

Where the interesting species grow – remarkable records of lichens and lichenicolous fungi found during a Nordic Lichen Society meeting in Estonia

Ave Suija¹, Inga Jüriado¹, Piret Lõhmus¹, Rolands Moisejevs², Jurga Motiejūnaitė³,
Andrei Tsurukau^{4,5}, Martin Kukwa⁶

¹Institute of Ecology and Earth Sciences, University of Tartu, Lai 40, EE-51005 Tartu, Estonia.
E-mails: ave.suija@ut.ee; inga.juriado@ut.ee; piret.lohmus@ut.ee

²Institute of Life Sciences and Technology, Daugavpils University, Parades 1A, LV-5401 Daugavpils, Latvia. E-mail:
rolands.moisejevs@biology.lv

³Institute of Botany, Nature Research Centre, Žaliųjų Ežerų 49, LT-08406 Vilnius, Lithuania.
E-mail: jurga.motiejunaite@gamtc.lt

⁴Department of Biology, Francisk Skorina Gomel State University, Sovetskaja 104, BY-246019 Gomel, Belarus.
E-mail: tsurukau@gmail.com

⁵Department of Ecology, Botany and Nature Protection, Institute of Natural Sciences, Samara National Research
University, Moskovskoye road 34, RU-443086 Samara, Russia

⁶Department of Plant Taxonomy and Nature Conservation, Faculty of Biology, University of Gdańsk, Wita Stwosza 59,
PL-80–308 Gdańsk, Poland. E-mail: martin.kukwa@ug.edu.pl

Abstract: In August 2019, the Nordic Lichen Society held its bi-annual meeting and excursion in south-western Estonia. The most remarkable findings of lichenized and lichenicolous fungi are recorded herewith, including nine new species (of them two lichenicolous), and one new intraspecific taxon for the country. Full species lists are provided for two notable locations, sandstone outcrop at the river Pärnu and an oak woodland in the Naissoo Nature Reserve, for which no previous data were available, to illustrate the importance of collective survey effort.

Kokkuvõte: 2019. a augustis toimus Eestis korraline, iga kahe aasta järel korraldatav Põhjamaade Lihhenoloogide Ühingu kokkutulek ja ekskursioon. Artiklis anname ülevaate huvitavatest lihheniseerunud ja lihhenikoolsete liikide leidudest, sealhulgas üheksa (neist kahe lihhenikoolse) liigi esmaleiust Eestis ja ühe liigisese taksoni esmaleiust. Lisaks esitatakse lihheniseerunud, lihhenikoolsete ja neile lähedaste seente täisnimekirjad, mis koostati kahe elupaiga – Tori Põrgu Maastikukaitseala liivakivipaljandi ning Naissoo Looduskaitseala koosseisu jääva Naissoo tammiku – kohta.

Keywords: new species, red-listed species, sandstone lichens, lichens in oakwood

INTRODUCTION

Nordic Lichen Society (NLS) is an organization of Nordic and Baltic lichenology aiming to share knowledge about lichen diversity between professionals and amateurs, and to educate next generation of researchers and lichen enthusiasts. The society holds bi-annual meetings and excursions mainly within member countries, and this time, the opportunity to organize the meeting was given to Estonia. During 6–10 August 2019, the 23rd NLS meeting was held in south-western Estonia, consisting of four full-days field excursions to different habitats including coastal meadows and dry calcareous grasslands (alvars), sandstone and limestone cliffs, and different wooded habitats. In addi-

tion to the field activities, Martin Kukwa from the University of Gdansk gave a lecture and held a workshop about sterile sorediate lichens containing usnic acid and xanthonenes.

The meetings bring together professionals and amateurs, and it is not a surprise that such gatherings notably raise the knowledge about biodiversity of the region (see, e.g., Thell et al., 2014; Holien et al., 2016). Several locally new lichenized or lichenicolous taxa have been recorded in recent international lichenological gatherings in Estonia: e.g., 17 (of them 10 lichenicolous) species in 14th symposium of Baltic Mycologists and Lichenologists (BLS) (Halonen

et al., 2000), 30 (13 lichenicolous) species in 5th symposium of International Association of Lichenologists (IAL) (Aptroot et al., 2005) and 11 (6 lichenicolous) species in 17th BLS symposium (Suija et al., 2009). To follow the idea, we asked the participants to survey and record as many lichenized and lichenicolous species as possible in two locations that represented little-studied habitat types in Estonia and from where previous data were missing. These habitats were middle-Devonian sandstone outcrops at the bank of the Pärnu river in the Tori Põrgu Landscape Reserve and oak woodland in the Naissoo Nature Reserve. In this paper, we present findings that (1) represent records of new, rare (with less than ten known localities), protected, red-listed or otherwise interesting species in Estonia from 12 locations that were visited during the meeting; and (2) provide full lists of lichens and lichenicolous fungi found in two study sites.

MATERIALS AND METHODS

Study area

South-West of Estonia and islands were chosen as the site for NLS meeting because of the richness of habitats valuable for lichens. During the 4-days meeting, we visited 12 locations (Fig. 1), covering oak-dominated woodlands, alvars, sandstone and limestone outcrops, a park around manor house, and old-growth forests. We made detailed surveys within limited time frame and compiled lists of lichenized and lichenicolous species for two locations (4 and 10 in the list below). Short descriptions of these habitats are given before their species lists.

