

Updates to the list of Estonian lichenized, lichenicolous and allied fungi

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Herewith, we continue to upgrade the Estonian checklist of lichenized, lichenicolous and allied fungi, and report thirteen fungal species and one variety as new for Estonia, of them nine are lichenized and five are lichenicolous. Two species – *Acarospora oligospora* and *Lathagrium auriforme* – considered to be extinct in Estonia were rediscovered. One species, *Usnea articulata*, is excluded from the checklist of Estonian lichens. The determination methods are thoroughly described in Jüriado et al. (2022). Lichen substances of some specimens were detected by thin layer chromatography (TLC, solvent A, Orange et al., 2001). The abbreviations of the country regions and frequency classes follow Randlane & Saag (1999). The cited specimens are deposited in the fungarium of the Natural History Museum, University of Tartu (TUF). Extracted DNA samples are deposited in the DNA and Environmental Sample Collection (TUE). A blast search (Altschul et al., 1990) in National Center for Biotechnology Information (NCBI; <https://www.ncbi.nlm.nih.gov>) and / or SH Matching ver. 2.0.0 (Abarenkov et al., 2022) in PlutoF workbench (Abarenkov et al., 2010) were used to compare new sequences with those deposited in NCBI and UNITE (Abarenkov et al., 2023; <https://unite.ut.ee>) nucleotide repositories. The new DNA sequences are publicly available under UDB-codes in PlutoF work bench (<https://plutof.ut.ee>), in eElurikkus data portal (<https://elurikkus.ee>) and some also in NCBI. The UNITE Species Hypotheses (SH; Kõljalg et al., 2013) mentioned for some species are considered at the threshold level 1.5%. The

following abbreviations are used for persons: AS – Ave Suija, EO – Ede Oja, IJ – Inga Jüriado, LM – Ljudmilla Martin, PD – Polina Degtjarenko, TR – Tiina Randlane.

ACAROSPORA OLIGOSPORA (Nyl.) Arnold – WIs: Saare Co., Saaremaa Island, Saaremaa comm., Ilpla (58.301783°N, 22.645916°E), plate alvar, on granite stone, leg. IJ & AS 12 Sept 2009, det. AS 6 June 2011 (TUF093828). Freq.: rr.

This taxon has previously been recorded in Estonia once by A. Bruttan, from the same region (WIs), but on a different island (Muhu Island), at the end of the 19th century (Randlane & Saag, 2004), and was considered extinct in Estonia (Randlane et al., 2023). The new report confirms that this taxon still exists in the present-day lichen biota of Estonia. Similarly, the species was recently rediscovered in Sweden and Norway after almost 100 years (Westberg, 2016).

CRYPTODISCUS EPICLADONIA Zhurb. & Pino-Bodas – NW: Harju Co., Tallinn, Kakumäe (59.4486°N, 24.5906°E), on *Cladonia arbuscula*, leg. K. Mereschkowsky 1911, det. AS (TUF069652, ex ICEB13444). Freq.: rr.

The species is characterized by having urceolate ascomata with light orange-yellow disc and white pruinose rim (Pino-Bodas et al., 2017). The anatomical characteristics of our specimen fit with the description: ascomatal structures hyaline, I–, height of hymenium c. 70 µm, asci narrow cylindrical c. 65–75 × 4–5 µm, ascospores hyaline, trans-septate, thread-like, (30–)48.71

$\pm 6.63(-57) \times (1.0-1.46 \pm 0.13(-1.5) \mu\text{m}$ ($n=14$). The species has been reported from Russia and Canada (Pino-Bodas et al., 2017), but inclusion of eDNA samples extends the distribution area to Sweden, Cambodia and Bhutan (<https://www.gbif.org/species/10047941>).

DIDYMOCYRTIS PSEUDEVERNIAE (Etayo & Diederich) Ertz & Diederich – SW: Pärnu Co., Häädemeeste comm., Luitemaa Nature Reserve (58.1364°N, 24.5116°E), on *Pseudevernia furfuracea* (additionally infected with *Lichenocodium erodens*) on *Pinus sylvestris* trunk, leg. AS 17 Sept 2023 & det. AS (TUF095152; UDB07675131). Freq.: rr.

