

Epibryon kondratyukii sp. nov., a new algicolous fungus, and notes on rare lichenicolous fungi collected in Southern Ukraine

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Abstract: The new algicolous fungus *Epibryon kondratyukii* sp. nov. grows on *Coccomyxa*-like films on leaves of *Polytrichum piliferum* in Southern Ukraine. The species is characterized by sessile black setose pseudothecia, short 0–2-celled paraphysoids, 8-spored fissitunicate asci and hyaline 0–1-septate ascospores. The lichenicolous fungi *Adelococcus interlatens*, *Ascochyta candelariellicola*, *Clypeococcum psoromatis*, *Epithamnolia rangiferinae*, *Lawalreea lecanorae*, *Llimoniella adnata*, *Merismatium decolorans*, *Sphaerellothecium cladoniae*, *Stigmidium bellemerei*, *S. ramalinae* and *Weddellomyces epicallopisma* are new to the mycobiota of the Ukraine. *Cladonia foliacea* is a new host for *Epithamnolia rangiferinae*, *Lecidea fuscoatra* for *Katherinomyces cetrariae*, and *Flavoplaca austroctrina* for *Weddellomyces epicallopisma*.

Keywords: *Ascochyta*, *Epibryon*, *Epithamnolia*, *Katherinomyces*

INTRODUCTION

The studies on diversity of lichenicolous fungi in the steppe zone of Ukraine started at the end of the last century (Kondratyuk & Khodosovtsev, 1997). Currently, this research is one of the main projects of the mycological investigation in Southern Ukraine (e.g. Khodosovtsev & Darmostuk, 2016, 2017; Darmostuk & Khodosovtsev, 2017; Darmostuk et al., 2018). Eleven species of lichenicolous fungi new to Ukraine were recently collected and identified. The recently described *Katherinomyces cetrariae* (Khodosovtsev et al., 2016) was found on a new host. In addition, we found a fungus with small perithecia growing on algal *Coccomyxa*-like films on leaves of *Polytrichum piliferum* Hedw. that we describe as new to science in this paper.

MATERIAL AND METHODS

The specimens were examined by standard microscope techniques using LOMO microscopes MBS-1 and MICROMED-2. Microscopical examination was done in water, 10% KOH (K), and Lugol's iodine solution, directly (I) or after pretreatment with KOH (K/I), or Brilliant Cresyl Blue (BCr). The measurements were made in water with an accuracy of 0.5 μm for ascospores, asci, conidia, conidiogenous cells, conidiophores, and ascomatal and pycnidial wall cells, and 5 μm for ascomata and pycnidia. The measurements are given as (min-)x-SD -

x+SD(-max), where x is the average and SD is the standard deviation. The photographs were taken with a Levenhuk C510 NG camera. All examined specimens are deposited in the lichenological herbarium of Kherson State University (KHER) and M.G. Kholodny Institute of botany NAS of Ukraine (KW). The new species to Ukraine are indicate with asterisk (*).

The species

*ADELOCOCCUS INTERLATENS (Arnold) Matzer & Hafellner

Specimen examined. Ukraine. Kherson region, Vysokopil'ya district, near Nataliino village 47°28'40.9"N 33°20'41.4"E, alt. 25 m, on thallus of *Sarcogyne regularis* Körb. growing on marl limestone, 5 May 2018, A. Khodosovtsev, V. Darmostuk (KHER 12145).

Notes. The species has been reported from Europe on endolithic thalli of calcicolous lichens, such as *Clauzadea immersa* (Hoffm.) Hafellner & Bellem., *Hymenelia prevostii* (Duby) Kremp. and *Sarcogyne regularis* (Arnold, 1879, Matzer & Hafellner, 1990, Navarro-Rosinés, 1992).