List of localities

6 August 2019 (all localities in Pärnu County, Kihnu island)

1. Rootsiküla, north-western coast of Kihnu island, juniper shrubland in pasture and the granite stones at the sea, 58.10007°N, 23.9764°E
2. Rootsiküla, surroundings of Kihnu lighthouse, 58.09906°N, 23.96923°E
3. Linaküla, wooded and coastal meadows with erratic boulders, 58.137699°N, 23.966962°E

7 August 2019 (all localities in Pärnu County)

4. Tori community, Tori borough, Tori Põrgu (Tori Hell), sandstone outcrop at the river Pärnu, 58.483497°N, 24.816716°E

5. Tori community, Tori borough, Tori cemetery, 58.483139°N, 24.81857°E

6. Häädemeeste community, Nigula Nature Reserve, Nigula bog study trail, Salupeaksi bog island with old-growth broad-leaved deciduous forest, 58.018707°N, 24.68077°E

8 August 2019

7. Saare County, Muhu island, Muhu community, Nõmmküla alvar, 58.66775°N, 23.20594°E

8. Saare County, Muhu island, Üügu Nature Park, Üügu cliffs and alvar, 58.67169°N, 23.2373°E

9. Pärnu County, Lääneranna community, Puhtu-Laelatu Nature Reserve, Puhtu peninsula, old-growth broad-leaved deciduous forest, 58.55744°N, 23.55018°E

9 August 2019 (all localities in Pärnu County)

10. Lääneranna community, Naissoo Nature Reserve, Naissoo oak forest mixed with some birches, 58.609033°N, 24.187376°E

11. Lääneranna community, Nedrema Nature Reserve, Nedrema wooded meadow, 58.538175°N, 24.071151°E

12. Pärnu, Tõstamaa borough, Tõstamaa park around Tõstamaa manor house, park with *Acer platanoides*, *Larix europaea* and *Quercus robur*, 58.343499°N, 23.997766°E

Species identification

To confirm field identifications of some specimens, lichen substances were detected using thin layer chromatography method described in Orange et al. (2001) using solvent system A (AS, AT) and C (AT, MK), and DNA sequences were analyzed. DNA was extracted with a lysis procedure, amplified, purified and sequenced following the protocols in Voitk et al. (2020). The internal transcribed spacer (nuITS) region was amplified using the primer pair ITSOF / LA-W (Tederloo et al., 2008). The voucher specimens are deposited in BILAS, DAU, GSU, TU, and UGDA, and the DNA sequences are accessible under UDB-codes through public Web output UNITE (<http://unite.ut.ee>; Kõljalg et al., 2013). The distribution and rarity data were extracted from Data management and Publishing Platform PlutoF (<https://plutof.ut.ee>).

RESULTS

During the 4-days field excursions, ten new taxa for Estonia were recorded, among them seven

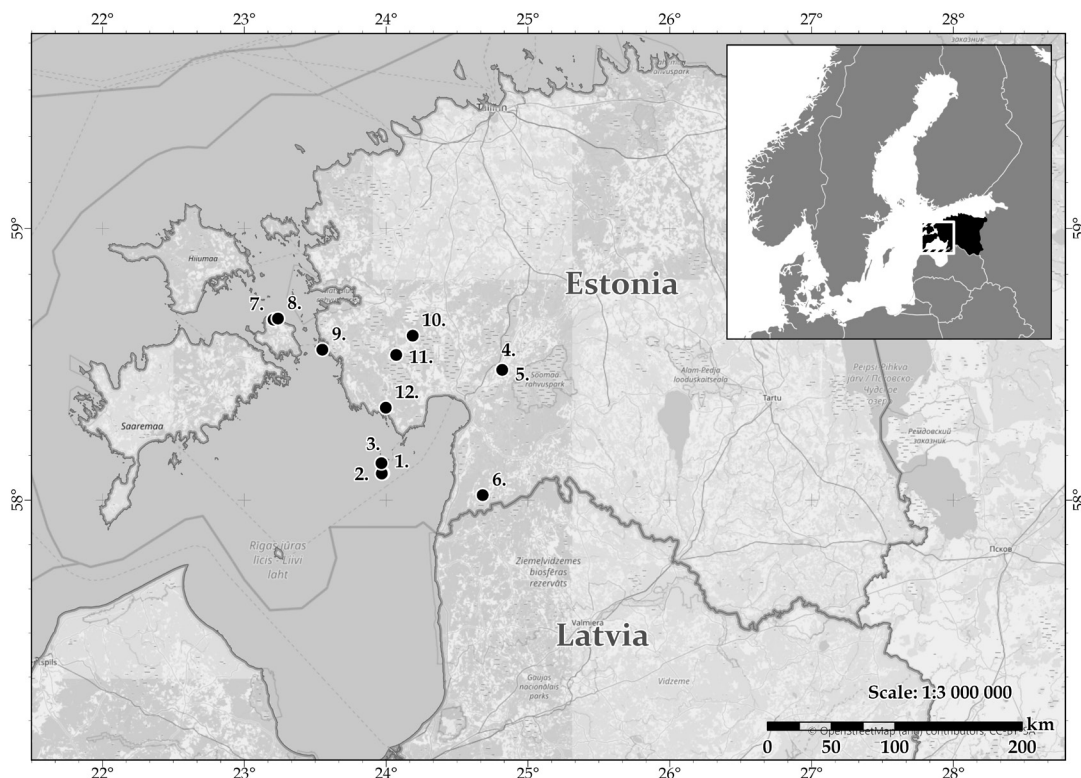


Fig. 1. The excursion sites of the 23rd Nordic Lichen Society meeting in Estonia

lichenized species, one lichenized intraspecific taxon and two lichenicolous species. New localities were found for two threatened and three near-threatened species, according to the recent assessment of the threat status of Estonian lichens (Lõhmus et al., 2019). These species are: *Enchylium limosum* (red-listed category Vulnerable) and *Lobaria pulmonaria* (Vulnerable and III protection category), and *Cladonia portentosa*, *Peltigera ponojensis* and *Sclerophora pallida* (red-listed category Near Threatened, the latter also III protection category). New localities were found for 14 rare species, i.e. species with up to 10 localities in Estonia. However, the frequency class *sensu* Randle & Saag (1999) changed for one lichenized – *Ochrolechia bahusiensis* – and for two lichenicolous species – *Abrothallus caeruleus* (from rare to rather rare) and *Trichonectria rubefaciens* (from very rare to rare). During the excursions several protected and /or red-listed species were re-found in previously known localities, e.g. *Lobaria pulmonaria* in Nigula Nature Reserve and in Puhtu-Laelatu

Nature Reserve, *Gyalolechia bracteata* (Critically Endangered and III category), *Placidium squamulosum* (Near Threatened), *Solorina saccata* (Endangered and II category), *Vulpicida juniperinus* (Near Threatened) in Üügu Landscape Reserve on Muhu island.

