

The first records of the lichen-forming, lichenicolous and allied fungi from Ukraine

Oleksandr Khodosovtsev

Kherson State University, Universytetska Str. 27, Kherson 73000, Ivano-Frankivsk, Shevchenko Str., 16, 76018, Ukraine
Kamianska Sich National Nature Park, 33a, Beryslavska Str., Mylove village, Kherson Region, 74351, Ukraine
Holosiivsky National Nature Park, 6-A, Generala Rodimtseva Str., Kyiv, 03041, Ukraine
E-mail: khodosovtsev@gmail.com

Abstract: Fifteen species of lichen-forming, lichenicolous and allied fungi are reported for the first time from Ukraine. These species are *Buellia ocellata*, *Catillaria fungoides*, *Cecidonia xenophana*, *Cladonia suburgida*, *Celothelium lutescens*, *Endococcus protoblasteniae*, *Kuettlingeria areolata*, *Lahmia kunzei*, *Lecanora microloba*, *Lecidea nylanderii*, *Myriolecis zosteriae*, *Pyrenodesmia helygeoides*, *Sagedia zonata*, *Verrucula arnoldaria*, *Zahlbrucknerella calcarea*. The genera *Cecidonia*, *Celothelium*, *Lahmia*, *Sagedia*, *Zahlbrucknerella*, familia *Celotheliaceae*, *Lahmiaceae*, and orders *Lahmiales* and *Phaemoniliales* are also new to the country.

Keywords: diversity, taxon occurrences, Autonomous Republic of Crimea, Kherson, Kyiv, Rivne, Ternopil, Europe

INTRODUCTION

The latest edition of the checklist of lichen-forming and lichenicolous fungi (Kondratyuk et al., 2021) recently summarized lichenological studies on the territory of Ukraine. The book showed the heterogeneity of data on these organisms within different regions of Ukraine. The Kherson and Mykolaiv regions had the most up-to-date information, including descriptions of new species (e.g. Khodosovtsev et al., 2018; Darmostuk & Khodosovtsev, 2018, 2019), whereas the Chernivtsi, Volyn and Rivne regions had the lowest coverage of lichenological studies. Moreover, the data on some ecological groups are historical and are in need of updating. Thus, lichen-forming fungi of subalpine Carpathian rock habitats were studied in the 1920–1930s (e.g., Hruby, 1925; Suza, 1926; Sulma, 1933), while studies of corticolous lichen-forming fungi in the primeval forests of the Carpathian Biosphere Reserve were conducted at the modern level (Malíček et al., 2018; Vondrák et al., 2018). In recent years, we have carried out pilot studies on lichen-forming, lichenicolous and allied fungi in the Carpathians grasslands, Polissia forests in the Rivne region and old oak forests in the city of Kiev within several projects. The information on the localities and distributions of the new species for Ukraine from these regions, including the few herbarium data collected from the Kherson region and the Autonomous Republic of Crimea (AR Crimea), are presented in this paper.

MATERIAL AND METHODS

The material was collected mainly during field surveys in the regions of Chernivtsi, Ivano-Frankivsk and Zakarpattia in July – August 2021, in the Rivne region in November 2022 and in the green areas of Kiev during the blackout in October 2022 – February 2023. Several specimens have been identified from the old collections of the Herbarium (KHER). Specimens of lichen-forming, lichenicolous and allied fungi were examined in nature with a ×10 objective. Standard microscopy techniques were applied using Optika-1 and Zeiss Axioscope microscopes. The microscopic examination was carried out in water and 10% KOH (K). Nomenclature is according to Index Fungorum (www.indexfungorum.org). All study specimens are in the lichenological herbarium of Kherson State University (KSU). The data of the species collected and identified by me before February 2022 will be deposited in the GBIF (<https://doi.org/10.15468/7c7xxz>).

RESULTS AND DISCUSSION

Fifteen species of lichen-forming, lichenicolous and related fungi have been found for the first time in Ukraine. Of these, ten species are lichen-forming, three are lichenicolous and two are facultatively lichenized fungi. Also new to the country are the genera *Cecidonia* Triebel & Rambold, *Celothelium* A. Massal., *Lahmia* Körb., *Sagedia* Ach., *Zahlbrucknerella* Herre, the families *Celotheliaceae* Lücking, Aptroot & Sipman, *Lahmiaceae* O.E. Erikss. and the orders

Lahmiales O.E. Erikss. and *Phaeomoniellales* K.H. Chen, A.E. Arnold, Gueidan & Lutzoni. The list of species is given below.

THE SPECIES

BUELLIA OCELLATA (Flot.) Körb.

The lichen-forming fungus is characterized by a grey-yellowish thallus (C+ orange), immersed apothecia, poorly visible true margin and 1-cell brown ascospores. In Ukraine, the species grows on the schist together with *Acarospora veronensis* A. Massal., *Candelariella vitellina* (Hoffm.) Müll. Arg., *Ionaspis odora* (Ach. ex Schaer.) Stein., *Lecanora polytropa* (Ehrh. ex Hoffm.) Rabenh., *Lecidella carpathica* Körb., *Rhizocarpon badioatrum* (Flörke ex Spreng.) Th. Fr., *R. geographicum* (Flörke ex Spreng.) Th. Fr., *Porpidia contraponenda* (Arnold) Knoph & Hertel, *Trapelia placodioides* Coppins & P. James and *T. coarctata* (Sm.) Choisy. The species is known from many European countries, Macaronesia, Australia, Asia, Oceania (New Zealand), North America (Canada, USA), South America (Argentina, Ecuador) (Scheidegger, 1993; Aptroot et al., 2007; Lendemmer & Harris, 2013; Elix et al., 2018).

