

Notes on two lichenicolous *Epigloea* species from Central Europe

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Abstract

Taxonomic remarks, known distribution, ecological notes and new records in Central Europe for two species of *Epigloea* are provided. Many specimens recognized here under *E. soleiformis* characterize slightly wider and more ellipsoid ascospores than those described in the protologue but they are regarded as some kind of a phenetic variability of this species. *E. soleiformis* seems to be not only algicolous fungus but also facultatively lichenicolous on *Placynthiella* spp. and terricolous *Peltigera* spp. while *E. urosperma* is found to be exclusively lichenicolous on *Placynthiella dasaea*. *E. soleiformis* is new for the Western Carpathians and the Harz Mts, and *E. urosperma* is new for whole Carpathians.

Keywords: Ascomycota, taxonomy, algicolous fungi, lichenicolous fungi, lichens, Poland, Germany

Introduction

The genus *Epigloea* Zukal containing 12 species [1] belongs to the family Epigloeaceae (Zahlbr.) of uncertain taxonomic position within Ascomycota [2]. All of known *Epigloea* species are probably under-collected due to their inconspicuousness, ephemeral ascomata and specific niche requirements. Most of these microfungi live as a fine mycelium immersed in the gelatinous algal film. These algal films cover bare damp soils, rocks, rotten wood as well as plant debris (especially moribund bryophytes) and various terricolous and epibryophytic lichens. The biological nature of the algicolous lifestyle of *Epigloea* spp. remains poorly understood. They were described as lichens, “semi-lichens” or non-lichenized parasites of algae or their commensals [3–7]. Lichenicolous records (without the algal film) were very rare. Almost all of them referred to the lichen parasite – *E. urosperma* [6–8]. *E. soleiformis* has been reported as a lichenicolous, weakly parasitic fungus only from two localities in Asia [9] and from N Poland [10].

From the Carpathians only several reports on *Epigloea* are known, one of *Epigloea medioincrassata* (Grumann) Döbblers from Polish part of the Tatra Mts [11], one of *E. pleiospora* Döbblers from the Bieszczady Mts [12] and one of *E. soleiformis* Döbblers from the Ukrainian Eastern Carpathians [13].

The aim of this paper is to present some additional data that would contribute to the knowledge of the genus *Epigloea* and

the distribution of its two representatives in Central Europe with special remarks on the intraspecific variability within *E. soleiformis*.

Material and methods

Material was collected occasionally by the first author during several recent field trips in different regions of Poland and the Harz Mts in Germany. Results of field explorations of lichenicolous microlichens, mainly on terricolous *Placynthiella* spp. and *Peltigera* spp. carried out in 2005 and 2012 by the second author in the Wyzyna Śląsko-Krakowska upland geographical macroregion [14] have been included as well.

Fungi were identified by standard microscopy. Apothecial hand-made sections were mounted in water and sometimes in KOH or HNO₃ for better view of the size of investigated internal structures, especially ascospores. Details of anatomy were measured in water. Nomenclature of taxa follows MycoBank fungal databases [1].

Distributional, ecological and taxonomic notes have been included.

Specimens collected by P. Czarnota are deposited in the herbarium of the Gorce National Park (GPN) and by E. Hernik in the herbarium of Rzeszów University (RES) and his private herbarium.

Results

Epigloea soleiformis Döbblers

Beih Nova Hedwigia 79: 229.1984. Fig. 1a–e.

DIAGNOSTIC CHARACTERS. Description based on examined specimens only. Mycelium in membrane-like, dull green, gelatinous, very thin algal film, composed of loosely distributed *Coccomyxa* algae. Alga cells penetrated by fungus

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haustoria. Perithecioid ascomata partly immersed in the algal film or sometimes directly on the thallus of the lichen host (then mycelium invisible), 0.1–0.15 mm diam., globose, dull blackish green, surrounded by a thin, colorless, non-algal coat. Vertical section colorless except for the upper part of excipulum, which is dull green. Hamathecium of simple, thin paraphyses. Asci 8-spored, cylindrical, $9\text{--}11 \times 40\text{--}50 \mu\text{m}$. Ascospores 1-septate, ellipsoid, sometimes ovoid, not or only slightly constricted in the middle part, $4\text{--}5.5(6) \times (9\text{--})10\text{--}13(14) \mu\text{m}$. Pycnidia not seen. For detailed illustrated description see Döbbeler [3].