THE SPECIES LISTS

Abbreviations of the names of collectors and determiners: AS – Ave Suija, AT – Andrei Tsurykau, IJ – Inga Jüriado, JM – Jurga Motiejūnaitė, MK – Martin Kukwa, PL – Piret Lõhmus, RM – Rolands Moisejevs. Species that are new to Estonia are marked in **bold**. Lichenicolous / algicolous species are marked with #, non-lichenized species with + and indicator species of Woodland Key Habitat (WKH) (Anonymous, 2017) with !

New, rare, protected, threatened and otherwise interesting species

ABROTHALLUS CAERULESCENS I. Kotte – 7: on *Xanthoparmelia conspersa* on granite, AS (TU86821).

This is the sixth locality for the species, and the first record in Muhu island.

BOTRYOLEPRARIA LESDAINII (Hue) Canals, Hern.-Mar., Gómez-Bolea & Llimona – 8: cave, 3 m from entrance, on limestone, MK 20494 (UGDA), TLC: lesdainin. The species usually occurs on strongly shaded calcareous rocks, where it grows directly on rocks or on calcareous bryophytes in rain-sheltered habitats, but sometimes it is found also on other substrates (Laundon, 1992; Baruffo et al., 2006; Kukwa & Czarnota, 2008). So far *B. lesdainii* has been reported from Europe (e.g., Austria, Belgium, France, Germany, Italy, Finland, the British Isles, Poland, Portugal, Spain, Sweden) and North America (e.g., Laundon, 1992; Kümmerling & Leuckert, 1993; Kukwa, 2000; Baruffo et al., 2006; Kukwa & Czarnota, 2008).

CANDELARIELLA EFFLORESCENS R. C. Harris & W. R. Buck (aggregate) – 10: on *Quercus robur*, leg. AT, det. MK (GSU). It is the single taxon in *Candelariella* which produces soredia and has polysporous asci. Sterile specimens are similar to *C. reflexa* which differs by its much larger, indistinctly effigurate thallus, crateriform soralia arising in the center of the thallus and larger soredia (Westberg, 2007). *Candelariella efflorescens* is a common species in Europe, North America, reported also from the Caucasus (Westberg, 2007; Gasparyan & Sipman, 2016; Ismailov et al., 2017). The specimen is sterile but well-developed and has delimited punctiform soralia. However, according to Westberg & Clerc (2012), when sterile, it is usually impossible to separate between *C. efflorescens* and *C. xanthostigmoides* and therefore the specimen is referred here as *C. efflorescens* aggregate.

CATILLARIA CROATICA Zahlbr. – 6: on *Corylus avellana*, MK 20475 and 20476 (UGDA), TLC: no lichen substances (traces of terpenoids are the same as in the analyzed bark). This is a rarely reported species as it is almost always found sterile, but can be distinguished by light green-grey, superficial, well or poorly developed to immersed thallus consisting of scattered or almost contiguous areoles and numerous soralia, which are rounded, flat, convex or weakly capitate, discrete or partly fused and forming a leprose crust. Soredia are green, but externally pale brown pigmented in some specimens (Kukwa et al., 2012). The species has been reported from Europe (Austria, Belgium, Croatia, France, Lux-

embourg, Poland, Romania, Slovakia, Slovenia and Ukraine) and North America (Kukwa et al., 2012 and literature cited therein).

CHAENOTHECOPSIS VAINIOANA (Nádv.) Tibell – 10: on *Quercus robur*, together with *Anisomeridium polypori*, leg. AS, det. PL (TU87247). Rather rare species in Estonia, all records are from wooded meadows and oak-dominated woodlands.

CLADONIA MONOMORPHA Aptroot, Sipman & Herk – 4: on bryophytes growing on sandstone, AT (GSU), TLC: fumarprotocetraric acid; 10: on saxicolous bryophytes, MK 20531 (UGDA), TLC: fumarprotocetraric and protocetraric acids; AT (GSU). This is a member of a taxonomically difficult *Cladonia pyxidata* group and has not always been distinguished from *C. pyxidata* (Kowalewska et al., 2008 and literature cited therein), but recent molecular studies treat this species as a distinct taxon (Stenroos et al., 2019). The species is most similar to *C. pyxidata* and *C. pocillum*, from which it differs by the presence of bullate plates (commonly with whitish margins) inside and outside scyphi, and glomerulose apothecia (Aptroot et al., 2001; Kowalewska et al., 2008; Tsurykau & Golubkov, 2015). Chemically similar *C. chlorophaea* and *C. fimbriata* differ by producing soredia. *Cladonia monomorpha* is widely distributed in Europe, being also known from North America, including Greenland (Kowalewska et al., 2008), and Asia (Mongolia, Turkey and Russian Arctic) (Kowalewska et al., 2008; Osyczka et al., 2011; Golubkov & Tsurykau, 2017). *Cladonia monomorpha* has been reported previously from Estonia (Aptroot et al., 2005), but the specimens from a single locality (TU28247, TU30991, TU30992a) were redetermined as *Cladonia pyxidata*.

