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Lichens and lichenicolous fungi from Washington Land, western North Greenland

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Abstract: A total of 111 taxa of lichens and lichenicolous fungi are reported from three localities in Washington Land, western North Greenland. *Candelariella dispersa* and *Staurothele discedens* are reported as new to Greenland. 105 taxa of lichens and lichenicolous fungi are new to Washington Land. Geology, climate and vegetation of the area are briefly treated.

Kokkuvõte: E. S. Hansen. Washingtoni Maa (Põhja-Gröönimaa lääneosa) samblikud ja lihhenikoolsed seened.

Teatatakse 111 sambliku ja lihhenikoolse seeneliigi leiust Washingtoni Maalt Põhja-Gröönimaa lääneosas. *Candelariella dispersa* ja *Staurothele discedens* on uued leiud Gröönimaalt. 105 sambliku ja lihhenikoolse seene liiki on Washingtoni Maalt esmasleiud. Lühidalt käsitletakse uurimisala kliimat ja taimkatet.

INTRODUCTION

The author investigated the lichen flora of Washington Land in July 1999. Washington Land and Inglefield Land are separated by the big Humboldt Gletcher and belong to two different floristic provinces and districts, viz, North Greenland (CN; Washington Land) and North West Greenland (NWn; Inglefield Land) (Bay, 1992, 1997). The author formed a botanical team together with lic. scient. Jon Feilberg, who collected vascular plants. While 61 species of vascular plants were known from Washington Land (Bay, 1992), this area was almost completely unknown lichenologically prior to the new investigation. The only report being that of E. S. Hansen (1980), who recorded *Cladonia pocillum, Lecidea lapicida, Peltigera rufescens, Thamnolia subuliformis* and *Xanthoria elegans* from Washington Land. Thomson (1997) states the occurrence of one additional species, viz. *Lecanora marginata*, from the area. No lichenicolous fungi have been reported from Washington Land so far. E. S. Hansen (1995) has outlined the previous lichenological investigations in northern Greenland. 410 taxa of lichens, lichenicolous fungi and other fungi have recently been reported from Kronprins Christian Land and Lambert Land in North and North East Greenland (Alstrup et al., 2000).

Localities and geology

The following three localities in Washington Land were investigated by the author in the summer of 1999 (Fig. 1).

1. Area south of Aleqatsiaq Fjord. 80°23'N, 65°19'W. Alt. 0–200 m. 10–15 July 1999. Ordovician dolomites (Peel & Sønderholm, 1991; Dawes & Higgins, 2000).
2. Area east of Nikolaj Nielsen Kyst. 80°12'N, 67°12'W. Alt. 0–150 m. 16–23 July 1999. Ordovician-Silurian dolomites and limestones.
3. Cass Fjord. 80°09'N, 63°41'W. Alt. 0–100 m. 24–29 July 1999. Cambrian-Ordovician dolomites and limestones.

Siliceous erratics occur more or less commonly at the three localities.

Climate

Washington Land has a high arctic climate with a mean July temperature about 3–4 °C and an annual precipitation about 100–200 mm (Bennike & Jepsen, 2000). Most of the precipitation falls as snow.

MATERIAL AND METHODS

Lichens were collected at numerous sample plots at the three localities situated in Washington Land.The collected material, a total of about 400 specimens of lichens and