Specimen examined. Zakarpattia Region (Reg.), Rakhiv District (Distr.), Svidovets mountain range, Carpathian Biosphere Reserve, near Lake Ivor, 48.22889°N, 24.2333°E, 1630 m a.s.l., plot 21–31, 4 August 2021, A. Khodosovtsev (AK) (KHER 15031).

CATILLARIA FUNGOIDES Etayo & van den Boom

The lichen-forming fungus is characterized by specific black soralia. In Ukrainian localities, the associated species on an aspen were *Athallia pyracea* (Ach.) Arup, Fröden & Søchting, *Catillaria nigroclavata* (Nyl.) Schuler, *Lecania cyrtella* (Ach.) Th. Fr., *Leptorhaphis atomaria* (Ach.) Szatala, *Xanthoria parietina* (L.) Th. Fr., while there were *C. nigroclavata*, *Melanelixia glabratula* (Lamy) Sandler & Arup, *Physcia adscendens* (Fr.) H. Olivier, *P. dubia* (Hoffm.) Lettau, *Phlyctis argena* (Spreng.) Flot. on a hornbeam. It is known from Europe, Africa (Cabo Verde), Asia (Turkey) and North America (USA) (Van den Boom & Etayo, 2001; Van den Boom et al., 2007; Maliček et al., 2014; Cannon et al., 2022; Curtis & Lendemmer, 2022).

Specimens examined. Kyiv, Holosiivsky National Park, Teremky, 50.35972°N, 30.45306°E, 187

m a.s.l., on *Populus tremula* L., 23 Feb 2023, AK (KHER 15336); Pushcha Vodytsa, 50.53350°N, 30.42779°E, 175 m a.s.l., on *Carpinus betulus* L., 1 March 2023, AK (KHER 15350).

CECIDONIA XENOPHANA (Körb.) Triebel & Rambold
The species is difficult to distinguish from the host ascoma, but the lichenicolous fungus has smaller black apothecia (0.2–0.3 mm vs. 0.3–0.6 mm in *Porpidia contraponenda*) and smaller ascospores (9–12 × 5–7 μm vs. 15–25 × 5–11 μm in *P. contraponenda*). It is known from Europe, Asia, North America (Canada, USA) and Australia (Triebel & Rambold, 1988; Roux et al., 2006; Brackel von, 2019; Westberg et al., 2021).

Specimen examined. Zakarpattia Reg., Rakhiv Distr., Svidovets mountain range, Carpathian Biosphere Reserve, 48.23702°N, 24.22952°E, 1643 m a.s.l., plot 21–28, on *Porpidia contraponenda* on sandstone, 3 August 2021, AK (KHER 15024).

CLADONIA SUBTURGIDA Samp.

The species is morphologically similar to *C. cervicornis* (Ach.) Flot. but differs in larger squamules with a grey-brownish lower side, K+ yellow chemical test (for main chemotypes) and small podetia, 5–20 mm high, branched at the apices (Pino-Bodas et al., 2020). A consensus distribution model for *C. suburgida* with a Mediterranean range has recently been published (Pino-Bodas et al., 2020). It was shown that the probability of occurrence of this species on the Crimean peninsula is very low. Fortunately, after a complete revision of *Cladonia* P. Browne in KHER, we found a specimen of *C. suburgida* from the southern coast of Crimea with sub-Mediterranean climate (Khodosovtsev et al., 2021).

Specimen examined. AR Crimea, Yalta, Cape Martian Nature Reserve, 44.50975°N, 34.25092°E, 100 m a.s.l., on soil, 30 July 1990, AK (KHER 5536).

CELOTHELIUM LUTESCENS F. Berger & Aptroot (Fig. 1)
The genus *Celothelium* includes three species in Europe. One of them, *C. lutescens*, was described on the bark of *Prunus avium* L. (Berger & Aptroot, 1998). The specimens are characterised by ascomata 150–300 μm in diam. with pitted hemispherical involucrellum, pale brownish, yellowish to hyaline exciple (K+ bright yellow). Inside the ascoma there are agglutinated

branched interascal pseudoparaphyses, bitunicate 8-spored asci, spirally twisted ascospores, $(36\text{--}50\text{--}70\text{--}78) \times (2\text{--}3\text{--}4\text{--}5) \mu\text{m}$ with 5–7 septa ($n = 30$). The morphologically similar species *Leptosillia pinicola* (Samp.) Voglmayr & Jaklitsch differs from *Celothelium lutescens* by unitunicate asci, slightly narrower ascospores, $(35\text{--}44\text{--}58\text{--}65) \times (1.8\text{--}2.4\text{--}3.0\text{--}3.5)$ and growth on *Pinus* L. (Voglmayr et al., 2019).

In Ukraine, *Celothelium lutescens* usually has a saprotrophic strategy, but often is facultatively associated with *Desmococcus*-like and *Trebouxia*-like algae and does not form its own lichenized thallus. It is abundant on old bark of *Prunus avium* (circumference 190–230 cm), monodominant or associated with *Acrocordia gemmata* (Ach.) A. Massal, *Amandinea punctata* (Hoffm.) Coppins & Scheidegger, *Buellia griseovirens* (Turner & Borrer ex Sm.) Almb., *Candelariella efflorescens* R.C. Harris & W.R. Buck, *Caloplaca obscurella* (J. Lahm ex Körb.) Th. Fr., *Melanelixia glabrata*, *Melanohalea exasperatula* (Nyl.) O. Blanko et al., *Micarea*

denigrata (Fr.) Hedl., *Parmelia sulcata* Tayl., *Parmelina tiliacea* (Hoffm.) Hale, *Phaeophyscia orbicularis* (Neck.) Moberg, *Physcia adscendens*, *Physconia enteroxantha* (Nyl.) Poelt, *Rebentischia pomiformis* P. Karst. (non-lichenized fungus), *Scoliosporum perpusillum* (Lahm) Körb. and *S. sarothamni* (Vainio) Vězda. The species are known from Austria and Germany (Berger & Aptroot, 1998; Kanz et al., 2005).