DIDYMOCYRTIS RAMALINAE (Roberge ex Desm.) Ertz, Diederich & Hafellner – 3: on the thallus of *Ramalina fastigiata* growing on *Padus avium*, MK 20447 (UGDA). The finding represents the asexual stage of the fungus. The dimensions of hyaline, ellipsoid conidia are 5.5–6.5 × 3.5 µm. The fungus, mainly its asexual stage, is recorded from many countries in Europe but the species is also known in Africa and Australasia (Ertz et al., 2015).

ENCHYLIIUM LIMOSUM (Ach.) Otálora, P. M. Jørg. & Wedin – 4: on sandstone, AS (TU86765, TU86767). The species is rather rare (this is the seventh record), and it belongs to the red-listed

category Vulnerable according to the the latest version of the Red List of Estonia (Lõhmus et al., 2019).

HALECANIA VIRIDESCENS Coppins & P. James – 6: on wood of log, MK 20474 (UGDA), TLC: argopsin (major), norargopsin (minor), ‘gracilenta unknown 1’. This is the second, but the first published record in Estonia. The species was previously found from Heinlaid islet in Hiiumaa County as growing on twig of *Rhamnus cathartica* (TU45760.a.), but because of the scarce material remained unreported. *Halecania viridescens* is usually sterile and characterized by small, fragile, usually punctiform or rarely confluent soralia (often with a brown pigment in the external soredia), and the presence of argopsin and ‘gracilenta unknown 1’ (Tønsberg, 1992; Kukwa & Jabłońska, 2009). The species is rarely reported, but widespread and has been reported from several countries in Europe, North America, central America (Guatemala) and Africa (the Canary Islands) (Kukwa & Jabłońska, 2009 and literature cited therein).

LECANORA PERSIMILIS (Th. Fr.) Arnold – 2: roadside trees, on *Fraxinus excelsior*, MK 20442a (UGDA). This is the second record of this species in Estonia, known previously from northern Estonia (Martin et al., 2011).

LECANORA SUBCARPINEA Szatala – 10: on *Quercus robur*, MK 20536 (UGDA), TLC: atranorin (major), psoromic acid (minor), unknown (trace). The disc of ascomata is slightly pruinose, C+ yellow, apothecial margin Pd+ yellow. The species is rare in Estonia (this is the fifth locality), the closest locality in Nedrema wooded meadow is ca 10 kilometres (Aptroot et al., 2005).

LECIDELLA ELAEOCHROMA f. SORALIFERA (Erichsen) D. Hawksw. – 3: on *Fraxinus excelsior*, MK 20449 (UGDA); leg. AS, det. MK (TU86789). This is a rarely reported sorediate form of a very common *Lecidella elaeochroma* (Tønsberg, 1992).

LEPRARIA RIGIDULA (B. de Lesd.) Tønsberg – 1: on *Juniperus communis*, MK 20435 (UGDA), TLC: atranorin, nephrosteranic acid. The presence of a rare fatty acid, nephrosteranic acid, and soredia with long projecting hyphae are diagnostic characters of this taxon. It is a rather common epiphytic species in open habitats in Europe but found also on other substrates and outside Europe (Tønsberg, 1992; Baruffo et al., 2006; Kukwa, 2006; Saag et al., 2009).

LEPRARIA VOUAUXII (Hue) R. C. Harris – 4: on sandstone, MK 20456, MK 20458 (UGDA); 9: together with *L. finkii* on *Ulmus scabra*, MK 20515 (UGDA); 12: on *Acer platanoides*, AS (TU87653). All specimens contain pannaric acid 6-methylester detected with TLC. The species is rather rare, known from less than ten localities in Estonia. *Lepraria vouauxii* grows on various substrates, but often on tree bark in open habitats (Tønsberg, 1992; Baruffo et al. 2006; Kukwa, 2006; Saag et al., 2009). Many records from South America were recently segregated as *L. cryptovouauxii* (Guzow-Krzemińska et al., 2019).

LOBARIA PULMONARIA (L.) Hoffm. – 12: on *Quercus robur*, AS (not collected). The species is protected in Estonia and was recently evaluated according to IUCN criteria as Vulnerable (Lõhmus et al., 2019). It was recorded growing on a single tree in Tõstamaa park.

OCHROLECHIA BAHUSIENSIS H. Magn. – 10: together with *Lepra albescens* (KC negative) on *Quercus robur*, MK 20532 (UGDA); 12: on *Pinus sylvestris*, MK 20550 (UGDA), TLC: gyrophoric acid, murolic acid complex, unidentified pigments. The species had ten localities in Estonia but is probably under-recorded due to similarities with several other *Ochrolechia* species. This is a widespread species in Europe which is mostly confined to lower altitudes, and found mainly on bark of deciduous trees in various types of ecosystems (Kukwa, 2011).

OCHROLECHIA SZATALAENSIS Verseghy – 7: on *Juniperus communis*, MK 20505 (UGDA; UDB0779091). The cortex of apothecial margin in the Estonian specimen is not glassy at the base in sectioned apothecia, but white and thus more similar to *O. upsaliensis* (Kukwa, 2011). However, the nuITS sequences are one-to-one identical to the sequences of *O. szatalaensis* (MK811817, MK811903, MK811865, FR799244) deposited in GenBank. This is a frequent but scattered species in Estonia, however, as morphological characters of the specimen deviate from the known description, we still report it here.