*ASCOCHYTA CANDELARIELLICOLA D. Hawksw. & Kalb

Specimens examined. Ukraine. Mykolaiv region, Ochakiv district, Berezan Island, 46°36'04.0"N 31°24'36.1"E, alt. 5 m, 20 July 2018, A. Khodosovtsev, V. Darmostuk (KHER 11663); Kherson region, Kalanchak district, Khorly village, 46°04'52.8"N

33°17'57.2"E, alt. 9 m, on *Populus*, 8 August 2017, V. Darmostuk (KHER 11316). Both specimens inhabited the apothecia of *Candelariella aurella* (Hoffm.) Zahlbr.

Notes. Our specimens fit the concept of *Ascochyta candelariellicola* (Hawksworth & Kalb, 1992). The species is characterized by globose, immersed, black conidiomata up to 60 µm in diameter, ampulliform hyaline conidiogenous cells (3.2–)3.6–4.8(–5.4) µm ($n=10$) and hyaline broadly ellipsoid (1–)3-septate conidia (8.4–)10.2–13.0(–15.8) × (2.8–)3.0–3.2(–3.8) µm ($n=30$). It grows in the hymenium of *Candelariella aurella*, infected apothecia of which become decolorized. *Ascochyta candelariellicola* was known only from the type locality in Mexico. It is new to the Europe.

*CLYPEOCOCCUM PSOROMATIS (A. Massal.) Etayo

Specimens examined. Ukraine. Autonomous Republic of Crimea, Chornomorsk district, Tarkhankut peninsula, 45°25'33.5"N 32°32'20.6"E, on soil, 12 September 1994, A. Khodosovtsev (KHER 4952 sub *Squamarina cartilaginea*); Edukuyskii (Leninskii) district, cape Opuk, 45°02'30.4"N 36°13'27.6"E, on limestone, 11 September 1994, A. Khodosovtsev (KHER 12147). Both specimens inhabited the thalli of *Squamarina cartilaginea* (With.) P. James.

Notes. *Clypeococcum psoromatis* is abundant in Mediterranean countries (France, Greece, Italy, Portugal and Spain) (Navarro-Rosinés et al., 1994; Etayo, 2010) but is reported for the first time from Ukraine.

EPIBRYON KONDRATYUKII Khodos. & Darmostuk sp. nov. (Fig. 1)

Mycobank No.: MB 831470

Diagnosis. Morphologically similar to *Epibryon casaesii* (Bubák & Gonz. Frag.) Döbeler but differs by the presence of 0–2-celled paraphysoids 1.0–2.0 µm wide, ascospores (7.0–)8.3–10.2(–13.0) × (2.0–)2.4–3.2(–3.8) µm and by being associated with *Coccomyxa*-like algae on *Polytrichum*.

Type. Ukraine. Mykolayiv region, Voznesensk district, Aktove village, right bank of the river Mertvovod, Aktovsky valley, 47°41'41.7"N 31°26'21.8"E, alt. 45 m, on algal film over *Polytrichum piliferum*, on sun-exposed granite outcrops, 1 May 2016, A. Khodosovtsev & V. Darmostuk (KHER 10017 – holotype, KHER 10007–10016 – isotypes).

Description. Vegetative hyphae loosely intermixed with algal cells, without visible intracel-

lular haustoria, c. 2–3(–4) µm thick, light brownish in gelatinous film and medium brown below ascomata; *Chlamydospora*-like cells medium brown, forming short chains, one- or two-celled 6–9 × 3–5 µm; pseudothecia sessile or immersed in algal film, globose, dark-brown to black, setose, closed, (20–)35–85(–90) µm ($n=25$) diam.; ostiole brown, indistinct; perithecial wall composed of angular pseudoparenchymatous cells (*textura angularis*) in cross section, c. 7–10 µm thick, cells medium brown, angular in squash preparation, (3.0–)3.4–3.8(–5.3) µm ($n=20$) wide with dark brown pigment deposited in the cell walls; setae dark brown, up to 50 µm on upper half of ascomata, erect, straight to somewhat curved, unbranched, subcylindrical to mostly narrowed from base to top, (11–)18–32(–40) × (2.0–)3.0 ± 4.6(–6.0) µm ($n=30$) in medium part, c. 4–6 µm wide below and 2–3 µm wide above, 0–1-septate, thick-walled, smooth, apex more less acute; hamathecium usually invisible, formed of short 0–2-celled paraphysoids at the base of asci, 1.0–2.0 µm wide; asci 8-spored, fissitunicate, clavate, (21–)24–28(–31) × (7.0–)7.4–8.6(–10) µm ($n=15$), apex wall 2–6 µm thick, K/I–; ascoplasma I+ orange; ascospores hyaline,

