenestrata* (holotype). F, *O. pluriporoides* Homchant. & Coppins (holotype).

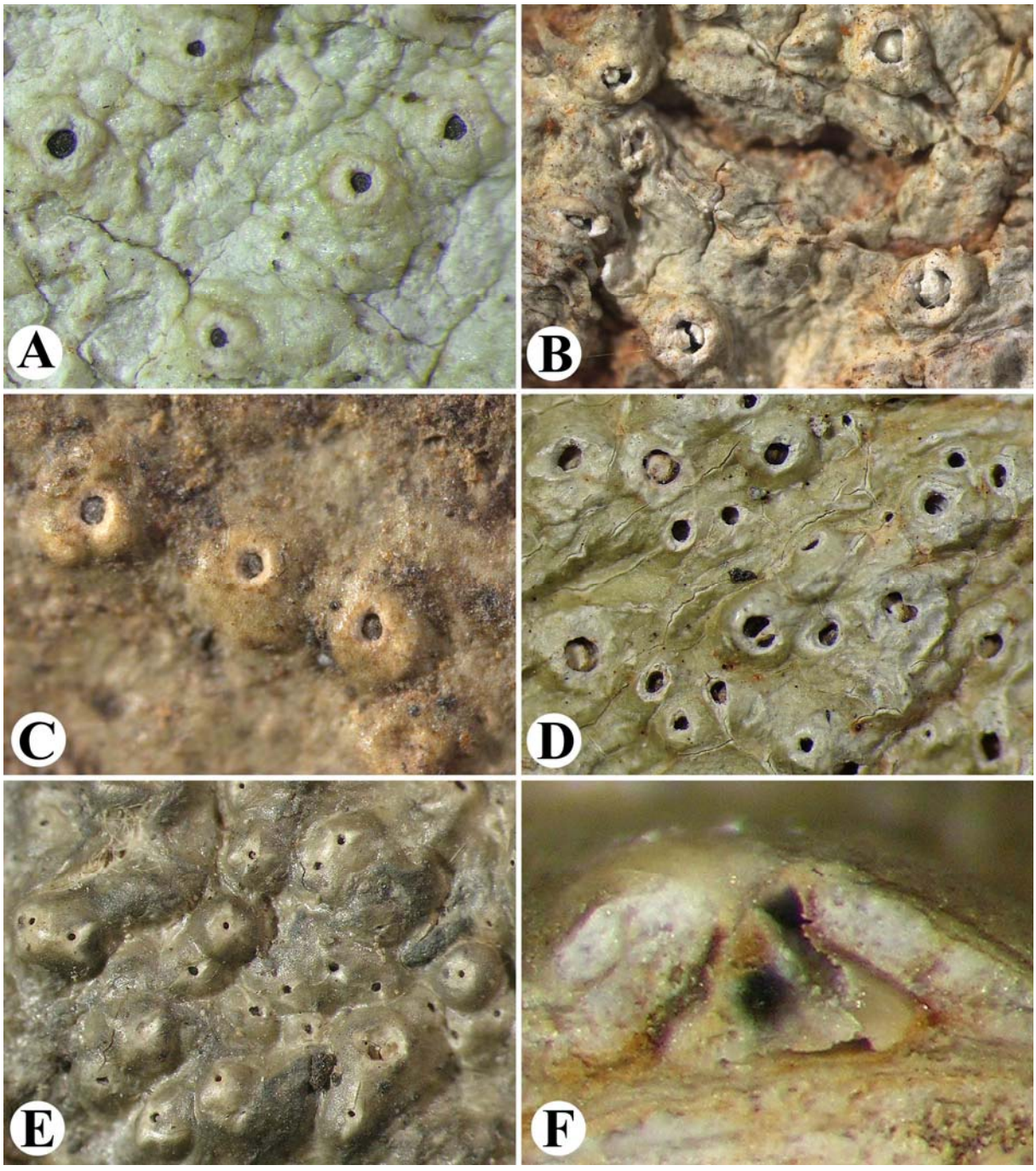

Figure 15 — Morphology of *Ocellularia* species. A, *O. albothallina* (holotype). B, *O. australiana* (holotype). C, *O. cloonanii* (holotype). D, *O. rondoniana* (holotype). E–F, *O. pluripora* (holotype; F, section through ascoma).