PARMELIA SERRANA A. Crespo, M. C. Molina & D. Hawksw. – 6: on *Betula pendula*, leg. AS, det. AT & AS (TU86826; UDB0778439); AT (GSU; verified by A. Thell), TLC of both collections: salazinic acid, atranorin and fatty acids. The

population in Salupeaksi is a mixture of two cryptic species, *P. ernstiae* and *P. serrana*, which are realistically identifiable only by DNA sequences (Haugan & Timdal, 2019; Tsurykau et al., 2019). We compared nuITS sequences and composition of lichen substances of three specimens, two of which corresponded to *P. serrana* and one to *P. ernstiae* (E. Ossowska, pers. comm.). The latter specimen is deposited in UGDA.

PRONECTRIA ERYTHRINELLA (Nyl.) Lowen. – 5: all records on *Peltigera praetextata* growing on mossy stone fence, AS (TU86773), AT (GSU), JM (BILAS). The species has less than ten scattered localities in Estonia.

PRONECTRIA SANTESSONII (Lowen & D. Hawksw.) Lowen – 3: on *Anaptychia ciliaris* on *Fraxinus excelsior*, AS (TU87916), AT (GSU), both det. JM. The species has been found previously only once in Estonia (Martin et al., 2012). The characteristics of the specimens are in concordance with the protologue of the species (Lowen & Hawksworth, 1986). The dimensions of the ascospores of TU87916 are $12.5\text{--}(13.96\pm 1.05)\text{--}16 \times 5\text{--}(5.8\pm 0.59)\text{--}7 \mu\text{m}$ ($n=13$).

SCLEROCOCCUM HOMOCLINELLUM (Nyl.) Ertz & Diederich (syn. *Dactylospora homoclinella* (Nyl.) Hafellner) – 7: on *Protoparmeliopsis muralis* on granite, AS (TU86806; UDB0778820). This is the second record of this species from Estonia, previously reported as growing on *Buellia griseovirens* (Suija, 2005).

SCLEROPHORA PALLIDA (Pers.) Y. J. Yao & Spooner – 5: on *Fraxinus excelsior*, leg. AS, det. PL (TU86820); 6: RM (DAU600001114); PL (TU). This species is protected in Estonia and has recently been evaluated as Near Threatened in the latest version of the national Red List (Lõhmus et al., 2019).

SPIROGRAPHA TRICUPULATA (F. Berger & E. Zimm.) Flakus, Etayo & Miadlikowska (syn. *Cornutispora tricupulata* F. Berger & E. Zimm) – 11: on *Physcia* cf. *tenella* on willow twig, MK 20547 (UGDA). *Spirographa tricupulata* is characterized by having conidia composed of three equal arms, $4\text{--}5.2 \times 2.4\text{--}3 \mu\text{m}$, which are strongly swollen at the base and develop $1.2\text{--}1.5 \mu\text{m}$ long cilia at the ends (Zimmermann & Berger, 2018). The conidia of the Estonian specimen have swollen, almost equal arms, $4 \times 2 \mu\text{m}$ and with cilia c. $1.5 \mu\text{m}$ long. So far, the species has been known only

from Austria (Zimmermann & Berger, 2018). This is the second *Spirographa* species besides *S. lichenicola* (D. Hawksw. & Sutton) Flakus, Etayo & Miadlikowska (syn. *Cornutispora lichenicola* D. Hawksw. & B. Sutton) that is reported from Estonia (Aptroot et al., 2005).

STIGMIDIUM SOLORINARIUM (Vain.) D. Hawksw. – 8: on *Solorina* sp. on limestone cliffs, AS (TU86805). This is the second record of this *Solorina*-specialized lichenicolous species in Estonia (Suija et al., 2009).

TRICHONECTRIA RUBEFACIENS (Ellis & Everh.) Diederich & Schoers – 10: on *Parmelia sulcata*, AT (not collected). This is the third locality for the species in Estonia. *Trichonectria rubefaciens* is one of those lichenicolous species that is easily recognizable in field because of characteristic reddish orange perithecia on the discoloured thalli of *Parmelia* species (Sérusiaux et al., 1999).

XANTHORIICOLA PHYSICIAE (Kalchbr.) D. Hawksw. – 3: on *Xanthoria parietina*, AS (TU86790). The dematiaceous lichenicolous species has less than ten localities in Estonia but is probably under-recorded although it is one of the most easily recognizable species among lichenicolous fungi as the host apothecia turn black due to the infection. Microscopically, each blackened apothecium contains mycelium that forms conidiogenous area in the host hymenium near the surface of the apothecium. The conidiogenous area is characteristic for this fungus as it is formed by penicillate, short and brown, monophialidic conidiogenous cells. Brown, globose and warted conidia in dimensions of $3.5\text{--}6 \mu\text{m}$ that develop terminally on conidiogenous cells lie on the surface of the host apothecium (Hawksworth & Punithalingam, 1973) giving apothecia a black appearance.

XYLOGRAPHA PARALLELA (Ach.) Fr. – 10: on wood, together with *Buellia griseovirens*, *Lecanora symmicta* and *Placynthiella icmalea*, IJ (TU88412). This is the tenth record of the lignicolous species in Estonia.

List of species on Tori sandstone outcrop

The Tori Põrgu Landscape Reserve was created in 1959 to protect middle-Devonian sandstone bank and caves at the Pärnu river in south-western Estonia. The length of the bank is ca 400 m and its maximum height is 8.25 m being thus

the most representative outcrop of this epoch in the East Baltic area (Fig. 2). There are three caves created by the stream waters eroding the sandstone bank and expanded by human activities. The largest cave is called “Tori Põrgu” (“Tori Hell” in translation) as in the Estonian folklore, this was the lodging of horned family, namely Vanapagan (“The Old Heathen”, also known as “The Old Devil” or „The Old Empty One”) and others (Laugaste & Liiv, 1970).

