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 – \textit{Acarospora oligospora} and \textit{Lathagrium auriforme} – considered to be extinct in Estonia were rediscovered. One species, \textit{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.

\textbf{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).

\textbf{Cryptodiscus epiladosia} Zhurb. & Pino-Bodas – NW: Harju Co., Tallinn, Kakumäe (59.4486°N, 24.5906°E), on \textit{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
± 6.63(–57) × (1.0–)1.46 ±0.13(–1.5) μm (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).

# Didiomycyrtis 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 Lichenoconium 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 × 5.5–7 μm vs. 11–14 × 6–8.5 μm in X. lactea (Navarro-Rosines & Hladun, 1996; Arup et al., 2014). The ascospores of our specimens are 13–16 × 6–7 μm. 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. acadiense (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. acadiense (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. acadiense 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. acadiense.

Lathagrium auriforme (With.) Otálora, P.M. Jørg. & Wedin – NW: Harju Co., Harku comm., Muraste village (59.454946°N, 24.67641°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 subsessile; 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).

**Lichenosconium 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 *Lichenosconium* 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 *Lichenosconium* 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, Tammiku 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 chrysophalmae** 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).

**Polycaulion 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).
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.

Verrucaria tectorum (A. Massal.) Körb. – SW: Pärnu Co., Läänerranna comm., Varbla Islets Nature Reserve, Kuralaid (58.4385°N, 23.6667°E), on limestone together with Caloplaca chlorina, Flavoplaca dichroa, Lecanora sp., 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 scat-terly 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 aipolaie 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 twig of Fraxinus excelsior, leg. J. Liira 30 June 2015, det. AS (TUF075109); Tartu, Anne Nature Reserve (58.3634°N, 26.7775°E), Cala swamp forest site type forest, on P. aipolia on twig of...
**ACKNOWLEDGMENTS**

Most of the new species collected by AS were found in the framework of the project “The database of nature and cultural heritage values of Estonian small islands” (T210052PKKK (18509) funded by Environmental Investment Centre (EIC)). The work was funded by the Estonian Research Council grants (PRG1170 to AS; PRG874 to PD). The field work studies by IJ were supported by the Environmental Investment Centre and the Estonian Research Council grant (PSG884). Rasmus Puusepp and Marju Vahter are thanked for their lab work. Martin Westberg is cordially thanked for the helpful comments.

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