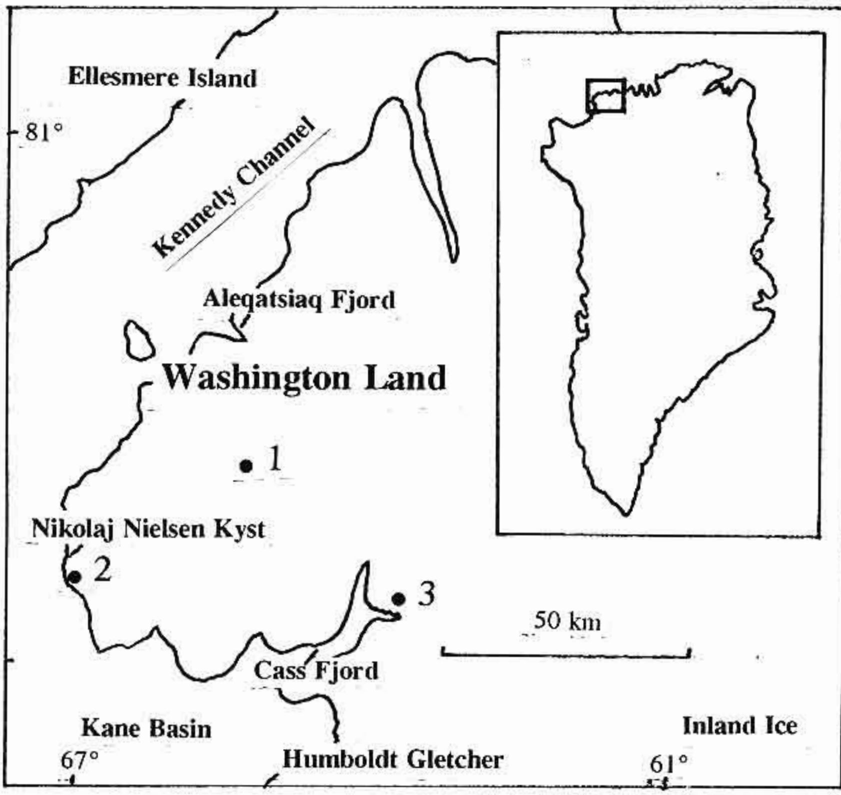

Fig. 1. Location of investigation area in western North Greenland: 1 – Aleqatsiaq Fjord; 2 – Nikolaj Nielsen Kyst; 3 – Cass Fjord. The small Greenland map shows the situation of the investigation area.

lichenicolous fungi, was studied with Zeiss light microscopes. Standard TLC methods were used for identification of specimens of *Buellia elegans* and some greyish white crustose specimens belonging to *Lepraria* and *Leproloma*. The material is deposited at the Botanical Museum, University of Copenhagen (C).

General remarks on the lichen vegetation

The terricolous vegetation in the area south of Aleqatsiaq Fjord (loc. 1) is extremely open and very sparse in most places. It consists of small heath patches dominated by *Saxifraga oppositifolia*, *Salix arctica* and *Dryas sp.*, marches and moist mossy slopes with *Dacampia hookeri*, *Fulgensia bracteata* and *Lepraria frigida*. Open areas among the dwarf shrubs are colonized by lichens such as *Buellia papillata*, *Lecanora epibryon*, *Megaspora verrucosa* and *Physconia muscigena*. These lichens are best developed around birdstones and lemming holes. The area east of Nikolaj Nielsen Kyst (loc. 2) is characterized by similar lichen associations, but the lichen flora is generally more rich in species. *Lecidea ramulosa*, *Mycobilimbia lobulata* and *Protoblastenia terricola* are dominant lichens on moist polygone soil in open *Saxifraga oppositifolia- S. platysepala-Salix arctica* vegetation. Thin layers of dry, sandy soil over rocks composed of dolomite hold lichens such as *Buellia elegans*, *Caloplaca tominii*, *Collema substellatum*, *Gypsoplaca macrophylla* and *Toninia arctica*. The plant cover is generally more dense in the Cass Fjord area (loc. 3) than at the two other localities investigated. Thus *Buellia elegans*, *Cladonia pocillum*, *Fulgensia bracteata*, *Megaspora verrucosa*, *Peltigera rufescens* and *Psora decipiens* form a compact mosaic vegetation together with *Salix arctica*, *Saxifraga oppositifolia* and *Dryas sp.* *Acarospora rhizobola*, *Catapyrenium daedaleum* and *Solorina saccata* were found growing at Cass Fjord, only.

Nitrophilous, saxicolous lichens are of great importance at all of the three localities visited. *Xanthoria elegans* forms a conspicuous association with *Melanelia infumata*, *Physcia dubia*, *P. caesia* and *Xanthoria borealis* on the top of boulders composed of dolomite or limestone. Siliceous birdstones at Nikolaj Nielsen Kyst hold four species of *Umbilicaria*, viz. *U. decussata*, *U. lyngei*, *U. torrefacta* and *U. virginis*. Numerous siliceous stones on old marine terraces at this locality are covered by thalli of *Dimelaena oreina*, *Rhizocarpon pusillum*, *Sporastatia testudinea* and *Xanthoria elegans*. *Lecidea atrobrunnea* grows abundantly on stones closer to the coast. Moist boulders and rocks composed of dolomite at Cass Fjord hold the following lichens: *Caloplaca castellana*, *C. flavovirescens*, *C. paulii*, *Placynthium asperellum*, *Porpidia flavicunda*, *P. flavocaerulescens*, *Protoblastenia calva*, *P. incrustans*, *P. rupestris* and *Xanthoria sorediata*. *Aspicilia candida* covers some limestone boulders almost completely. Depressions temporarily moistened by melt water in the area south of Aleqatsiaq Fjord represent a particular niche occupied by, for example, *Ionaspis suaveolens*, *Staurothele discedens* and *S. fuscocuprea*.