Systematic studies of lichens on Devonian sandstone cliffs are scarce in Estonia. There is one diploma work (Tenson, 1970), and one species inventory (Ingerpuu & Suija, 2010) dealing with sandstone lichens in central and eastern parts of Estonia. The list here is the first from the southwestern part of Estonia, including 26 species, all recorded as growing directly on sandstone. The number of species is close to that of Kallaste sandstone outcrop in eastern Estonia (28 species; Ingerpuu & Suija, 2010). The list includes three notable species, *Cladonia monomorpha*, *Enchylium limosum* and *Lepraria vouauxii* (see the list above).

ATHALLIA HOLOCARPA (Hoffm.) Arup, Frödén & Söchting – AS (TU86768).

BACIDIA BAGLIETTOANA (A. Massal. & De Not.) Jatta – AS (TU86772).

BÆOMYCES RUFUS (Huds.) Rebert. – AS (TU89609).

In some spots, the specimens of *Baeomyces* were surrounded by the black mycelial network. *Sphaerellothecium conioides* is the



Fig. 2. The sandstone outcrop of Tori Põrgu Landscape Reserve. Photo: Jurga Motiejūnaitė

only species that has such dark-brown vegetative hyphae and grows on *B. rufus* (Roux & Triebel, 1994). However, no ascomata were developed and therefore the identity of the fungus remained unclear.

BILIMBIA SABULETORUM (Schreb.) Arnold – AS (TU86766).

CHAENOTHECA FURFURACEA (L.) Tibell – AS.

CLADONIA CHLOROPHAEA (Flörke ex Sommerf.) Spreng. – AS (TU86825; UDB0778437); MK 20457 (UGDA); AT (GSU).

CLADONIA MONOMORPHA Aptroot, Sipman & Herk – AT (GSU).

ENCHYLIUM LIMOSUM (Ach.) Otálora, P. M. Jørg. & Wedin – AS (TU86767; TU86765).

EVERNIA PRUNASTRI (L.) Ach. – AS.

FLAVOPLACA CITRINA (Hoffm.) Arup, Frödén & Söchting – AS (TU86764).

HAEMATOMMA OCHROLEUCUM (Neck.) J. R. Laundon – MK 20463 (UGDA).

LECIDELLA CARPATHICA Körb. – RM (DAU 600001111).

LEPRARIA FINKII (B. de Lesd.) R. C. Harris (syn. *L. lobificans* auct.) – MK 20459 (UGDA).

LEPRARIA INCANA (L.) Ach. – MK 20467 (UGDA).

LEPRARIA VOUAUXII (Hue) R. C. Harris – MK 20456; MK 20458 (UGDA).

LEPROPLACA CHRYSODETA (Vain. ex Räsänen) J. R. Laundon – AS (TU86800); MK 20460 (UGDA).

PARMELIA SULCATA Taylor – AS.

PELTIGERA CANINA (L.) Willd. – MK 20464 (UGDA).

PELTIGERA DIDACTYLA (With.) J. R. Laundon – AS.

PELTIGERA MEMBRANACEA (Ach.) Nyl. – MK 20465 (UGDA).

PELTIGERA NECKERI Hepp ex Müll. Arg. – AS (TU86770); MK 20466 (UGDA).

PELTIGERA PRAETEXTATA (Flörke ex Sommerf.) Zopf – AS.

PELTIGERA RUFESCENS (Weiss) Humb. – AS (TU86769).

PHLYCTIS ARGENA (Ach.) Flot. – MK 20461 (UGDA).

RAMALINA FARINACEA (L.) Ach. – AS (TU86771); MK 2045 (UGDA).

RAMALINA POLLINARIA (Westr.) Ach. – MK 20455 (UGDA).

List of species in the oak wood in Naissoo Nature Reserve

The Naissoo Nature Reserve (115.71 ha) is located in south-western part of Estonia and was created in 1964 to protect old oak woods and spruce forests. The oldest oaks (*Quercus robur*)

in the area are 230 years old. The calciferous meadows (alvars) are less represented in the area. The oakwoods are probably former wooded pastures and wooded meadows that are now overgrown due to the cessation of mowing and grazing (Naissoo looduskaitseala ...). In some places, the remnants of limestone fences and piles of stones are visible under the oak trees.

The list is based on the collective survey effort made during 1.5 hours in a limited area in eastern part of the reserve. The species list includes 95 species, of which 83 are lichenized, 11 lichenicolous-algicolous fungi, and one is a non-lichenized calicioid fungus. During the limited timeframe, the participants found four rare species (*Lecanora subcarpineae*, *Ochrolechia bahusiensis*, *Trichonectria rubefaciens* and *Xylographa parallela*), and two species new to Estonia (*Candelariella efflorescens* and *Cladonia monomorpha*). In addition, participants recorded several Woodland Key Habitat (WKH) species that grow mainly on oaks in the area. No collector's initials are indicated for the common species that were registered by most of the participants.