Specimens examined (all on *Prunus avium*). Kyiv, park Feofania, 50.34663° N, 30.48457° E, 167 m a.s.l., 26 October 2022, AK (KHER15231); Holosiivsky National Nature Park, landmark Teremky, 50.35799°N, 30.44514°E, 210 m a.s.l., 6 February 2023, AK (KHER 15294); same location, 50.35946°N, 30.45168°E, 22 August 2022, AK (KHER 15239).

ENDOCOCCUS PROTOBLASTENIAE Diederich

This lichenicolous fungus forms semi-immersed subspherical perithecia, 100–150 μm diam. on areoles of *Protoblastenia* (Zahlbr.) J. Steiner, dark brown pigment in all parts of a perithecial

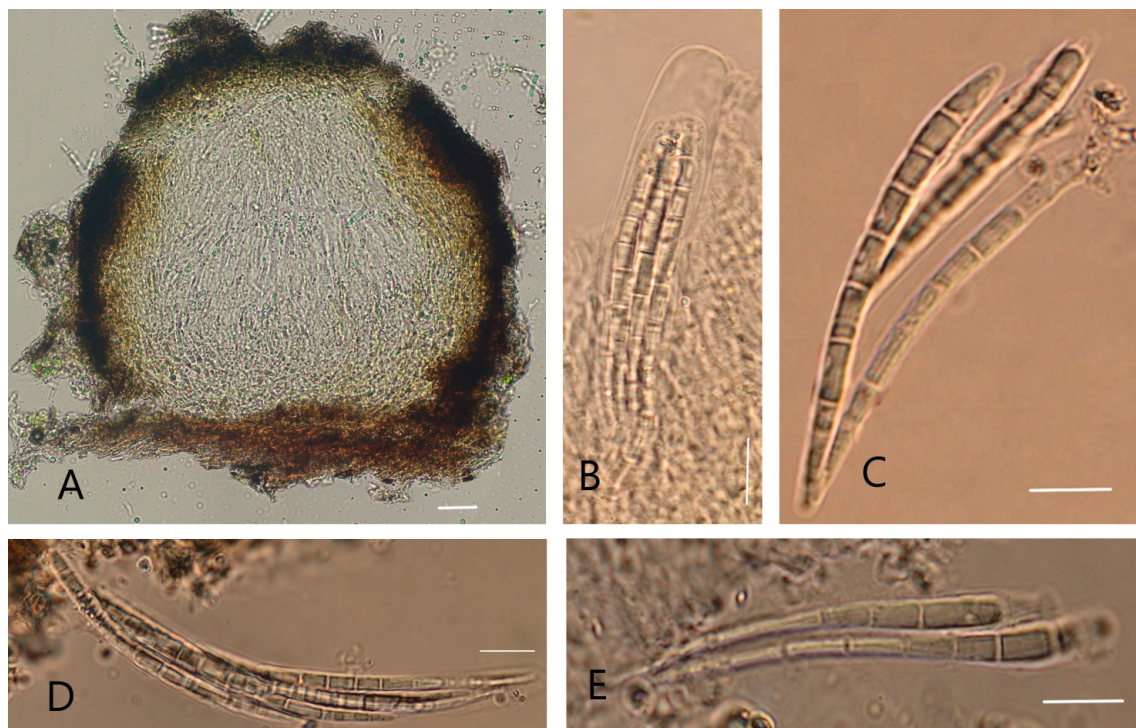


Fig. 1. *Celothelium lutescens*: A – section across ascomata (in water); B – bitunicate asci; C, E – ascospores, D – ascospores in the endoasci. Scale bars: A – 20 μm , B–E – 10 μm (in KOH).

wall, and 1-septate brown ascospores, $9.5\text{--}14 \times 4.5\text{--}5.0 \mu\text{m}$ (Sérusiaux et al., 1999). It was described from Luxembourg and subsequently found in Denmark, Estonia, France, the UK and Sweden (Sérusiaux et al., 1999; Suija et al., 2005; Roux, 2012; Alstrup et al., 2013; Westberg et al., 2021).

Specimen examined. Ivano-Frankivsk Region, Verkhovynsky District, polonyna (alpine grassland) Preluchny, Vasykova Mt., Verkhovynsky National Nature Park, $47.80454^{\circ}\text{N } 24.89699^{\circ}\text{E}$, 1507 m a.s.l., on *Protoblastenia rupestris* (Scop.) J. Steiner, on limestone, 2 July 2021, AK (KHER 14984).

KUETTLINGERIA AREOLATA (Zahlbr.) I. V. Frolov et al. The species is characterized a brown-grey to grey thallus without vegetative diaspores and a zeorine apothecia with an orange-brown disc contrasting with a yellow-orange proper margin and a grey thalline margin. In Ukraine, the species grows together with *C. isidiigera* Vězda. It is known from European countries at high altitudes (John, 1996; Frolov et al., 2021; Wirth et al., 2011; Nimis et al., 2018; Arcadia, 2022).

Specimen examined. Zakarpattia Reg., Rahiv Distr., Dragobrat village, Carpathian Biosphere Reserve, Svydovets mountain range, near Lake Ivor, $48.22764^{\circ}\text{N}, 24.23229^{\circ}\text{E}$, 1630 m a.s.l., on base-rich sandstone, 4 August 2021, AK (KHER 15152).

LAHMIA KUNZEI Kőr. (Fig. 2)

The fungus is characterised by black cleistothecoid ascomata which appear as stalked black urceolate apothecia when mature, $200\text{--}300 \mu\text{m}$ in diam. and $300\text{--}500 \mu\text{m}$ in height, bitunicate (but not fissitunicate) 8-spored asci and hyaline $0\text{--}1\text{--}(3)\text{-septate}$ falcate ascospores, $18\text{--}37 \times 4\text{--}5 \mu\text{m}$. The species was re-described in North America as *Parkerella* Funk (Funk, 1976) because it is rarely reported in the mycological and lichenological literature. The species is known from Europe and North America (Körber, 1865; Funk, 1976; Eriksson, 1986).