ANNOTATED LIST OF LICHENS AND LICHENICOLOUS FUNGI

The following list of lichens is based on the author's collections. Nomenclature follows Santesson (1993) with some exceptions. Numbers 1, 2, 3 indicate the three localities listed above. Annotations are given as regards the substrate of the lichens and presence of apothecia (ap) or perithecia (pe). "st" means that the specimen is sterile. Lichenicolous fungi are marked with an asterisk (*). The frequency is stated for selected lichens. Collections, which have been distributed previously from herbarium C as part of "Lichenes Groenlandici Exsiccati" (LGE), are stated by their numbers. The species are new to Washington Land, if not otherwise stated.

ACAROSPORA RHIZOBOLA (Nyl.) Alstrup. 3. On soil over dolomite, together with *Catapyrenium lachnum*, *Megaspora verrucosa*, *Psora decipiens* and *Toninia arctica*; ap.

A. VERONENSIS A. Massal. 3. On calcareous birdstone, together with *Physcia caesia*, *Rhizoplaca melanophthalma* and *Xanthoria elegans*; ap; rare.

* ARTHONIA DESTRUENS Rehm. 2. Parasitic on *Xanthoria elegans* on birdstone composed of dolomite; ap.

* A. MOLENDOI (Frauenf.) R. Sant. 2. Parasitic on *Caloplaca sp.* on calcareous birdstone; ap. Like *Arthonia destruens*, *A. molendoi* turns the host white (Alstrup & Hawksworth, 1990).

ASPICILIA CANDIDA (Anzi) Hue. 1, 2, 3. On siliceous and calcareous rocks, together with *Caloplaca castellana*, *Placynthium asperellum*, *Sporastatia testudinea* and *Staurothele spp.*; ap; common; LGE No. 777.

* BISPORA CHRISTIANSENII D. Hawksw. 1, 2. Parasitic on *Candelariella aurella* and *Protoblastenia incrustans* on rocks composed of dolomite.

* B. LICHENUM Diederich. 2. Parasitic on *Phaeorrhiza nimbosa*.

BUELLIA ELEGANS Poelt. 2, 3. On calcareous soil, loess, gravel and mosses, together with *Collema substellatum*, *Megaspora verrucosa*, *Psora decipiens* and *Toninia spp.*; st; common; LGE No. 756, 773. The Greenland specimens of *Buellia elegans* contain atranorin and norstictic acid and accordingly belong to chemotype 1 by Trinkaus & Mayrhofer (2000).

B. PAPILLATA (Sommerf.) Tuck. 1, 2, 3. On dead mosses, soil and old bones of musk oxen, together with *Caloplaca cerina* and *Lecanora epibryon*; ap; common.

* B. PULVERULENTA (Anzi) Jatta. 2. Parasitic on *Physcia caesia* and *Physconia muscigena* on birdstones; ap.

B. PUNCTATA (Hoffm.) A. Massal. 3. On old bone of musk ox; ap.

CALOPLACA ALCARUM Poelt. 1, 2. On coastal calcareous rock and old bone, together with *Candelariella aurella* and *Lecanora contractula*; ap; rare.

C. CASTELLANA (Räsänen) Poelt. 1, 2, 3. Parasitic on *Placynthium asperellum* on calcareous and siliceous rocks; ap; common.

C. CERINA (Ehrh. ex Hedw.) Th. Fr. 1, 2, 3. On dead mosses, dead twig of *Salix arctica* and bones of musk oxen; ap; common.

C. FLAVOVIRESCENS (Wulfen) Dalla Torre & Sarnth. 3. On calcareous boulder, together with *Caloplaca paulii*, *Candelariella aurella* and *Placynthium asperellum*; ap; rare. *Caloplaca flavovirescens* has previously been reported from a few localities in South West and North East Greenland (E. S. Hansen et al. 1987; Alstrup et al. 2000).