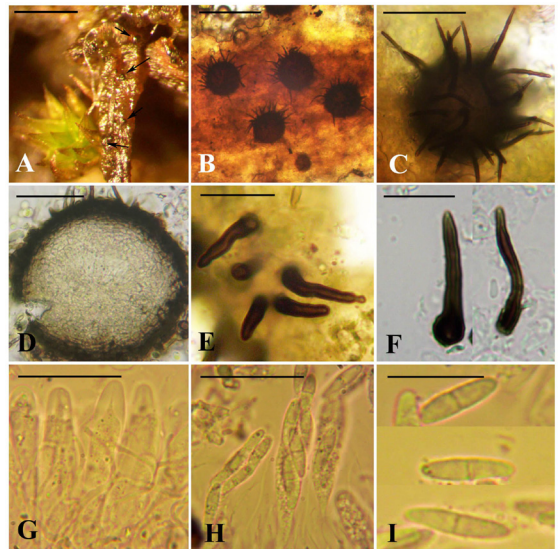


Fig. 1. *Epibryon kondratyukii* (all from holotype): A, B, C – pseudothecia on the host; D – cross-section of pseudothecium; E, F – setae; G – asci with paraphysoids; H, I – ascospore. Scale bars: A – 1 mm, B – 100 µm, C – 50 µm, D, E, F, G, H – 25 µm, I – 10 µm.

0–1-septate, subclavate, without appendages, not ornamented, upper cell shorter and broader than lower cell, (7.0–)8.3–10.2(–13.0) × (2.0–)2.4–3.2(–3.8) μm, length/width (2.5–)2.8– 3.6(–4.8) ($n=40$). Pycnidia not seen.

Ecology and distribution. The species formed extensive blackish areas (if dry) on *Coccomyxa*-like algal films on leaf of *Polytrichum piliferum* in exposed places over granite outcrops. Evidently, the biological nature of this fungus (whether mutualistic or commensal) is similar to the algalicolous *Epigloea* species (Döbbeler, 1984). The vegetative hyphae of *Epibryon kondratyukii* envelop the living algal sheaths without visible intracellular haustoria. Likewise, dead algal cells were not found in the fresh material. Probably, fungal hyphae adsorb the gelatinous substance produced by the algal cells. The species is known only from type location in the steppe zone of Ukraine so far.

Etymology. The epithet honours the Ukrainian lichenologist Sergiy Kondratyuk at the occasion of his 60th birthday.

Notes. The morphology of new species is similar to other known *Epibryon* species. Döbbeler (1978) proposed this genus for bryosymbiont species, with the type species *E. plagiochilae* (Gonz. Frag.) Döbbeler. This species is characterized by setose small globose ascomata, fissitunicate asci with two-celled hyaline ascospores and the absence of paraphysoids. However, the genus includes species with paraphysoids, non-setose ascomata and brownish ascospores as well. During a molecular study (Stenroos et al., 2010), the type species and some other *Epibryon* taxa fell into the class Eurotiomycetes, and came out as polyphyletic. Hyde et al. (2013) included the genus in Dothideomycetes and associated it with Pseudoperisporiaceae, the species of which have branched, septate pseudoparaphyses in a gelatinous matrix. The last features are not characters for the type species of *Epibryon*. The morphology of *Epibryon* is similar to genus *Antennulariella*, and a differentiation can be found in the ascomatal setae length. The type species of the genus, *A. fuliginosa* Woron., described from *Ilex* leaves in the Caucasus, has a thick non-lichenized mycelium 400–500 μm thick, pseudothecia 60–75 μm diam., ascomatal septate appendages similar to setae up to 100 μm length and a foliicolous habit (Woronichin,