- ! ACROCORDIA GEMMATA (Ach.) A. Massal. – on *Quercus robur*, PL (TU87927).
 ! ALYXORIA VARIA (Pers.) Ertz & Tehler – on *Q. robur*, MK 20527 (UGDA); AS (TU86801).
 ANAPTYCHIA CILIARIS (L.) Körb. – on *Q. robur*.
 ANISOMERIDIUM POLYPORI (Ellis & Everh.) M. E. Barr – on *Q. robur*, AS (TU87247.b).
 ARTHONIA MEDIELLA Nyl. – on *Q. robur*, MK 20520 (UGDA); on *Picea abies*, MK 20526 (UGDA); PL (TU87926).
 ARTHONIA RADIATA (Pers.) Ach. – on twig of *Q. robur*, MK 20525 (UGDA).
 ARTHONIA SPADICEA Leight. – on *Q. robur*, PL.
 ARTHONIA VINOSA Leight. – on *Q. robur*.
 ASPICILIA CONTORTA subsp. HOFFMANNIANA S. Ekman & Fröberg – on limestone, IJ.
 # ATHELIA ARACHNOIDEA (Berk.) Jülich – on *Xanthoria parietina*.
 BACIDIA ARCEUTINA (Ach.) Arnold – on *Q. robur*, AS.
 BIATORA EFFLORESCENS (Hedl.) Räsänen – on *Q. robur*, MK 20533 (UGDA).
 BILIMBIA SABULETORUM (Schreb.) Arnold – on mosses on limestone, IJ (TU88410).
 BUELLIA GRISEOVIRENS (Turner & Borrer ex Sm.) Almb. – on lignum, IJ (TU88409.c); on lignum, IJ (TU88412.b); on *Q. robur*, PL; on *Juniperus communis*, AS.

- CALICIUM GLAUCELLUM Ach. – on lignum of *Q. robur* log, PL (TU87929).
 CALICIUM SALICINUM Pers. – on *Q. robur*, PL.
 CALICIUM VIRIDE Pers. – on *Q. robur*, PL.
CANDELARIELLA EFFLORESCENS R. C. Harris & W. R. Buck (aggregate) – on *Q. robur*, leg. AT, det. MK (GSU).
 CANDELARIELLA XANTHOSTIGMA (Ach.) Lettau – on *Q. robur*, MK 20535 (UGDA); PL.
 ! CHAENOTHECA BRACHYPODA (Ach.) Tibell – on lignum of *Q. robur* log, PL.
 CHAENOTHECA CHRYSOCEPHALA (Turner ex Ach.) Th. Fr. – on *Pinus sylvestris*, IJ.
 CHAENOTHECA TRICHIALIS (Ach.) Th. Fr. – on *P. sylvestris*, IJ; on *Q. robur*, PL.
 # CHAENOTHECOPSIS VAINIOANA (Nädv.) Tibell – on *Q. robur*, leg. AS, det. PL (TU87247.a); PL (TU87928).
 CLADONIA CHLOROPHAEA (Flörke ex Sommerf.) Spreng. (aggregate) – IJ.
 CLADONIA CONIOCRAEA (Flörke) Spreng. – on lignum, IJ (TU88408.a); on mosses on limestone, IJ (TU88411.b).
 CLADONIA FIMBRIATA (L.) Fr. – on *Q. robur*, IJ.
CLADONIA MONOMORPHA Aptroot, Sipman & Herk – on saxicolous bryophytes, MK 20531 (UGDA); AT (GSU).
 CLADONIA OCHROCHLORA Flörke – on mosses on limestone, AS (TU87246.a); on base of *Betula*, IJ (TU88405); on *Juniperus communis*, AS.
 CLADONIA POCILLUM (Ach.) Grognot – on mosses on limestone, IJ (TU88407).
 COENOGONIUM PINETI (Schrad. ex Ach.) Lücking & Lumbsch – on *Q. robur* AS.
 EVERNIA PRUNASTRI (L.) Ach. – on *Q. robur*.
 # HETEROCEPHALACRIA PHYSIACEARUM (Diederich) Millanes & Wedin – on thallus of *Physcia adscendens*, AS.
 HYPOCENOMYCE SCALARIS (Ach.) M. Choisy – on old *Betula*, IJ (TU88406.b).
 HYPOGYMNIA PHYSODES (L.) Nyl. – on *Q. robur*; *B. pendula*.
 HYPOGYMNIA TUBULOSA (Schaer.) Hav. – on *Q. robur*.
 # INTRALICHEN sp. – in apothecia of *Lecanora*, AS (TU86802).
 LATHAGRIUM FUSCOVIRENS (With.) Otálora, P. M. Jørg. & Wedin – on mosses on limestone, JM (TU86797.a); IJ.
 LECANORA CARPINEA (L.) Vain. – on twig of *Q. robur*, MK 20525a (UGDA); on *Q. robur*, MK 20536a (UGDA).
 LECANORA CHLAROTERA Nyl. – on *Q. robur*.