C. HOLOCARPA (Hoffm. ex Ach.) A. E. Wade. 3. On dead twigs of *Salix arctica*; ap; rare. The species occurs occasionally in West Greenland, while it appears to be very rare in East Greenland (Alstrup, 1982; E. S. Hansen, 2000; Lynge, 1940).

C. JUNGERMANNIAE (Vahl) Th. Fr. 1. On plant remains; ap; rare.

C. PAULII Poelt. 3. On calcareous boulders; ap; rare. Previous collections of the species are available from Marmorilik in Central West Greenland and Centrum Sø in North East Greenland (E. S. Hansen et al., 1987; Alstrup et al., 2000).

C. SAXIFRAGARUM Poelt. 1, 2, 3. On dead *Dryas sp.* and *Saxifraga oppositifolia*, together with *Caloplaca cerina*, *C. tiroliensis* and *Rinodina roscida*; ap; common.

C. TIROLIENSIS Zahlbr. 1, 2, 3. On mosses and plant remains, together with *Caloplaca cerina*, *Lecanora epibryon* and *Physconia muscigena*; ap; common.

C. TOMINII Savicz. 1, 2, 3. On mosses and soil over dolomite, together with *Candelariella terrigena* and *Lecanora dispersa*; st (apart from a specimen from Nikolaj Nielsen Kyst with distinct apothecia). Most Greenland collections of *Caloplaca tominii* are from areas characterized by a low annual precipitation (E. S. Hansen et al., 1987).

CANDELARIELLA AURELLA (Hoffm.) Zahlbr. 1, 2, 3. On calcareous rocks, old bones of musk oxen, calcareous soil, mosses and dead *Dryas sp.* and *Saxifraga oppositifolia*; ap; common.

C. DISPERSA (Räsänen) Hakul. 1, 2, 3. On thalli of *Placynthium asperellum*; ap. New to Greenland. Recently Thomsson (1997) mapped the distribution of *Candelariella dispersa* in North America.

C. PLACODIZANS (Nyl.) H. Magn. 2. On mosses, together with *Physconia muscigena*; ap.

C. TERRIGENA Räsänen. 1, 2, 3. On soil, mosses and pellet; ap; common.

C. VITELLINA (Hoffm.) Müll. Arg. 3. On calcareous birdstone, together with *Physcia dubia* and *Xanthoria elegans*; ap.

CATAPYRENIUM DAEDALEUM (Kremp.) Stein. 3. On mosses on soil; pe.

C. LACHNEUM (Ach.) R. Sant. 1, 2, 3. On soil, together with *Fulgensia bracteata*, *Megaspora verrucosa* and *Parmeliella triptophylla*; pe.

CATILLARIA PHILIPPEA (Mont.) A. Massal. 3. On calcareous rock, together with *Caloplaca flavovirescens* and *C. paulii*; ap; rare.

CEPHALOPHYSIS LEUCOSPILA (Anzi) H. Kilias & Scheid. 1, 3. On dolomite, together with *Candelariella aurella*, *Lecanora dispersa*, *Placynthium asperellum* and *Protoblastenia incrustans*; ap; common.

CLADONIA POCILLUM (Ach.) Grognot. 2, 3. On mosses and soil, together with *Buellia elegans* and *Peltigera rufescens*; st; locally common; LGE No. 769, 775. Previously reported from Cass Fjord by E. S. Hansen (1980).

COLLEMA CRISTATUM (L.) Weber ex F. H. Wigg. 2. On mosses, together with *Cladonia pocillum*; st; rare.

C. SUBSTELLATUM H. Magn. 1, 2, 3. On loess and sandy and gravelly soil, together with, for example, *Buellia elegans*; st; LGE No. 758. The species is common in North East Greenland and eastern part of North Greenland (E. S. Hansen, 1993, 1995; Alstrup et al., 2000).

C. UNDULATUM Laurer ex Flot. var. GRANULOSUM Degel. 1, 2, 3. On soil, mosses and plant remains; st.

* DACAMPIA HOOKERI (Borrer) A. Massal. 1. On moist soil, together with *Fulgensia bracteata* and *Solorina bispora*, on which it grows parasitically in the beginning; pe; LGE No. 751.

DIMELAENA OREINA (Ach.) Norman. 1, 2, 3. On siliceous rocks and dolomite, together with *Physcia dubia*, *Placynthium asperellum*, *Rhizocarpon geminatum*, *Sporastatia testudinea* and *Xanthoria elegans*; ap; locally abundant; LGE No. 767.