1915). Unfortunately, molecular data for *Antennulariella* species are missing (Hyde et al., 2013; Chomnunti et al., 2014) and the genus is formally included in Dothideomycetes. Short ascomatal setae are also formed in *Niesslia* (e.g. Etayo et al., 2013), which includes a few lichenicolous representatives (Diederich et al., 2018). However, this genus has unitunicate, longer asci and larger ascomata. *Wentiomycetes* is similar to the lichenized species of *Antennulariella* by having hyaline, 1-septate ascospores produced in fissitunicate asci, but the ascomatal setae in the type species, *Wentiomycetes javanicus* Koord. (Koorders, 1907) are dichotomously branched at the apex.

Epibryon kondratyukii morphologically resembles *E. casaresii* (Bubák & Gonz. Frag.) Döbbeler, which grows directly on moss leaf (*Barbilophozia*, *Frullania*, *Mnium*, *Mylia*, *Pogonatum*, *Scapania*, *Sphagnum*, *Tritomaria*) (Döbbeler, 1978), but differs by the presence of paraphysoids and by being associated with *Coccomyxa*-like algae on *Polytrichum*. *Epibryon bryophilum* (Fuckel) Döbbeler has larger ascospores (15–18 × 6.5–7.5 μm vs. 7–13 × 2–3.8 μm in *E. kondratyukii*). *E. polyphagum* Döbbeler is another species associated with green algae and mosses (*Racomitrium*) (Döbbeler, 1978), but differs from *E. kondratyukii* by aetose lager ascomata and longer ascospores (11–14 μm vs. 7.0–13 μm in *E. kondratyukii*). Paraphysoids are present only in *E. dicrani* (Racov.) Döbbeler, but this species has shorter ascospores (7.5 × 2.5 μm vs. 7–13 × 2.0–3.8 μm in *E. kondratyukii*) and is associated with *Dicranum scoparium* Hedw. The new species is morphologically similar to the lichenized, corticolous *Antennulariella lichenisata* Coppins & Aptroot, which has longer ascospores (13–16 μm vs. 7–13 μm in *E. kondratyukii*), wider asci (10–13.5 μm vs. 7–10 μm in *E. kondratyukii*) and a *Trentepohlia* photobiont (Coppins & Aptroot, 2008).

*EPITHAMNOLIA RANGIFERINAE E. Zimm., Diederich & Suija (Fig. 2 A, B, C)

Specimen examined. Ukraine. Kherson region, Oleshky district, near Nechaevo village, 46°34'06.6"N 32°46'53.2"E, alt. 13 m, on *Cladonia foliacea* (Huds.) Willd., on sand, 12 April 2018, V. Darmostuk (KHER 11639).

Notes. This recently described species (Suija et al., 2017) has superficial cupulate brown con-

idiomata (60–)65–85(–105) μm ($n=15$), hyaline septate conidiophores developing in the base of the conidiomata, hyaline phialidic lageniform to fusiform conidiogenous cells and aseptate short bacilliform conidia (3.8–)4.4–5.6(–6.0) \times (1.2–)1.4–1.8(–2.0) μm , length/breadth ratio is (2.4–)2.8–3.6(–4.2) ($n=30$). Our specimen has longer conidiogenous cells ((12.4–)14.2–16.0(–18.8) \times (1.6–)2.0–2.2(–2.4) μm ($n=30$) vs. (9.5–)10.4–12.4(–13.3) μm in protologue) and grows on the thallus of *Cladonia foliacea* vs. *Cladonia rangiferina* (L.) Weber ex F.H. Wigg. Some decolorisation of infected thalline parts was observed. *Cladonia foliacea* is a new host species. The fungus was previously known only from Austria and Switzerland (Suija et al., 2017; Zimmermann & Berger, 2018).