Specimens examined (all on *Populus tremula*). Kyiv, Holosiivsky National Nature Park, landmark Teremky, $50.35969^{\circ}\text{N}, 30.45307^{\circ}\text{E}$, 23 February 2023, AK (KHER 15334); Rivne Reg., Sarny Distr., Rivnensky Nature Reserve, near Lake Somyne, $51.39035^{\circ}\text{N}, 26.84965^{\circ}\text{E}$, 10 February 2022, AK (KHER 15339).

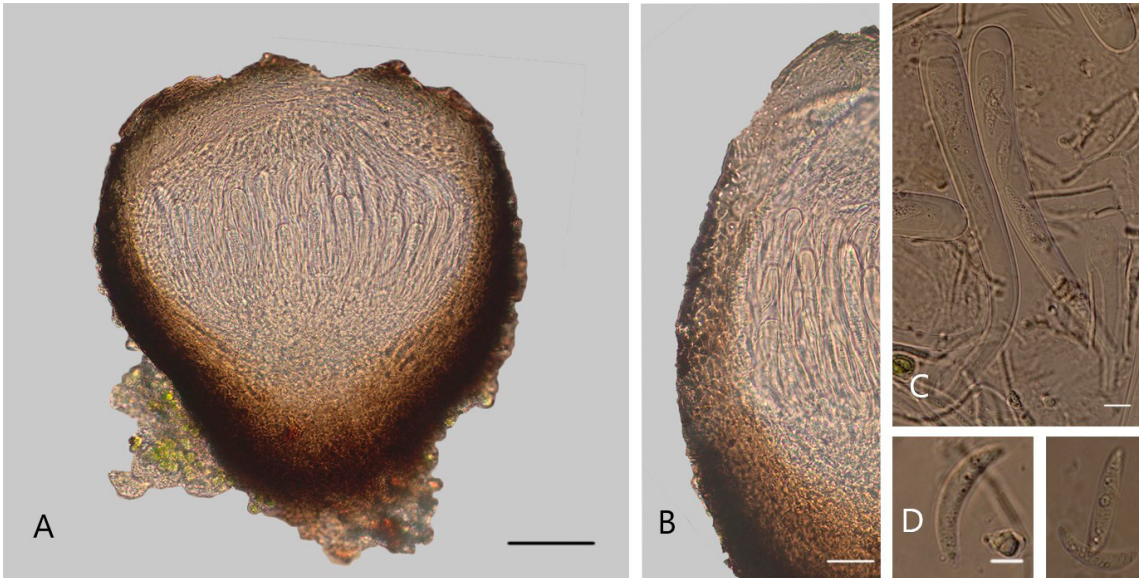


Fig. 2. *Lahmia kuntzei*: A – section across ascomata (in water); B – wall of ascomata (in water); C – asci (in KOH), D – ascospores (in KOH). Scale bars: A – $50 \mu\text{m}$, B – $20 \mu\text{m}$, C, D – $5 \mu\text{m}$.

LECANORA MICROLOBA Śliwa & Flakus

The lichen-forming fungus was described from the Carpathian Mountains (Poland) on a mylonitized granite rock (Śliwa & Flakus, 2010) and is characterised by a grey-green to yellow-green small rosule with a minute lobate to crenate marginal areole and containing the gyrophoric acid (C+ red). The species is similar to the microlobate species of the *Lecanora polytropa* group (Roux et al., 2022), but the last differs in the absence of gyrophoric acid in the cortex. This is the first record after the species was described as new to science.

Specimens examined. Autonomous Republic of Crimea, Alushta Distr., Pryvitne village, 44.87775°N, 34.69533°E, 660 m a.s.l., NW exposition, on conglomerate, 5 May 2001, AK (KHER 6661).

LECIDEA NYLANDERI (Anzi) Th. Fr.

Morphologically, this sterile lichen-forming fungus is similar to *Lepraria incana* (L.) Ach., but differs in larger coarse granules, 20–70 µm in diam. and the presence of a bluish prothallus. This species is known from Europe, North America and Asia (Hauck & Javkhlan, 2006; Smith et al., 2009; Nimis et al., 2018; Christensen, 2020).

Specimens examined. Rivne Reg., Volodymyrets'kyi Distr., Rivnensky Nature Reserve, Biloozerske department, quarter 53, part 17, 51.478370°N, 25.794233°E, 163 m a.s.l., on *Picea abies* H. Karst., 11 November 2022, AK (KHER 15343); same location, quarter 53, 51.478134°N, 25.794059°E, 170 m a.s.l., on *Pinus sylvestris* L., 11 November 2022, AK (KHER 15341); Sarny Distr., Rivnensky Nature Reserve, Karasynske department, near Lake Somyne, 51.384830°N, 26.897963°E, 165 m a.s.l., on *Betula pendula* Roth, 10 November 2022 (KHER 15343).

MYRIOLECIS ZOSTERAE (Ach.) Śliwa et al. var. ZOSTERAE

The species is similar to *Myriolecis hagenii* (Ach.) Śliwa, Zhao Xin & Lumbsch, but differs in constricted base apothecia. The specimen from the Black Sea coast of Ukraine differs from the type subspecies by a thin white pruina similar to *M. zosteriae* var. *palanderi* (Vain.) Śliwa. This lichen-forming fungus is known from European coastal countries, Asia (Mongolia), North America (Canada, USA) and South America (Argentina), Antarctica (Heard Island, Kerguelen)

(Laundon, 2003; Øvstedal & Gremmen, 2006, 2009; Śliwa, 2007, 2017; Dolnik et al., 2008; De La Rosa et al., 2012; Nimis et al., 2018).