The species is a strict specialist known to grow on *P. furfuracea* only (Ertz et al., 2015). *Didymocyrtis pseudeverniae* was previously known through eDNA sample from Estonia (<https://elurikkus.ee/bie-hub/species/229472#overview>).

GYALOLECHIA MARMORATA (Bagl.) Nimis & Arup – WIs: Saare Co., Saaremaa comm., Sääre Nature Reserve, Vesitükimaa (57.8935°N, 22.0426°E), on limestone together with *Xanthoria parietina*, *Lecanora persimilis*, etc.), leg. AS 23 July 2022 & det. AS (TUF091950.a; UDB07673165); Vahase island (58.14898°N, 22.474°E), on limestone pebble together with *Verrucaria nigrescens* and *Verrucaria* sp., leg. AS 22 July 2022, det. AS (TUF095146; UDB07674878). Freq.: rr.

This species is characterized by having an immersed thallus, yellowish to reddish orange ascomata, bipolar ascospores with narrow spore isthmus, and by growing on calcareous rocks (Arup et al., 2014; 2023). The cited specimens were originally determined as *Xanthocarpia (Caloplaca) lactea*, from which it differs by somewhat bigger ascomata 0.2–0.5 mm vs. 0.1–0.3 mm, and longer and narrower ascospores $13.5-19 \times 5.5-7 \mu\text{m}$ vs. $11-14 \times 6-8.5 \mu\text{m}$ in *X. lactea* (Navarro-Rosines & Hladlun, 1996; Arup et al., 2014). The ascospores of our specimens are $13-16 \times 6-7 \mu\text{m}$. The species is widespread in southern Europe; in the Nordic countries it is known from Norway and Sweden (Arup et al., 2014; Westberg et al., 2021). The identification was confirmed by SH-matching (Abarenkov et al., 2022) (<https://dx.doi.org/10.15156/BIO/SH1302869.09FU>).

LEPTOGIUM AFF. ACADIENSE J.W. Hinds, F.L. Anderson & Lendemer – NW: Ida-Viru Co., Alutaguse comm., Oonurme village (59.1434°N, 26.9521°E), on *Populus tremula*, leg. PD 1 May 2021, det. PD & EO (TUF092217; UDB07675662); Lääne-Viru Co., Haljala comm., Viitna (59.50994°N, 26.03559°E), on *P. tremula*, leg. T. Sepp 14 Oct 2022, det. AS & EO (TUF049912; NCBI acc. code: PP477095). Freq.: rr.

The species belongs to the *Leptogium saturninum* group and was known only from North America so far (Stone et al., 2016). The mitochondrial small subunit rDNA (mtSSU) sequence (PP477095) from one of the Estonian specimens (TUF049912) is 100% identical to the mtSSU sequences of *L. acadience* (KX117105, KX117106, KX117098) from North American specimens published by Stone et al. (2016). The ITS sequence from another specimen (TUF092217) is more similar to the ITS sequences of *L. acadience* (KX117139, KX117140) than to those of *L. saturninum* but with c. 93% of sequence identity only. The Estonian specimens have stalked, tree-like aggregations of isidia on the lichen thallus thus fitting the description. According to Stone et al. (2016), this characteristic of mature isidia easily separates it from *L. saturninum* even in the field as the aggregations of *L. saturninum* are cushion-like or appear as sessile to stalked globular structures. Another useful character for identifications is the internal structure of the thallus: fungal hyphae of *L. acadience* run in all directions with large spaces between them, however near the lobe tips perpendicular hyphae to the cortices can be seen, but not parallel, while in other species the hyphae run both parallel and perpendicular to the thallus surface, forming the pattern of right angles (Stone et al., 2016). Considering the differences in distribution and discrepancies in ITS sequence, we prefer to handle the cited specimens as belonging to species affined to *L. acadience*.