**KATHERINOMYCES CETRARIAE* Khodos. (Fig. 2 D, E, F, G)

Specimens examined. Ukraine. Zaporizzia region, Chernihiv district, near Novopoltavka village, 47°15'00.1"N 36°17'30.7"E, alt. 46 m, on granite stone, 2 October 2007, A. Khodosovtsev, T. Zavyalova (KHER 4401, 4363); near Kamianka village, 47°14'20.5"N 36°00'10.7"E, alt. 42 m, on granite stone, 19 July 1995, A. Khodosovtsev (KHER 6387). Both specimens inhabited the thalli of *Lecidea fuscoatra* (L.) Ach.

Notes. Our specimens are characterized by an immersed light brown vegetative mycelium (2.2–)3.0–4.2(–4.6) μm ($n=30$) thick, erumpent black globose conidiomata opening irregularly (90–)95–100(–110) μm ($n=10$) diam., a brownish thin conidiomatal wall up to 5 μm thick. Conidiophores indistinct. Conidiogenous cells brown, ellipsoid, slightly verrucose, (5.0–)5.6–7.6(–8.4) \times (2.2–)3.0–5.6(–6.2) μm ($n=30$). Conidia aseptate, broadly ellipsoid to irregular, brown, verrucose, (6.6–)9.2–10.4(–12.0) \times (3.2–)4.0–5.2(–6.0) μm , length/breadth ratio (1.3–)2.0–2.4(–3.2) ($n=60$). Infected thalli become whitish due to damage of the upper cortex. The specimens differ from the type description by bigger conidiomata (vs. 30–50 μm in holotype). Originally, the species was known only on *Cetraria aculeata* (Schreb.) Fr., on which it does not cause any damage (Khodosovtsev et al., 2016, 2018). The examined specimens suggest that *Katherinomyces cetrariae* is able to parasitize unrelated host species, however, more studies, including molecular data are needed to ascertain that populations on different hosts belong to the same species.

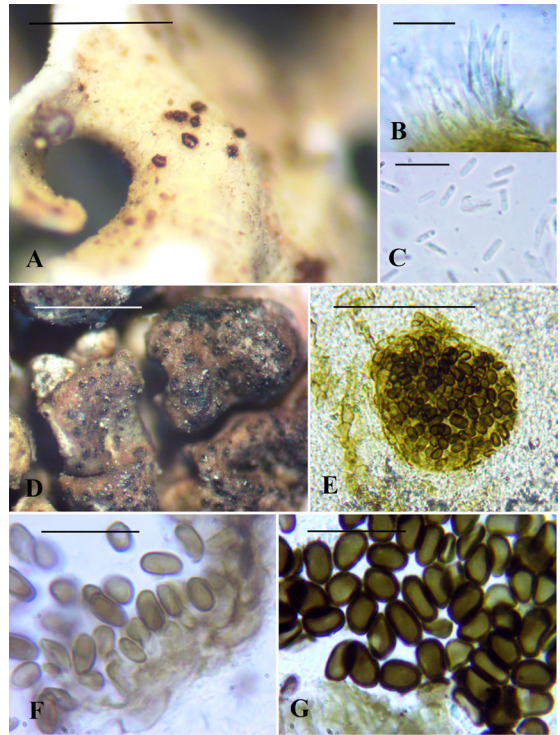


Fig. 2. *Epithamnolia rangiferinae* (KHER 11639): A – conidiomata on host thallus; B – conidiogenous cells; C – conidia. *Katherinomyces cetrariae* (KHER 4401): D – conidiomata on host thallus; E – cross-section of conidioma (in K); F – conidiogenous cells with conidia; G – conidia (in K). Scale bar: A, D – 1mm, E – 100 μm , F, G – 20 μm , B, C – 10 μm .