* ENDOCOCCUS RUGULOSUS Nyl. 1. Parasitic on *Aspicilia candida* on siliceous rock; pe.

FULGENSIA BRACTEATA (Hoffm.) Räsänen. 1, 2, 3. On moist soil and over mosses, together with *Dacampia sp.*, *Lepraria frigida* and *Solorina bispora*; ap; common; LGE No. 754, 762.

GYPSOPLACA MACROPHYLLA (Zahlbr.) Timdal. 2, 3. On loess and sandy soil, together with *Leptogium lichenoides* and *Toninia sedifolia*; st.

IONASPIS HETEROMORPHA (Kremp.) Arnold. 1. On dolomite; ap.

I. SUAVEOLENS (Fr.) Th. Fr. 1, 2. On stones composed of dolomite in depressions and along watercourses, together with *Staurothele discedens* and *S. fuscocuprea*; ap; locally abundant; LGE No. 753.

LECANORA CONTRACTULA Nyl. 1, 2, 3. On old bones and birdstones composed of dolomite, together with *Caloplaca alcarum*, *Candelariella aurella* and *Physcia dubia*; ap.

L. CRENULATA Hook. 1. On dolomite manured by birds, together with *Candelariella aurella*, *Physcia dubia* and *Xanthoria elegans*; ap.

L. DISPERSA (Pers.) Sommerf. 1, 2, 3. On old bones of musk oxen, together with *Candelariella aurella*; also on birdstones composed of dolomite, together with *Physcia caesia*, *P. dubia*, *Polysporina simplex*, *Xanthoria borealis* and *X. elegans*; ap.

L. EPIBRYON (Ach.) Ach. 1, 2, 3. On soil, mosses and plant remains, together with *Buellia papillata*, *Caloplaca tiroliensis*, *Lecidella wulfenii*, *Megaspora verrucosa* and *Physconia muscigena*; ap; common; LGE No. 755.

L. INTRICATA (Ach.) Ach. 3. On calcareous rock, together with *Placynthium asperellum*, *Rhizocarpon geminatum*, *R. intermediellum* and *Xanthoria elegans*; ap.

L. MARGINATA (Schaer.) Hertel & Rambold. 1, 2, 3. On calcareous and siliceous stones, together with *Caloplaca castellana*, *Placynthium asperellum*, *Rhizocarpon geminatum* and *Xanthoria elegans*; ap. There is one previous record of *Lecanora marginata* fromWashington Land (Thomson, 1997).

LECIDEA ATROBRUNNEA (Ramond ex Lam. & DC.) Schaer. 1, 2, 3. On manured siliceous rocks, together with *Aspicilia spp.*, *Rhizocarpon geminatum*, *Sporastatia testudinea* and *Xanthoria elegans*; ap; LGE No. 770.

L. ATROMARGINATA H. Magn. 1, 2, 3. On siliceous and calcareous rocks; ap.

L. AURICULATA Th. Fr. 1, 2, 3. Along fissures in siliceous rocks; ap.

L. RAMULOSA Th. Fr. 2, 3. On soil and mosses, together with, for example, *Fulgensia bracteata*, *Lecanora epibryon* and *Solorina bispora*; st; locally abundant; LGE No. 765, 780.

L. TESSELATA Flörke. 1, 2, 3. On dolomite, calcareous rocks and siliceous rocks partly covered by a thin layer of limonite, together with *Placynthium asperellum*, *Rhizocarpon pusillum*, *Sporastatia testudinea* and *Xanthoria elegans*; ap; common.

LECIDELLA BULLATA Körb. 1, 2, 3. On dolomite and siliceous birdstones, together with, for example, *Candelariella aurella*, *Lecanora dispersa* and *Sporastatia testudinea*; ap.

L. EUPHOREA (Flörke) Hertel. 2. On old bone, together with *Caloplaca cerina* and *Candelariella aurella*; ap.

L. STIGMATEA (Ach.) Hertel & Leuckert. 3. On calcareous rock, together with *Xanthoria elegans*; ap.

L. WULFENII (Hepp) Körb. 2. On mosses and plant remains, together with *Buellia papillata*, *Lecanora epibryon* and *Megaspora verrucosa*; ap.