Specimen examined. Kherson Reg., Skadovsk Distr., Black Sea Biosphere Reserve, Tendrivska Spit Island, 46.24435°N, 31.62287°E, 1 m a.s.l., on *Artemisia* sp., 6 October 2017, AK & V. Darmostuk (KHER 12236).

PYRENODESMIA HELYGEOIDES (Vain.) Arnold
Morphologically *Pyrenodesmia helygeoides* is similar to *Kuettlingeria diphyodes* (Nyl.) Frolov & Vondrák, both species have a grey thallus without vegetative diaspores and a black zeorine apothecia without anthraquinones. However, the molecular study (Frolov et al., 2021) showed that it belongs to different clades of *Kuettlingeria* Trevis. and *Pyrenodesmia* A. Massal. The species differ in their ecology. *Kuettlingeria diphyodes* is a rare lichen-forming fungus known from a few localities in France at low altitudes on periodically flooded acidic siliceous rocks in watercourses (Frolov et al., 2021), whereas *P. helygeoides* is an arctic-alpine lichen-forming growth on neutral to carbonaceous siliceous rocks at high altitudes. At the study location, *Pyrenodesmia helygeoides* is associated with *Acarospora badiofusca* (Nyl.) Th. Fr., *Catillaria atomarioides* (Müll. Arg.) H. Kilius, *Lichinella stipatula* Nyl., *Porpidia macrocarpa* (DC.) Hertel et Schwab and *Pyrenopsis grumulifera* Nyl. The species known from Europe (Italy, Russia) (Frolov et al., 2021; Nimis, 2023).

Specimen examined. Zakarpattia Reg., Rahiv Distr., Dragobrat village, Carpathian Biosphere Reserve, Svydovets mountain range, near Lake Ivor, 48.22835°N, 24.23040°E, 1720 m a.s.l., on sandstone, 4 August 2021, AK (KHER 15139).

SAGEDIA ZONATA Ach.

The species is similar to *Circinaria caesiocinerea* (Nyl. ex Malbr.) A. Nordin, Savić & Tibell, but differs in broad pale concentric areas on the thallus. In the Carpathian locality, the lichen-forming fungus is associated with *Acarospora veronensis*, *Candelariella vitellina*, *Ionaspis odora*, *Lecanora polytropa*, *Lecidella carpathica*, *Rhizocarpon badioatrum*, *R. geographicum*, *Porpidia contraponenda*, *Trapelia placodioides* and *T. coarctata*. The species is known from Europe and North America (Nimis et al., 2018; Westberg et al., 2021).

Specimen examined. Zakarpattia Reg., Rakhiv Distr., Carpathian Biosphere Reserve, Svydovets mountain range, near Lake Ivor, 48.22889°N, 24.2333°E, 1630 m a.s.l., on sandstone, 4 August 2021, AK (KHER 15029).

VERRUCULA ARNOLDARIA Nav.-Ros. & Cl. Roux

The host of this species belongs to *Calogaya arnoldii* (Wedd.) Arup, Fröden & Söchting. The specimen is characterized by a pruinose yellow-orange thallus, narrow ascospores (9.5–)10–12.0(–13.5) × (4–)4.5–6.0(–6.5) μm (n=20) and grows on a rain-protected limestone surface. The lichenicolous fungus replaces host areoles and lobes by its own grey thallus and forms ascospores (12.0–)12.25–13.25(–13.5) × (6.25–)6.5–7.5(–7.75) μm (n=10). The species is known from France, Italy and Spain (Navarro-Rosinés et al., 2007; Nimis, 2023).

Specimen examined. Ternopil Reg., Buchach Distr., Perevoloka village, 49.11796°N, 25.35286°E, 255 m a.s.l., on *Calogaya arnoldii*, on travertine rock, 17 May 2019, AK and Valerii Darmostuk (KHER 14648).

ZHLBRUCKNERELLA CALCAREA (Herre) Zahlbr.

The filamentous lichen-forming fungus differs from *Ephebe lanata* (L.) Vainio by a *Scytonema*-like photobiont, trichomes with false branching and growth on calcareous rocks. At the study location, the associated species were *Circinaria calcarea* (L.) A. Nordin, S. Savič et Tibell, *Lathagrium fuscovirens* (With.) Otálora, P. M. Jørg. & Wedin, *Laundonia flavovirescens* (Wulfen) S.Y. Kondr., L. Lökös & Hur, *Phaeophyscia endococcina* (Körb.) Moberg, *Placynthium asperellum* (Ach.) Trevis., *P. nigrum* (Huds.) S. O. Gray, *Protoparmeliopsis versicolor* (Pers.) M. Choisy, *Toninia candida* (F. Weber) Th. Fr. The species is known from Europe, North America (Canada, USA), Africa (Republic of South Africa), Asia (China, Tajikistan), Australia, New Zealand (Hanssen, 1977; Galloway, 1985; Schultz, 2014; Nimis et al., 2018).

Specimen examined. Chernivtsi Reg., Vyzhnytskyi Distr., Sarata village, Cheremosky Regional Landscape Park, 47.73888°N, 24.98913°E, 1135 m a.s.l., on limestone, 3 July 2021, AK (KHER 15187).

A wide European, Holarctic or cosmopolitan distribution is observed for most of the species recorded. The exceptions are *Celothelium*

lutescens, *Lecanora microloba* and *Pyrenodesmia helygeoides*, which are known from a few European countries. The finding of *Lecanora microloba* is the first outside the type localities. *Celothelium lutescens* has only been collected in Austria and Germany. *Pyrenodesmia helygeoides* probably has a wider distribution. However, a detailed survey of European *Pyrenodesmia* collections is needed to determine its true distribution. Some species such as *Buellia ocellata*, *Cecidonia xenophana* and *Zahlbrucknerella calcarea* have a wide distribution but are rarely collected.