**LAWALREEA LECANORAE* Diederich

Specimens examined. Ukraine. Kherson region, Bilozerka district, near Stanislav village, 46°34'35.2"N 32°11'02.4"E, alt. 9 m, on *Ephedra*, 30 May 2017, A. Khodosovtsev, V. Darmostuk (KHER 11318); Kalanchak district, Khorly village, 46°04'52.8"N 33°17'57.2"E, alt. 9 m, on *Populus*, 8 August 2017, V. Darmostuk (KHER 11316). Both specimens inhabited the apothecia of *Myriolecis hagenii* (Ach.) Šliwa, Zhao Xin & Lumbsch.

Notes. Previously, the species was reported on apothecia of corticolous *Lecanora* species from Spain, France, Luxembourg, Germany, Poland and Russia (Boqueras, 2000; Diederich, 1990; Jando & Kukwa, 2003; Kocourková & Brackel, 2005; Signoret & Diederich, 2003; Zhurbenko & Notov, 2015).

*LLIMONIELLA ADNATA Hafellner & Nav.-Ros.

Specimen examined. Ukraine. Kherson region, Velyka Oleksandrivka district, near Bilohorka village, right bank of river Ingulets, 47°12'21.41"N 33°08'03.81"E, alt. 41 m, on green algal crust, on soil, 2 May 2017, G. Naumovych (KHER 11654).

Notes. The specimen is characterized by semi-immersed to sessile roundish marginate apothecia (150–)165–180(–195) μm diam., an orange brown exciple without hairs, K+ shortly violet, hyaline hymenium up to 100 μm , 8-spored cylindrical asci and hyaline aseptate ellipsoid ascospores with 1–2 big guttules, (9.8–)11.2–13.4(–13.8) \times (4.8–)5.5–6.5(–7.0) μm , length/breadth ratio (1.6–)2.0–2.4(–2.8) ($n=40$).

This species has been collected on a cyanobacterial soil crust under destroyed lichen thalli. Probably, the host is *Placidium squamulosum* (Ach.) Breuss because this species is also known from this location. *Llimoniella adnata* was reported from Spain and Russia (Diederich & Etayo, 2000).

*MERISMATIUM DECOLORANS (Rehm ex Arnold) Triebel

Specimen examined. Ukraine. Kherson region, Novotroitsk district, Churyuk Island, 46°05'01.4"N 34°15'30.7"E, alt. 5 m, on *Cladonia* sp., on soil, 6 October 2018, V. Darmostuk (KHER 12124).

Notes. A common species in Europe with a wide host-specificity, previously known on a few *Cladonia* species (Zhurbenko & Pino-Bodas, 2017).

*SPHAERELLOTHECIUM CLADONIAE (Alstrup & Zhurb.) Hafellner

Specimen examined. Ukraine. Autonomous Republic of Crimea, Sudakskiy district, Cape Meganom, 44°48'41.3"N 35°04'48.0"E, alt. 68 m, on thallus of *Cladonia foliacea*, on soil, 8 August 2004, A. Khodosovtsev (KHER 12146).

Notes. A widespread species in the Holarctic (e.g. Zhurbenko & Pino-Bodas, 2017). The infected thallus parts in our specimen turn whitish.

*STIGMIDIUM BELLEMEREI Cl. Roux & Nav.-Ros.

Specimen examined. Ukraine. Kherson region, Bilozerka district, Fedorivka village, 46°48'18.6"N 32°48'19.4"E, alt. 25 m, on *Lecania turicensis* (Hepp) Müll. Arg., on limestone, 13 June 2018, V. Darmostuk (KHER 11631).