- LECANORA EXPALLENS Ach. – on *Q. robur*, PL.
 LECANORA PULICARIS (Pers.) Ach. – on *B. pendula*, IJ.
 LECANORA STROBILINA (Spreng.) Kieff. – on twig of *Q. robur*, MK 20522 (UGDA).
 LECANORA SUBCARPINEA Szatala – on *Q. robur*, MK 20536 (UGDA).
 LECANORA SYMMICTA (Ach.) Ach. – on lignum, IJ (TU88412.c).
 LECIDELLA ELAEOCHROMA (Ach.) M. Choisy – all on *Q. robur*, MK 20521 (UGDA); MK 20530a (UGDA); MK 20537 (UGDA).
 LECIDELLA FLAVOSOREDIA (Vězda) Hertel & Leuckert – on *Q. robur*, MK.
 LEPRA ALBESCENS (Huds.) Hafellner (syn. *Pertusaria albescens* (Huds.) M. Choisy & Werner) – on *Q. robur*, MK 20532 (UGDA).
 LEPRA AMARA (Ach.) Hafellner (syn. *Pertusaria amara* (Ach.) Nyl.) – on lignum, IJ (TU88408.b).
 LEPRARIA EBURNEA J. R. Laundon – both on *Q. robur*, MK 20539 (UGDA); MK 20541a (UGDA).
 LEPRARIA FINKII (B. de Lesd.) R. C. Harris – on *Q. robur*, MK 20540 (UGDA).
 LEPRARIA INCANA (L.) Ach. – both on *Q. robur*, MK 20541 (UGDA); MK 20542 (UGDA).
 # LICHENOCONIUM XANTHORIAE M. S. Christ. – on *Xanthoria parietina*, AT (GSU).
 # MARCHANDIOMYCES AURANTIACUS (Lasch) Diederich & Etayo – on *Physcia tenella*, AS.
 MELANELIXIA GLABRATULA (Lamy) Sandler & Arup – on *Q. robur*.
 MELANELIXIA SUBAURIFERA (Nyl.) O. Blanco, A. Crespo, Divakar, Essl., D. Hawksw. & Lumbsch – on *Q. robur*.
 MELANOHALEA EXASPERATULA (Nyl.) O. Blanco, A. Crespo, Divakar, Essl., D. Hawksw. & Lumbsch – on *Q. robur*.
 MICAREA MISELLA (Nyl.) Hedl. – on lignum, IJ (TU88409.a).
 # MICROCALICIUM DISSEMINATUM (Ach.) Vain. – on *Q. robur*, PL (TU87930).
 + MYCOCALICIUM SUBTILE (Pers.) Szatala – on lignum, IJ (TU88409.b); on lignum of *Q. robur*, PL.
 # NESOLECHIA OXYSPORA (Tul.) A. Massal. – all on thalli of *Parmelia sulcata*, AT; growing on twig of *Salix*, MK 20523 (UGDA), on twig of *Q. robur*, AS (TU86774).
 OCHROLECHIA ARBOREA (Kreyer) Almb. – on twig of *Q. robur*, MK 20524 (UGDA).
 OCHROLECHIA BAHUSIENSIS H. Magn. – on *Q. robur*, MK 20532 (UGDA).
 OPEGRAPHA VULGATA (Ach.) Ach. – on *Q. robur*, PL (TU87931).
 PACHYPHIALE FAGICOLA (Arnold) Zwackh – on *Q. robur*, MK 20535a (UGDA).
 PARMELIA ERNSTIAE Feuerer & A. Thell – on *Q. robur*, MK 20529 (UGDA).
 PARMELIA SULCATA Taylor – on *B. pendula*.
 PELTIGERA CANINA (L.) Willd. – on *Q. robur*, PL, det. IJ (TU87932).
 PELTIGERA NECKERI Hepp ex Müll. Arg. – on ground over mosses, IJ (TU89562; UDB0779902).
 PELTIGERA PRAETEXTATA (Flörke ex Sommerf.) Zopf – on mosses in stone pile, AS.
 PERTUSARIA COCCODES (Ach.) Nyl. – both on *Q. robur*, MK 20532a (UGDA); MK 20534 (UGDA).
 PERTUSARIA CORONATA (Ach.) Th. Fr. – on *Q. robur*, PL. In the field UV + orange, K+ yellow, then orange.
 PERTUSARIA LEIOPLACA DC. – on *Q. robur*.
 PHLYCTIS ARGENA (Spreng.) Flot. – all on *Q. robur*, MK 20528 (UGDA); MK 20530 (UGDA); MK 20538 (UGDA); AS (TU86808).
 PHYSCIA ADSCENDENS (Fr.) H. Olivier – on *Q. robur*.
 PHYSCIA AIPOLIA (Ehrh. ex Humb.) Fürnr. – on *Q. robur*.
 PHYSCIA STELLARIS (L.) Nyl. – on *Q. robur*.
 PHYSCIA TENELLA (Scop.) DC. – on *Q. robur*.
 PHYSCONIA DISTORTA (With.) J. R. Laundon – on *Q. robur*.
 PHYSCONIA PERISIDIOSA (Erichsen) Moberg – on *Q. robur*.
 PLACYNTHIELLA ICMALEA (Ach.) Coppins & P. James – on lignum, IJ (TU88412.d); on log of *Q. robur*, on wood, PL.
 PLATISMATIA GLAUCA (L.) W. L. Culb. & C. F. Culb. – on *Q. robur*.
 POLYCAULIONA POLYCARPA (Hoffm.) Frödén, Arup & Söchting – on *Q. robur*.
 PSEUDEVERNIA FURFURACEA (L.) Zopf – on *Q. robur*.
 RAMALINA FASTIGIATA (Pers.) Ach. – on *Q. robur*.
 SCYTIINIUM LICHENOIDES (L.) Otálora, P. M. Jørg. & Wedin – all records on mosses on limestone, JM (TU86797.b); AS (TU87246.b); IJ (TU88411.a).
 TONINIOPSIS SUBINCOMPTA (Nyl.) Kistenich, Timdal, Bendiksby & S. Ekman (syn. *Bacidia subincompta* (Nyl.) Arnold) – on *Q. robur*, PL.
 TRAPELIOPSIS FLEXUOSA (Fr.) Coppins & P. James – on base of *Betula*, IJ (TU88406.a); on *J. communis*.
 # TREMELLA HYPOGYMNAE Diederich & M. S. Christ. – on *Hypogymnia physodes*, JM (TU86796).

- # TRICHONECTRIA RUBEFACIENS (Ellis & Everh.)
Diederich & Schroers – on thallus of *Parmelia sulcata*, AT.
- VERRUCARIA DOLOSA Hepp – on limestone, AS
(TU86823; UDB0778442).
- # VOUAUXIELLA LICHENICOLA (Linds.) Petr. & Syd.
– on apothecia of *Lecanora chlorotera*, AS.
- VULPICIDA PINASTRI (Scop.) J.-E. Mattsson & M. J.
Lai – on *Q. robur*.
- XANTHOPARMELIA CONSPERSA (Ach.) Hale – on granite stone, AS.
- XANTHORIA PARIETINA (L.) Th. Fr. – on *Q. robur*.
- XYLOGRAPHA PARALLELA (Ach.) Fr. – on lignum, IJ
(TU88412.a).

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