LATHAGRIUM AURIFORME (With.) Otálora, P.M. Jørg. & Wedin – NW: Harju Co., Harku comm., Muraste village (59.454946°N, 24.467641°E), limestone quarry, leg. LM & J. Martin 19 Sept 1999, det. LM 2 Feb 2021 (TUF093233). Freq.: rr.

Lathagrium auriforme has also been considered as extinct in Estonia so far (Randlane et al.,

2023) as its only known specimen (TAMM0001876) was collected by J. Ruubel in 1932 from the same region (NW, Harju Co., Paldiski town), not far from the new locality. Now we can report that this taxon has been preserved in the present-day lichen biota of Estonia.

LECANORA MARGINATA (Schaer.) Hertel & Rambold – NW: Harju Co., north-east of peninsula Pakri, on alvar (59.379932°N, 24.082207°E), on granite boulder, leg. J. Martin & LM 8 July 2010, det. LM 15 Sept 2006 (TUF069636, ex ICEB13454). Freq.: rr.

The species is distinguished by the developed white to yellowish crustose thallus, apothecia lecideine, at first immersed, then sessile; proper margin black, sometimes slightly white-pruinose, thalline margin soon becoming excluded (Smith et al., 2009; Nimis, 2022). Ascospores of our specimen were 1-celled, 10–13 × 4.5–6 µm (n=8). *Lecanora marginata* grows on limestone and more or less calciferous siliceous rocks, most commonly in alpine and subalpine areas (Smith et al., 2009; Westberg et al., 2021; Nimis, 2022).

LICHENOCONIUM LICHENICOLA (P. Karst.) Petr. & Syd. – WIs: Saare Co., Ruhnu comm., Ruhnu island, in the yard of Ruhnu museum (57.8081°N, 23.2411°E), on thallus of *Physcia aipolia* on twig of deciduous tree, leg. AS 29 Aug 2023 & det. AS (TUF095140). Freq. rr.

Compared to other *Lichenocodium* species, *L. lichenicola* is relatively rare and probably confined to *Physcia aipolia* and other *Physcia* species only (Lawrey et al., 2011; literature herein). While most *Lichenocodium* species have brown globose to subglobose conidia, then *L. lichenicola* is one of the few having conidia ellipsoid in shape with truncated base (Hawksworth, 1977; Lawrey et al., 2015).

LOBOTHALLIA RECEDENS (Taylor) A. Nordin, Savić & Tibell – NW: Harju Co., Tallinn, Nõmme, Tammi stones (59.3935°N, 24.63274°E), leg. IJ 28 May 2021, det. AS & IJ 20 Feb 2023 (TUF050013; UDB07673155). Freq.: rr.

Based on the phylogenetic analyses, Nordin et al. (2010) broadened the concept of the genus *Lobothallia* and now the non-lobate crustose

species are also members of the genus. The specimen of *L. recedens* found in Estonia has blue-gray cracked-areolate thallus; apothecia are numerous, small, 0.2–0.3 mm diam., immersed, compressed, and with black disc. The species is distributed mainly in Europe (<https://www.gbif.org/species/6755124>).

MINUTOPHOMA CHRYSOPHTHALMAE D. Hawksw. – WIs: Saare Co., Ruhnu comm., Ruhnu island, at the forest path (57.800°N, 23.252°E), on *Chrysothrix candelaris* on *Picea abies*, leg. AS 29 Aug 2023 & det. AS (TUF095149). Freq.: rr.

This anamorphic species specialized to *Chrysothrix* is known from the British Isles (Hawksworth, 1981), Sweden and Norway (Frisch et al., 2020; Westberg et al., 2021).

POLYCAULIONA PHLOGINA (Ach.) Arup, Frödén & Söchting – SE: Võru Co., Antsla comm., Ähijärve, centre of the Karula National Park (57.713°N, 26.505°E), on basement of building (on concrete), leg. AS 24 Aug 2023 & det. AS (TUF095130; UDB07674870). Freq.: rr.