Celothelium lutescens and *Lahmia kunzei* have been described as lichenized fungi (Körber, 1865; Berger & Aptroot, 1998), but these fungi do not fit the definition of a 'lichen' (Lücking et al., 2021). Some ascomata of *Celothelium lutescens* were loosely associated with the *Trebouxia*-like and *Desmococcus*-like algae, but others were found directly on the peridermal cells of *Prunus avium*. Young ascomata of *Lahmia kunzei* grow deep in the peridermal fissures of *Populus tremula*, while mature ascomata are loosely associated with *Desmococcus*- and *Trebouxia*-like algae at the edges of the fissures. Lichenized and non-lichenized forms per species have been illustrated for *Schizoxylon albescens* Gilenstam, H. Döring & Wedin and some *Stictis* Pers. species (Wedin et al., 2006). Perhaps these fungi can be defined as 'semilichens' (Vondrák et al., 2022), as they have a commensal strategy with both xylotrophic and algotrophic nutrition.

We took advantage of the blackout in Ukraine in the winter of 2022–2023 to carry out detailed observations of lichenized, lichenicolous and allied fungi in the urbanised parks of Kiev. *Catillaria fungoides*, *Celothelium lutescens* and *Lahmia kunzei* were discovered in the small Teremky Park, part of the Holosiivskyi National Nature Park. Undoubtedly, the Carpathian reserves have a high potential of undiscovered diversity of lichen-forming and lichenicolous fungi. This has been demonstrated by a short pilot study, in which *Buellia ocellata*, *Endococcus protoblasteniae*, *Kuettlingeria areolata*, *Pyrenodesmia helygeoides*, *Sagedia zonata* and *Zahlbrucknerella calcarea* have been found.

ACKNOWLEDGEMENTS

Dedicated to the anniversary of famous Estonian lichenologist Professor Tiina Randlane. I am grateful to researchers of the Center for Molecular Medicine (UMC Utrecht, The Netherlands), especially Prof. Saskia van Mil and Dr. Anna Mukha who presented the microscope “Zeiss Axioscope” to Kherson State University (Ukraine), that made it possible to continue working with lichen-forming and lichenicolous fungi in Kyiv during the temporary occupation of Kherson by Russian Federation troops; Dr. Anna Kuzemko, Prof. Illia Chorney, Dr. Vasyly Budjak, Prof. Ivan Moysiienko, Dr. Ivan Danylyk, Dr. Roman Kish, Dr. Olga Chusova, Dr. Oksana Kucher, Dr. Daria Shyriaeva, Dr. Yulia Vashenyak, Dr. Denys Vynokurov, Dr. Olesia Bezsmertna, Dr. Alla Tokariuk for their help during field work in 2021; to Dr. Tetiana Mikhailyuk for the possibility to take photographs on an Olympus BX51 granted by Alexander von Humboldt Foundation for M. G. Kholodny Institute of Botany NAS of Ukraine. The study was partly supported by the European Federation of Academies of Sciences and Humanities (ALLEA, EFDS-FL2-06) and the Ukrainian Nature Conservation Group (UNCG).

REFERENCES

- Alstrup, V., Søchting, U., Dragsholt, C., Læssøe, T., Thell, A. & Kukwa, M. 2013. Additions to the lichens and lichenicolous fungi of Denmark 8. *Graphis Scripta* 25(2): 56–63.
- Aptroot, A., Saipunkaew, W., Sipman, H. J. M., Sparrius, L. B. & Wolseley, P. A. 2007. New lichens from Thailand, mainly microlichens from Chiang Mai. *Fungal Diversity* 24: 75–134.
- Arcadia, L. 2022. The lichens and lichenicolous fungi of Greece. Online draft version dated 10 November 2022. www.lichensofgreece.com (accessed 01.06.2023).
- Berger, F. & Aptroot, A. 1998. Eine neue Art der Gattung *Celothelium* (lichenisierte Ascomyceten) aus Österreich. *Herzogia* 13: 151–154.
- Brackel von, W. 2019. Weitere Funde von flechtenbewohnenden Pilzen in Bayern – Beitrag zu einer Checkliste. *Berichte der Bayerischen Botanischen Gesellschaft* 89: 105–126.
- Cannon, P., Orange, A., Aptroot, A., Coppins, B., Fletcher, A., Fryday, A., Sanderson, N., Simkin, J. & Van den Boom, P. 2022. Caliciales: Catillariaceae, including the genera *Catillaria* and *Solenopsisora*. *Revisions of British and Irish Lichens* 22: 1–13.
- Christensen, S. N. 2020. Lichens of *Pinus sylvestris* stands in Makedonia and Thraki, Northern Greece. *Herzogia* 33(1): 75–89.
- Curtis, T. & Lendemer, J. C. 2022. *Catillaria fungoides* (Catillariaceae; Lecanoromycetes) an inconspicuous crustose lichen previously overlooked in Eastern North America. *Castanea* 87(1): 12–19. <https://doi.org/10.2179/0008-7475.87.1.1299>
- Darmostuk, V. & Khodosovtsev, A. 2019. *Epibryon kondratyukii* sp. nov., a new algalicolous fungus, and notes on rare lichenicolous fungi collected in Southern Ukraine. *Folia Cryptogamica Estonica* 56: 109–116. <https://doi.org/10.12697/fce.2019.56.112019>
- Darmostuk, V., Khodosovtsev, A., Naumovych, G. & Kharechko, N. 2018. *Roselliniella lecidiae* sp. nov. and other interesting lichenicolous fungi from the Northern Black Sea region (Ukraine). *Turkish Journal of Botany* 42(3): 354–361. <https://doi.org/10.3906/bot-1709-5>
- De La Rosa, I., Messuti, M. & Śliwa, L. 2012. The *Lecanora dispersa* group (Lecanoraceae) in Argentina. *Lichenologist* 44(1): 101–114. <https://doi.org/10.1017/S0024282911000594>
- Dolnik, C., Abel, H., de Bruyn, U., van Dort, K., Gnüchtel, A., Neumann, P., Stolley, G. & Zimmer, D. 2008. *Lecanora zosteriae* und andere interessante Flechtenfunde aus Schleswig Holstein. *Kieler Notizen zur Pflanzenkunde* 36: 9–23.
- Elix, J. A., Mayrhofer, H. & Rodriguez, J. M. 2018. Two new species, a new combination and four new records of saxicolous buellioid lichens (Ascomycota, Caliciaceae) from southern South America. *Australasian Lichenology* 83: 3–13.
- Eriksson, O. 1986. *Lahmia* Körber (= *Parkerella* A. Funk) a misinterpreted genus with isolated position. *Mycotaxon* 27: 347–360.
- Frolov, I., Vondrák J., Košnar, J. & Arup, U. 2021. Phylogenetic relationships within *Pyrenodesmia* sensu lato and the role of pigments in its taxonomic interpretation. *Journal of Systematics and Evolution* 59(3): 454–474. <https://doi.org/10.1111/jse.12717>
- Funk, A. 1976. *Parkerella*, a new genus of *Coronophorales*. *Canadian Journal of Botany* 54(9): 868–871.
- Galloway, D. J. 1985. *Flora of New Zealand Lichens*. Wellington Government Printer.
- Hanssen, A. 1977. The genus *Zahlbrucknerella*. *Lichenologist* 9: 17–46.
- Hauck, M. & Javkhlan, S. 2006. Additions to the lichen flora of Mongolia: records from Khentey and Khangay. *Willdenowia* 36: 895–912.
- Hruby, J. 1925. Die Vegetationsverhältnisse Karpato – Russlands und der östlichen Slowakei. *Botanisches Archiv* 11(3–4): 203–271.
- John, V. 1996. Preliminary catalogue of lichenized and lichenicolous fungi of Mediterranean Turkey. *Bocconeia* 6: 173–216.
- Khodosovtsev, A. Ye., Darmostuk, V. V., Suija, A. & Ordynets, A. 2018. *Didymocyrtis trassii* sp. nov. and other lichenicolous fungi on *Cetraria aculeata*. *Lichenologist* 50(5): 529–540. <https://doi.org/10.1017/S0024282918000294>