NOTES. The new findings presented below characterize rather ellipsoid or only slightly ovoid ascospores almost exclusively lacking median constriction (Fig. 1c). They are usually slightly wider than described as typical in the protologue [3]. Kukwa et al. [10] gave similar description of two specimens from N Poland. Döbbeler [3] mentioned in his comment to the protologue of *E. soleiformis* that some revised Grumann's specimens from Bavaria had no median constriction usually observed in other specimens. He suggested that such specimens may represent some separate kind of a phenetic variability within this species and could be regarded under some intraspecific taxonomic level. The variability of the shape of ascospores of *E. soleiformis* found in different regions of Europe is presented by the following authors: Döbbeler [3]

(plate 11, 1–3), Ceynowa-Gieldon [4] (Fig. 8c), Pérez-Ortega and Barreno [6] (Fig. 1d). Moreover, Zhurbenko [9] in Russian specimens of *E. soleiformis* found ascospores which were not exclusively 1-septate but also occasionally simple.

Epigloea renitens (Grumm.) Döbbeler has a closest phenetic affinity to *E. soleiformis*. Döbbeler [3] showed that both species differ in the size of ascocarps, asci and ascospores; *E. soleiformis* forms smaller perithecioid ascomata ($70\text{--}150 \mu\text{m}$ vs. $105\text{--}220 \mu\text{m}$ in *E. renitens*) and its ellipsoid spores are also smaller and usually with median constriction while ascospores of *E. renitens* are mainly ovoid, slightly aciculate [6] and usually have distinctly larger one cell. In the description and pictures included by Döbbeler [3] we can find, however, some ascospores of both species completely similar to each other in their size and shape (distinctly ellipsoid and not constricted). Thus, the basic question – how is the real delimitation of both taxa? – seems to be unresolved, more so as an examination of the types of both species was not available by authors in recent time. Due to the lack of molecular evidences supporting the delimitation of different lineages confined to some phenetic characters of both taxa we propose to keep separately *E. renitens* and *E. soleiformis*, the later being the variable species characterized both constricted and not constricted ascospores, reaching $5.5 \mu\text{m}$ width. It is not excluded, however, that collections presented here represent some new species within the genus *Epigloea*.