Similar to several *Flavoplaca* species (*F. citrina*, *F. dichroa*, *F. flavocitrina*) and *Leproplaca* (*L. chrysodeta*), all known from Estonia. The key characteristics separating it from those species are given in Arup (2006) and Vondrak et al. (2010). The species is mainly corticolous, preferring nutrient rich substrata, only occasionally reported on man-made substrata such as concrete (Vondrak et al., 2010). Our specimen is one of such rare cases and identified by SH-matching (Abarenkov et al., 2022) (<https://dx.doi.org/10.15156/BIO/SH1300539.09FU>).

RINODINA ASPERSA (Borrer) J.R. Laundon – NW: Harju Co., Tallinn, Nõmme, Tammi stones (59.39352°N, 24.63274°E), leg. IJ 28 May 2021, det. IJ 3 Jan 2023 (TUF050015); SW: Pärnu Co., Lääneranna comm., Puhtu-Laelatu Nature Reserve, Uulutilaid (58.55238°N, 23.52217°E), on granite stone, leg. & det. AS 2 Aug 2022 (TUF095094; UDB07674642); WIs: Saare Co., Saaremaa comm., Nasva, Loode oak-wood (58.23723°N, 22.43990°E), on granite stone, leg. IJ 7 July 2020, det. IJ 3 Jan 2023 (TUF092068; UDB01004450); Abruka Nature Reserve, Kasse Island (58.1421°N, 22.54316°E), on granite stone, leg. & det. AS 21 July 2022 (TUF091974; UDB07673157; TUF095247);

Pöide comm., Orissaare (58.55936°N, 23.08048°E), on granite stone by stadium, leg. IJ 28 July 2020, det. IJ 3 Jan 2023 (TUF091907.a; UDB07672938); Mustjala comm., Võhma (58.54134°N, 23.33763°E), pasture-boulder field, on granite stone, leg. IJ 30 Sept 2021, det. IJ 3 Jan 2023 (TUF050014). Freq.: st r.

Estonian specimens of this mainly in Europe recorded species (<https://www.gbif.org/species/2609049>) compromise the descriptions of Smith et al. (2009) and Mayrhofer & Moberg (2002) – thallus grey, areoles scattered, rounded and discrete or form contiguous crust, prothallus black, usually conspicuous, sometimes fimbriate. Soralia concolorous or paler than areolae, greenish-white or yellowish, c. 0.5 mm. In Estonian specimens atranorin, gyrophoric acid and lecanoric acid were detected by TLC; the apothecia were observed in one specimen (TUF092068): the spores were 2-celled, *Pachysporaria*-type, 15–19 × 7–9 µm.

SARCOPLYRENIA GIBBA var. GEISLERI (Beckh.) Nav.-Ros. & Hladun – NW: Tallinn, south-eastern industrial region (59.4191°N, 24.8403°E), on concrete wall, leg. T. Sadrina 13 Sept 2005, det. LM 14 Apr 2006 (TUF069637, ex ICEB13455). Freq.: rr.

The habitat in sunny exposed situations, particularly walls, on limestone, concrete and sandstones. The species is recognized by the single or clusters (2–3) of perithecia and dumb-bell-shaped ascospores (Smith et al., 2009).

VARIOSPORA FLAVESCENS (Huds.) Arup, Frödén & Söchting [syn. *Caloplaca flavescens* (Huds.) J.R. Laundon; *Caloplaca heppiana* (Müll. Arg.) Zahlbr.] – WIs: Saare Co., Muhu Island, Muhu comm., Üügu cliff (58.67199°N, 23.23515°E), on calcareous stone, leg. IJ 26 June 2018, det. TR & AS 22 Feb 2023 (TUF050009; UDB07673153). Freq.: rr.