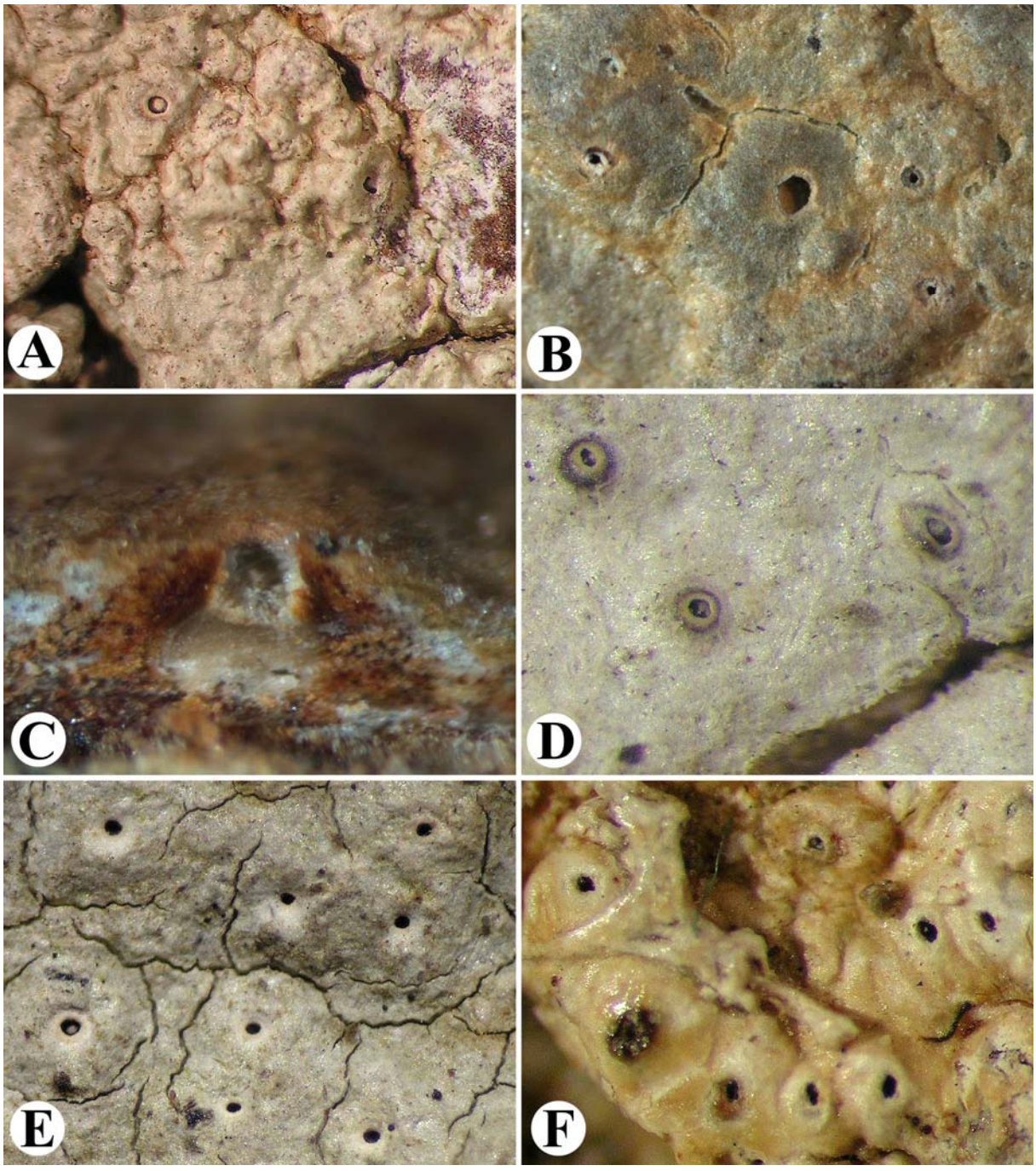

Figure 16 — Morphology of *Ocellularia* species. A, *O. plicata* (holotype). B–C, *O. garoana* (holotype; C, section through ascoma). D, *O. abbayesiana* (holotype). E, *O. umbilicatoides* (holotype). F, *O. terebrata* (holotype).