- Khodosovtsev, A. Ye., Shyriaieva, D. V., Bezsmertna, O. O., Vasheniak, Iu. A., Kucher, O. O., Chusova, O. O. & Kuzemko, A. A. 2021. Lichens of the genus *Cladonia* in grassland habitats of Ukraine. *Chornomorski botanical journal* 17(4): 348–384. <https://doi.org/10.32999/ksu1990-553X/2021-17-4-5>
- Kondratyuk, S. Y., Popova, L. P., Fedorenko, N. M. & Khodosovtsev, O. Y. 2021. *Prodromus of spore-forming plants of Ukraine: lichen-forming fungi*. Kyiv, Naukova Dumka.
- Körber, G. 1865. *Parerga lichenologica: Ergänzungen zum Systema lichenum Germaniae*. Breslau, E. Trewendt.
- Laundon, J. R. 2003. The status of *Lecanora zosterae* in the British Isles. *Lichenologist* 35(2): 97–102. [https://doi.org/10.1016/S0024-2829\(03\)00013-6](https://doi.org/10.1016/S0024-2829(03)00013-6)
- Lendemer, J. C. & Harris, R. C. 2013. *Buellia sharpiana* (Physciaceae, lichenized Ascomycetes), another new species from the Great Smoky Mountains of eastern North America. *Castanea* 78: 148–153.
- Lücking, R., Leavitt, S. D. & Hawksworth, D. L. 2021. Species in lichen-forming fungi: balancing between conceptual and practical considerations, and between phenotype and phylogenomics. *Fungal Diversity* 109: 99–154. <https://doi.org/10.1007/s13225-021-00477-7>
- Maliček, J., Palice, Z. & Vondrák, J. 2014. New lichen records and rediscoveries from the Czech Republic and Slovakia. *Herzogia* 27(2): 257–284.
- Maliček, J., Palice, Z., Acton, A., Berger, F., Bouda, F., Sanderson, N. & Vondrák, J. 2018. Uholka primeval forest in the Ukrainian Carpathians – a keynote area for diversity of forest lichens in Europe. *Herzogia* 31(1): 140–171.
- Navarro-Rosinés, P., Roux, C. & Gueidan, C. 2007. La genro *Verrucula* kaj *Verruculopsis* (Verrucariaceae, Verrucariales). *Bulletin de la Société linnéenne de Provence* 58: 133–180.
- Nimis P. L. 2023. *ITALIC – The Information System on Italian Lichens*. Version 7.0. University of Trieste, Dept. of Biology, (<https://dryades.units.it/italic>), accessed on 2023, 06, 01.
- Nimis, P. L., Hafellner, J., Roux, C., Clerc, P., Mayrhofer, H., Martellos, S. & Bilovitz, P. O. 2018. The lichens of the Alps – an annotated checklist. *MycKeys* 31: 1–634. <https://doi.org/10.3897/mycok.31.23568>
- Øvstedal, D. O. & Gremmen, N. J. M. 2006. Lichens of sub-Antarctic Heard Island. *South African Journal of Botany* 72(3): 353–366.
- Øvstedal, D. O. & Gremmen, N. J. M. 2009. Additional lichen records from Subantarctica 1. The Kerguelen Islands. *Australasian Lichenology* 64: 3–9.
- Pino-Bodas, R., Araujo E., Gutiérrez-Larruga, B. & Rosa Burgaz, A. R. 2020. *Cladonia suburgida* (Cladoniaceae, Lecanoromycetes), an overlooked, but common species in the Mediterranean region. *Symbiosis* 82: 9–18. <https://doi.org/10.1007/s13199-020-00688-7>
- Roux, C. 2012. Listo de la likenoj kaj nelikeniĝintaj fungoj de Francio. *Bulletin de la Société linnéenne de Provence* 16: 3–220.
- Roux, C., Coste, C., Masson, D. & Bauvet, C. 2006. Lichens et champignons lichénicoles du parc national des Cévennes (France) 3 – Les basses Cévennes. *Bulletin de la Société linnéenne de Provence* 57: 59–84.
- Roux, C., Bertrand, M., Poumart, S. & Uriac, P. 2022. Quelques espèces nouvelles saxicoles–calcifuges de *Lecanora* du groupe *polytropa* (Ascomycota, Lecanoraceae) découvertes en France. *Bulletin de la Société linnéenne de Provence* 73: 79–120.
- Triebel, D. & Rambold, G. 1988. *Cecidonia* und *Phacopsis* (Lecanorales): zwei lichenicole Pilzgatungen mit cecidogenen Arten. *Nova Hedwigia* 47: 279–309.
- Scheidegger, C. 1993. A revision of European saxicolous species of the genus *Buellia* De Not. And formerly included genera. *Lichenologist* 25(4): 315–364.
- Sérusiaux, E., Diederich, P., Brand, A. M. & Van den Boom, P. 1999. New or interesting lichens and lichenicolous fungi from Belgium and Luxembourg. VIII. *Lejeunia* 162: 1–95.
- Schultz, M. 2014. Significant type collections of Lichnaceae and allied lichenized ascomycetes in the herbaria of the Natural History Museum, Vienna (W) and the Institute of Botany, Vienna University (WU). *Annalen des Naturhistorischen Museums in Wien, Series B* 116: 207–246.
- Śliwa, L. 2007. A revision of the *Lecanora dispersa* complex in North America. *Polish Botanical Journal* 52(1): 1–70.
- Śliwa, L. 2017. New combination for *Myriolecis zosterae* (Ascomycota, Lichenized Fungi) varieties and a new record of the species for Poland. *Polish Botanical Journal* 62(1): 37–39.
- Śliwa, L. & Flakus, A. 2011. *Lecanora microloba*, a new saxicolous species from Poland. *Lichenologist* 43(1): 1–6. <https://doi.org/10.1017/S0024282910000551>
- Smith, C. W., Aptroot, B. J., Coppins, B. J., Flecher, A., Gilbert, O. L., James, P. W. & Wolseley, P. A. 2009. *The Lichens of Great Britain and Ireland*. Natural History Museum Publication. London.
- Suija, A., Nõmm, M. & Boch, S. 2005. New Estonian record. Lichens and lichenicolous fungi. *Folia Cryptogamica Estonica* 41: 135–136.
- Sulma, T. 1933. Materiały do flory porostów Czarnohory. *Kosmos. Ser. Botanika* 1(1–4): 19–38.
- Suza, J. 1926. Lišejníky Podkarpatské Rusi. *Sborník přírodních Společnosti Morave Ostravé. 1924/1925* 3: 1–16.
- Van den Boom, P. & Etayo, J. 2001. Two new sorediate species of lichens in the Catillariaceae from the Iberian Peninsula. *Lichenologist* 33(2): 103–110. <https://doi.org/10.1006/lich.2001.0307>
- Van den Boom, P. P. G., Van den Boom, B. & Yazıcı, K. 2007. *Catillaria fungoides* found in Cape Verde,