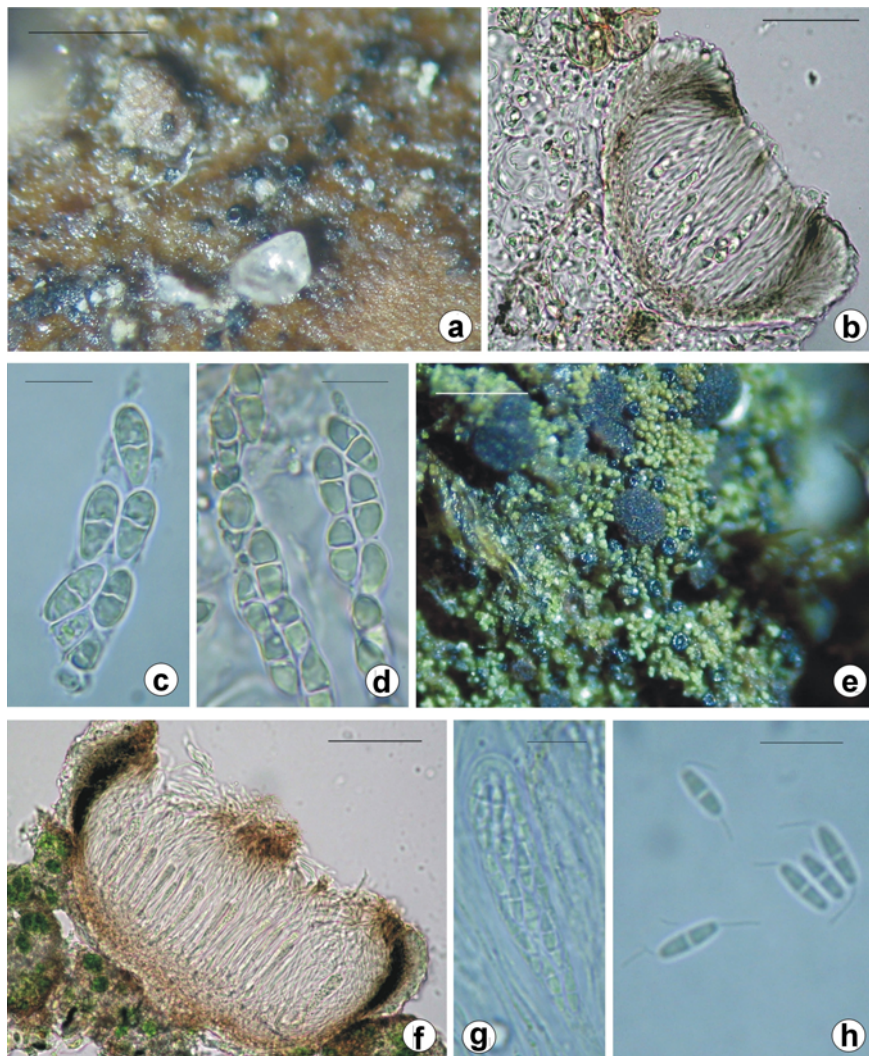


Fig. 1 Morphological and anatomical characters of examined *Epigloea*. **a–e** *E. soleiformis*. **a** Habit on *Peltigera* sp. (RES EH32a). **b** Ascomatal section (RES EH32). **c–d** Ascospores (Czarnota 6217 & Czarnota 2525a). **e** Habit on *Placynthiella dasaea* (RES EH27). **f–h** *E. urosperma*. **f** Ascomatal section (RES EH30). **g** 32-spored ascus (Czarnota 6289). **h** Ascospores (Czarnota 6289). Scale bars: **a, e** 1 mm; **b, f** 40 μm ; **c, d, g, h** 10 μm .

DISTRIBUTION AND ECOLOGY. *Epigloea soleiformis* is usually reported as a non-lichenized algicolous fungus on bryophytes, humus, soil, rotten wood, plant debris or rocks [3,4,6,15]. It was also found several times on terricolous or epibryophytic lichens including: *Trapeliopsis pseudogranulosa* Coppins & P. James, *T. granulosa* (Hoffm.) Lumbsch, *Placynthiella uliginosa* (Schrad.) Coppins & P. James [6], *Cladonia* spp. [3,4,16], *Peltigera aphthosa* (L.) Willd. [17] or accompanying *Absoconditella sphagnorum* Vězda & Poelt [4]. To date this species was not widely regarded, however, as a lichenicolous fungus. Only Zurbenko [9] based on his own collections of *Epigloea soleiformis* suggested that the species could not be only algicolous. In those cases *E. soleiformis* inhabited two representatives of *Stereocaulon* slightly discoloring phyllocladia and stems of their hosts. The usually present algal films were not observed. Recently also Kukwa et al. [10] included this species into the group of lichenicolous fungi inhabiting *Placynthiella dasaea* (Stirton) Tønsberg and *P. icmalea* (Ach.) Coppins & P. James.

Some of the new collections of *Epigloea soleiformis* mentioned below are also made directly on the thalli of terricolous or lignicolous *Placynthiella dasaea* without characteristic algal film overgrowing lichens. The inhabited hosts thalli are either normally colored or only sometimes slightly discolored, thus *E. soleiformis* could be regarded as the facultative commensal or slightly parasitic lichenicolous fungus. In two groups of cases, with or without algal film, dimensions of ascocarps and all internal ascomatal features not differ markedly.