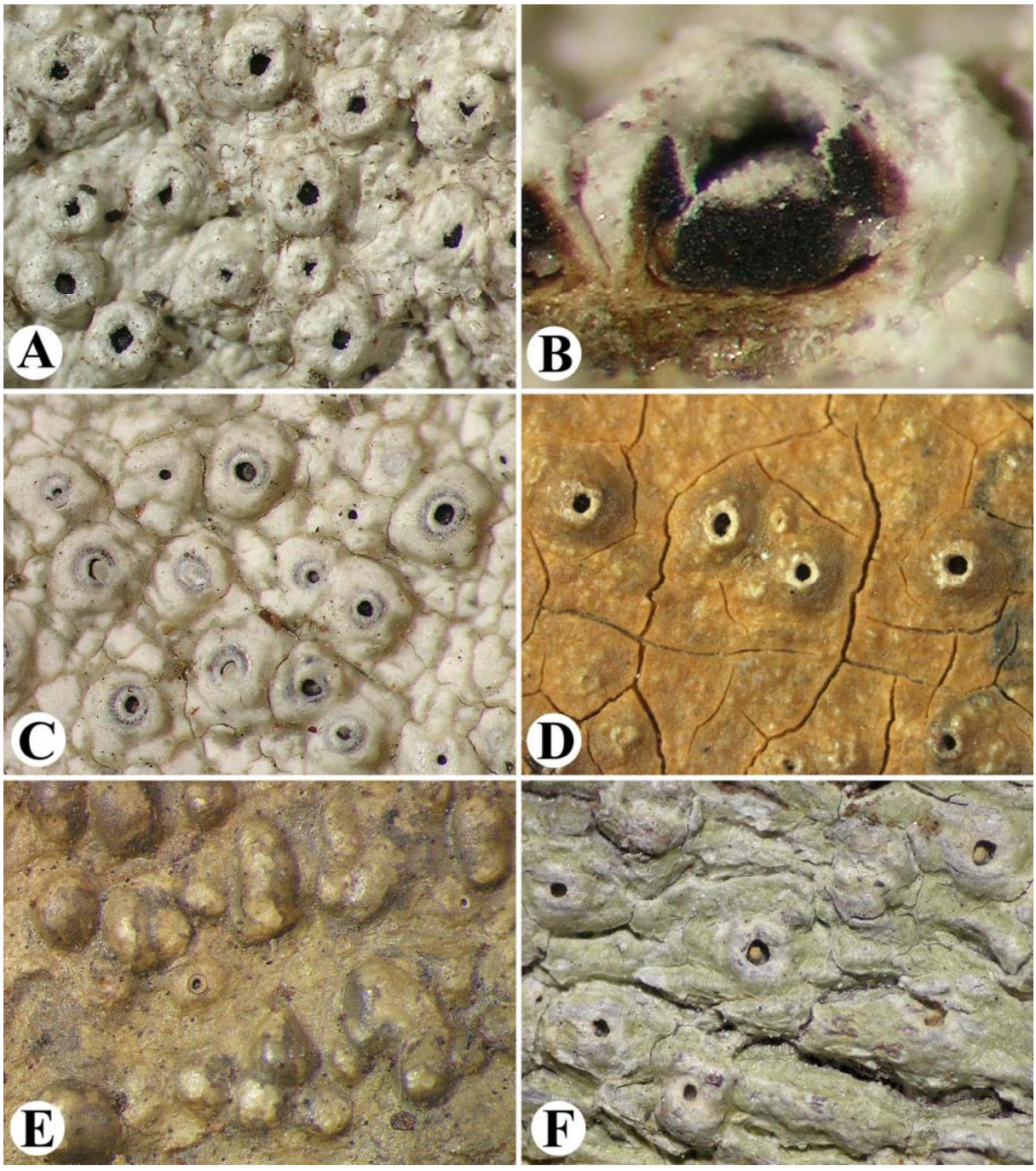

Figure 17 — Morphology of *Ocellularia* species. 17A–B, *O. antillensis* (Trinidad, *Hale 37444*; B, section through ascoma). C, *O. wirthii* (holotype). D, *O. conformalis* (holotype). E, *O. grantii* (holotype). F, *O. usnicolor* (holotype).

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Scaphis Eschw., *Systema Lichenum*: 14 (1824). – Tipo: *Scaphis anfractuosa* Eschw. ≡ *Graphis anfractuosa* (Eschw.) Eschw.

(Fig. 2A–F, 5J–L)

Descripción — Talo grisáceo a marrón amarillento pálido ...

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Distribución y Ecología — *Acanthothecis* es un género ...

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15a Ascosporas pequeñas, menos de 20 µm de largo 16
15b Ascosporas medianas a grandes, más de 20 µm de largo 18

Figuras, fotografías e ilustraciones:

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Tablas:

Tabla 1 — Separación tradicional de géneros en la familia *Graphidaceae* (según MÜLLER ARGOVIENSIS 1880, 1882, 1887a, b, 1894a; ZAHLBRUCKNER 1907, 1923, 1926).

Organización apotecios	Ascosporas hialinas transversal	Ascosporas hialinas muriformes	Ascosporas marrón grisáceas transversal	Ascosporas marrón grisáceas muriformes
Lirelas solitarias	*Graphis*	*Graphina*	*Phaeographis*	*Phaeographina*
Lirelas estromáticas	*Glyphis*	*Medusulina*	*Sarcographa*	*Sarcographina*

Referencias:

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