- The Netherlands and Turkey, with notes on accompanying species. *Österreichische Zeitschrift für Pilzkunde* 16: 1–3.
- Voglmayr, H., Aguirre-Hudson, M. B., Wagner, H. G., Tello, S. & Jaklitsch, W. M. 2019. Lichens or endophytes? The enigmatic genus *Leptosillia* in the Leptosilliaceae fam. nov. (Xylariales), and *Furfurella* gen. nov. *Persoonia* 42(1): 228–260. <https://doi.org/10.3767/persoonia.2019.42.09>
- Vondrák J., Malíček J., Palice Z., Bouda F., Berger, F., Sanderson N., Acton, A., Pouska, V. & Kish, R. 2018. Exploiting hotspots; effective determination of lichen diversity in a Carpathian virgin forest. *PLoS ONE* 13(9): e0203540. <https://doi.org/10.1371/journal.pone.0203540>
- Vondrák, J., Svoboda, S., Malíček, J., Palice, Z., Kocourková, J., Knudsen, K., Mayrhofer, H., Thüs, H. Schultz, M., Košnar, J. & Hofmeister, J. 2022. From Cinderella to Princess: an exceptional hotspot of lichen diversity in a long-inhabited central-European landscape. *Preslia* 94(1): 143–181. <https://doi.org/10.23855/preslia.2022.143>
- Wedin, M., Döring, H. & Gilenstam, G. 2006. *Stictis* s. lat. (Ostropales, Ascomycota) in northern Scandinavia, with a key and notes on morphological variation in relation to lifestyle. *Mycological research* 110: 773–789. <https://doi.org/10.1016/j.mycres.2006.04.010>
- Westberg, M., Moberg, R., Myrdal, M., Nordin, A. & Ekman, S. 2021. Santesson's Checklist of Fennoscandian Lichen-Forming and Lichenicolous Fungi. Uppsala University: Museum of Evolution.
- Wirth, V., Vondrák, J., de Bruyn, U. & Hauck, M. 2011. Erstnachweise von Flechtenarten für Deutschland und Frankreich. *Herzogia* 24(1): 155–158. <https://doi.org/10.13158/heia.24.1.2011.155>