Chambers and David [7] based on findings from abandoned lead-zinc mining sites in Great Britain concluded that *E. soleiformis* is a metal-tolerant species. New reports from metal-enriched areas of S Poland (Wyżyna Częstochowska upland) can support that hypothesis. Considering other reports made in different environmental circumstances, this fungus has a wide ecological tolerance in general.

Epigloea soleiformis is rarely reported but widespread around the world. Except records from Europe [3,4,6,7,10,13,15–18] it was found also in the subantarctic Marion Island [3], New Zealand [19], North America [20], Azores [21], Australia [7] as well as in Asia – Russian parts of Altai Mts and Sayan Mts [9]. Here it is given as new for the Western Carpathians and the Harz Mts.

SPECIMENS EXAMINED. Germany, Saxony-Anhalt, Harz Mts, Harz National Park: ca. 1 km N of education centre HohneHaus near Drei-Ahnen-Hohne, 51°46'58"N, 10°42'56"E, alt. ca. 400 m, on *Placynthiella dasaea* on clayey soil over root-system of *Picea abies* windthrow in a managed spruce forest, 2012.05.08, leg. P. Czarnota 7482 (GPN); *ibid.*, Heinrichshöhe, ca. 1.5 km SE of Brocken Mt., 51°47'28.4"N, 10°38'04.5"E, alt. ca. 950 m, on *Placynthiella dasaea* on soil over root-system of *Picea abies* windthrow in an old-growth mountain spruce forest, 2012.05.08, leg. P. Czarnota 7467 (GPN). Poland, Wyżyna Częstochowska upland: Pradła village (Fryszlerka settlement), on decaying thallus of *Peltigera* sp., 2005.08.18, leg. E. Hernik (RES EH32a–b; hb. E. Hernik); *ibid.*, Kostkowice village, on decaying thallus of *Peltigera* sp., 2005.11.03, leg. E. Hernik (RES EH33a–b); *ibid.*, Hucisko village, on decaying thallus of *Peltigera* sp. and *Placynthiella dasaea*, 2005.08.10, leg. E. Hernik (RES EH35); *ibid.*, Zawiercie town – Skarzyce, on thallus of *Placynthiella dasaea* and *P. icmalea*, on calcareous soil in pine-birch forest, 2012.09.03, leg. E. Hernik (RES EH27; hb. E. Hernik); *ibid.*, Zawiercie town – Pomrożyce, on *Placynthiella dasaea*, on humus in pine forest, 2012.08.23, leg. E. Hernik (RES EH31); Garb Tarnogórski hummock, Józefów village near

Zawiercie town, on thallus of *Placynthiella dasaea* overgrowing squamules of *Cladonia* sp., 2005.3.28, leg. E. Hernik (RES EH34); Obniżenie Górnej Warty depression, 1.5 km NE of Poraj village, on thallus of *Placynthiella dasaea* (in the company of *P. uliginosa*) on sandy dune in pine forest, 2012.10.25, leg. E. Hernik (RES EH28); *ibid.*, 0.8 km NW of Dębowiec village, on thallus of *Placynthiella dasaea* on humus in pine forest, 2012.10.25, leg. E. Hernik (RES EH 29a–b); Carpathians, Western Beskidy Mts, Beskid Sądecki Mts, Żebracze nature reserve, alt. 840 m, on thallus of *Placynthiella dasaea* mixed with *Coccomyxa* film over humus, 2001.07.05, leg. P. Czarnota 2525a (GPN); *ibid.*, Babia Góra Massif, Babia Góra National Park, SE slope of Kępa Mt., forest section No. 25c, 49°34'21.4"N, 19°33'52.4"E, alt. 1210 m, on *Placynthiella dasaea* on roots of fallen *Picea abies* within subalpine spruce forest, 2009.07.17, leg. P. Czarnota 6217 (GPN).

Epigloea urosperma Döbbeler

Sendtnera 2: 277. 1994. Fig. 1f–h.