The species previously belonged to the genus *Caloplaca* sect. *Gasparrinia* that included the majority of lobate *Caloplaca* species (Arup et al., 2013). The taxon is morphologically similar to *Calogaya pusilla* (A. Massal.) Arup, Frödén & Söchting, but is distinguished from it by lemon-shaped ascospores while *C. pusilla* has ellipsoid ascospores (Smith et al., 2009). Two further placodioid and rosette-forming species with lemon-shaped ascospores, *Calogaya*

biatorina (A. Massal.) Arup, Frödén & Söchting and *Variospora thallincola* (Wedd.) Arup, Frödén & Söchting, have been recorded in Estonia. Spores of *Calogaya biatorina* have a thin septum (about 1/4 of length of ascospore) while the septum of *V. flavescens* is wider, up to 1/2 of length of the ascospore (Smith et al., 2009; Vondrák et al., 2018). *Variospora thallincola* can be distinguished from *V. flavescens* by longer lobes, non-pruinose thallus and specific habitat (supra-littoral rocks in coastal areas) (Smith et al., 2009). Still, phenotypic characters in the polyphyletic group of lobate caloplacoid taxa are variable and morphological identification of species is complicated. *Variospora flavescens* has been recorded in Estonia previously from two localities (Trass & Randlane, 1994), but then re-identified as *Calogaya pusilla*. The identification of the specimen TUF050009 as *Variospora flavescens* was verified by fungal ITS sequence.

VERRUCARIA TECTORUM (A. Massal.) Körb. – SW: Pärnu Co., Lääneranna comm., Varbla Islets Nature Reserve, Kuralaid (58.4385°N, 23.6667°E), on limestone together with *Caloplaca chlorina*, *Flavoplaca dichroa*, *Lecanora* sp., leg. & det. AS 23 Sept 2022 (TUF091949.a; UDB07674100). Freq.: rr.

Verrucaria tectorum is the only isidiate or sore-diate *Verrucaria* species formerly reported as a special form of *Verrucaria nigrescens* or *V. viridula* (Breuss & Berger, 2010). This species is scatteredly reported in Europe, the closest records come from Latvia (Motiejūnaitė et al., 2016), the Leningrad region of Russia (Pykälä et al., 2012), and Norway and Sweden (Westberg et al., 2021).

ZYZYGOMYCES AIPOLIAE Diederich, Millanes, F. Berger & Ertz – SE: Põlva Co., Vastse-Kuuste comm., Vastse-Kuuste manor park (58.2527°N, 26.7831°E), on *Physcia aipolia* on twig of *Quercus robur*, leg. J. Liira 27 March 2011, det. AS (TUF046366; TUF046367); Tartu Co., Tartu comm., Vesneri village (58.43470°N, 26.851°E), on *P. aipolia* on twigs of *Fraxinus excelsior*, leg. J. Liira Dec 2014, det. AS (TUF074165.a); Vara comm., Alajõe village (58.5284°N, 26.9533°E), on *P. aipolia* on twig, leg. J. Liira 30 June 2015, det. AS (TUF075109); Tartu, Anne Nature Reserve (58.3634°N, 26.7775°E), *Calla* swamp forest site type forest, on *P. aipolia* on twig of

Populus, leg. AS & M. Suija 19 March 2020, det. AS (TUF089545). Ws: Pärnu Co., Ruhnu comm., Ruhnu island, in the yard of Ruhnu museum (57.8081°N, 23.2411°E), on *P. aipolia*, leg. & det. AS 29 Aug 2023 (TUF095147). Freq: r.

This species, strictly specialized to grow on *P. aipolia*, was recently segregated from *Z. physciacearum* (Diederich et al., 2022).

One species, *USNEA ARTICULATA* (L.) Hoffm., is excluded hereby from the checklist of Estonian lichens. The taxon was previously included in the list based on literature data only, with the indication that it has been recorded near Tallinn (Mereschkowski, 1913). As a matching herbarium specimen has not been found, it was considered as doubtful for Estonia (Randlane & Saag, 1999). However, current distributional data indicate that *U. articulata* occurs in central and southern Europe only, with the northernmost records from Great Britain, Poland and Germany (Randlane et al., 2009; <https://www.gbif.org/species/2606028>). Therefore, we consider the literature record of *U. articulata* from Estonia as erroneous and exclude the species from our list.

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