Notes. This species has been reported from France, Germany, Luxembourg and Czech Republic (Roux et al., 1998; Sérusiaux et al.,

1999; Triebel & Scholz, 2001; van den Boom & Palice, 2006).

*STIGMIDIUM RAMALINAE (Müll. Arg.) Etayo & Diederich

Specimen examined. Ukraine. Kherson region, Oleshky district, Kozachi Lagery, Pokosy, 46°36'19.5"N 32°56'46.0"E, alt. 32 m, on *Ramalina fraxinea* (L.) Ach., on *Populus* bark, 20 March 2008, A. Khodosovtsev (KHER 11655).

Notes. Vegetative mycelium immersed in the host thallus, brown, smooth walled, (5.4–)5.6–6.0(–6.4) μm wide. Ascomata scattered, black globose, (45–)50–55(–65) μm ($n=15$). Ascomatal wall brown, 5–8 μm thick, composed of two layers of elongate cells, *textura angularis*. Ostiolar and interascal filaments not observed. Asci bitunicate, clavate with thick apical part, 8-spored, (20.0–)22.4–26.6(–28.6) \times (7.6–)12.2–13.8(–14.6) μm ($n=15$), BCr+ blue, I–. Ascospores colourless, surface smooth, with visible halo, ellipsoid with slightly wider upper cell, 1-septate (overmature ascospores 3-septate), slightly constricted at the septa, (10.8–)11.6–13.0(–14.2) \times (3.2–)3.4–4.0(–4.6) μm , length/breadth ratio (2.4–)3.0–3.6(–4.4) ($n=35$).

There are two *Stigmidium* species known on *Ramalina* species: *Stigmidium epiramalina* (Vouaux) Hafellner and *Stigmidium ramalinae* (Müll. Arg.) Etayo & Diederich. As the protologues of both species have only minor differences in spore size, some authors consider them as synonyms (e.g., Etayo & Osorio, 2004). The situation is complicated by the fact that the type specimen of *Stigmidium epiramalina* (= *Pharcidia epiramalina* Vouaux) seems to be lost. Our specimen perfectly fits the detailed description provided by Etayo & Osorio (2004) for *Stigmidium ramalinae*.

Stigmidium ramalinae is a widespread species reported from Europe, Asia, South and North America (Hafellner, 1994; Hawksworth, 2003; Etayo & Osorio, 2004; van den Boom & Etayo, 2006; Etayo & Sancho, 2008; Kocourková et al., 2010; Kondratyuk et al., 2016).

*WEDDELLOMYCES EPICALLOPISMA (Wedd.) D. Hawksw.

Specimens examined. Ukraine. Autonomous Republic of Crimea, Edykuy (Leninskyi) district, near Mts Opuk, 45°02'33.0"N 36°13'30.7"E, alt. 65 m, on *Variospora aurantia* (Pers.) Arup, Frödén & Søchting, on limestone, 9 June 1983, E. Kopachevska, N. Beznis (KW 53290); Kherson region, Bilozerskyi district, near

Olexandrivka village, 46°40'10.5"N 32°06'30.3"E, alt. 20 m, on *Flavoplaca austrocitrina* (Vondrák, Řiha, Arup & Søchting) Arup, Søchting & Frödén, on concrete in channel, 9 January 2018, V. Darmostuk (KHER 11653); Velyka Oleksandrivka district, village Mala Olexandrivka, 47°17'18.5"N 33°16'04.9"E, alt. 35 m, on *Caloplaca* sp., on limestone, 29 September 2018, V. Darmostuk (KHER 12137).

Notes. This species has been reported on the thallus and apothecia of *Variospora aurantia* from Germany (Hawksworth & Diederich, 1991), Spain (Navarro-Rosinés & Roux, 1995), France (Weddell, 1873), British Isles (Hawksworth, 1986), Italy (Nimis & Poelt, 1987) and Israel (Calatayud & Navarro-Rosinés, 1998). *Flavoplaca austrocitrina* is a new host species.

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