DIAGNOSTIC CHARACTERS. Morphology similar to *E. soleiformis*, but ascocarps slightly larger, up to 0.2 mm, with widely marked depression around the ostiolum, thus they often resemble apothecia. Asci clavate, 32-spored. Ascospores 1-septate, ellipsoid, 6–8 × 2.5–3.5 μm, with two filamentous appendages of several μm length at both rounded ends. For detailed, illustrated description see Döbbeler [8].

NOTES. *Epigloea urosperma* is easily recognizable by 32-spored asci (Fig. 1g) and small ellipsoid spores with long, cilia-like appendages (Fig. 1h).

DISTRIBUTION AND ECOLOGY. Contrary to other representatives of the genus *Epigloea*, this species is not regarded algicolous but lichenicolous. It is known only from scattered localities in Europe: Germany, Sweden, Great Britain, Switzerland, Austria, N Poland [6,8,10,18,22], and recently it has been also found in South America, at one locality in Bolivia [23]. Older European collections of *E. urosperma* were usually made together with *Placynthiella uliginosa*. Döbbeler [8], however, in his comment for the protologue of *E. urosperma* mentioned *Saccomorpha uliginosa*-complex as the host for this species. It is possible that within this complex was also *Placynthiella dasaea* not well recognized at that time elsewhere (or overgrowing the true *P. uliginosa*), since the recent data from Bolivia [23], N Poland [10,22] and the new records presented here, show that *E. urosperma* is confined to *P. dasaea*.

The species is presented here as new for the Carpathians.

SPECIMENS EXAMINED. Poland, Równina Bielska plain, Białowieża Primeval Forest, Białowieża Forest District, forest sec. No. 494C, on thallus of *Placynthiella* cf. *dasaea* over humus on sandy soil in pine forest *Vaccinio vitis-idaea-Pinetum*, 2002.08.12, leg. P. Czarnota 3045 (GPN); Pojezierze Południowopomorskie lakeland, Bory Tucholskie Forest, "Krwawe Doły" nature reserve, 53°59'38"N, 18°00'31"E, alt. 140 m, on thallus of *Placynthiella dasaea* over *Pinus sylvestris* stump within boggy pine forest, 2006.09.14, leg. P. Czarnota 6582 (GPN); Obniżenie Górnej Warty depression, Korwinów village near Częstochowa city, on thallus of *Placynthiella dasaea* over sandy soil in young *Pinus sylvestris* plantation, 2012.10.24, leg. E. Hernik (RES EH30); Carpathians, Western Beskidy Mts, Babia Góra Massif, Babia Góra National Park: forest section no. 6d, N slope of Sokolica Mt., 49°35'29.4"N, 19°33'41.2"E, alt. 1050 m, on *Placynthiella dasaea* over decaying log of *Abies alba* within montane fir-beech-spruce forest, 2009.08.25, leg. P. Czarnota 6287 & 6289 (GPN).

Conclusion

Epigloea soleiformis is regarded here as more variable species than was originally described, but the real status and the phylogenetic affinity of all intraspecific groups which differ in the size and shape of ascospores can be confirmed by molecular evidences. The species seems to be at least occasionally lichenicolous, not algicolous as usually. It was found mainly on representatives of the genus *Placynthiella* (especially *P. dasaea*) and terricolous *Peltigera*. Its parasitic character manifests sometimes by a local discolouration of the host thallus. Similarly *E. urosperma* has been confirmed here as another lichenicolous member of the genus. Both species of *Epigloea* were rarely reported from Central Europe to date but they are probably more widespread and frequent elsewhere. In this work *E. soleiformis* is presented as a new species to the Western Carpathians and the Harz Mts in Germany, and *E. urosperma* is reported as new to whole Carpathians.

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Authors' contributions

The following declarations about authors' contributions to the research have been made: field studies, determination of the specimens, laboratory works, photographs, bibliography studies: EH, PC; writing the manuscript, preparing of the plate of photographs, final corrections: PC.

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