LEPRARIA FRIGIDA J. R. Laundon. 1, 3. On mosses. Thallus contains alectorialic acid and barbatolic acid (TLC). The Greenland specimens of *L. frigida* usually have greyish white thallus and occur in exposed places contrary to the similar *Lepraria eburnea*, which has a greyish to greenish thallus with a yellow tinge and grows in somewhat shady places (Purvis *et al.* 1992).

LEPTOGIUM LICHENOIDES (L.) Zahlbr. 2, 3. On mosses; st.

MEGASPORA VERRUCOSA (Ach.) Hafellner & V. Wirth. 1, 2, 3. On soil, mosses, plant remains and musk ox excrements and –bones, together with, for example, *Caloplaca tiroliensis*, *Lecanora epibryon* and *Rinodina roscida*; ap; common.

MELANELIA INFUMATA (Nyl.) Essl. 1, 2, 3. On mosses and soil on birdstones composed of dolomite, together with *Physcia caesia*, *P. dubia*, *Xanthoria borealis* and *X. elegans*; st; LGE No. 764.

* MUELLERELLA LICHENICOLA (Sommerf.: Fr.) D. Hawksw. 2, 3. Parasitic on *Caloplaca paulii*, *Lecidea atromarginata* and *Xanthoria elegans*; pe.

* M. PYGMAEA (Körb) D. Hawksw. 1. Parasitic on *Caloplaca flavovirescens*, *C. paulii*, *Lecidella stigmatea*, *Porpidia speirea* and *Protoblastenia rupestris*; pe.

MYCOBILIMBIA LOBULATA (Sommerf.) Hafellner. 1, 2. On moist soil, together with *Fulgensia bracteata*, *Lecidea ramulosa* and *Solorina bispora*; ap; locally abundant; LGE No. 766.

PARMELIELLA TRIPTOPHYLLA (Ach.) Müll. Arg. 2, 3. On soil and mosses; st.

PELTIGERA RUFESCENS (Weiss) Humb. 2, 3. On mosses and soil, together with *Cladonia pocillum* and *Fulgensia bracteata*; st; LGE No. 772. *Peltigera rufescens* has previously been reported from Cass Fjord (E. S. Hansen, 1980).

PHAEOPHYSCIA SCIASTRA (Ach.) Moberg. 2, 3. On mosses on birdstones, together with *Physconia muscigena* and *Xanthoria elegans*; st.

PHAEORRHIZA NIMBOSA (Fr.) H. Mayrhofer & Poelt. 2, 3. On soil and mosses, together with *Fulgensia bracteata*; ap.

* PHAEOSPOROBOLUS ALPINUS R. Sant., Alstrup & D. Hawksw. 1. Parasitic on *Buellia papillata*.

PHYSCIA CAESIA (Hoffm.) Fürnr. 1, 2, 3. On birdstones composed of dolomite, together with *Melanelia infumata*, *Phaeophyscia sciastra*, *Physcia dubia*, *Xanthoria borealis* and *X. elegans*; also on siliceous rocks and limestones; st; LGE No. 782.

P. DUBIA (Hoffm.) Lettau. 1, 2, 3. On mosses on birdstones composed of dolomite, limestone and gneiss, together with other nitrophilous lichens such as *Xanthoria borealis* and *X. elegans*; st.

PHYSCONIA MUSCIGENA (Ach.) Poelt. 1, 2, 3. On mosses, soil and plant remains, often at the base of birdstones and near lemming burrows, together with, for example, *Caloplaca tiroliensis*, *Lecanora epibryon*, *Thamnolia vermicularis* and *Xanthoria elegans*; ap; common; LGE No. 763, 779.

PLACYNTHIUM ASPERELLUM (Ach.) Trevis. 1, 2, 3. On siliceous rocks, dolomite and limestone, together with *Cephalophysis leucospila*, *Lecidea atrobrunnea*, *Protoblastenia incrustans*, *Rhizocarpon intermediellum* and *Sporastatia testudinea*; st; common.

P. SUBRADIATUM (Nyl.) Arnold. 1, 2, 3. On dolomite and limestone, together with *Candelariella aurella*; st.

POLYBLASTIA SENDTNERI Kremp. 1. On sandy soil; pe.

POLYSPORINA SIMPLEX (Davies) Vezda. 1, 2, 3. On dolomite and limestone rocks, together with, for example, *Candelariella aurella*, *Lecanora dispersa* and *Xanthoria elegans*; ap.

PORPIDIA FLAVICUNDA (Ach.) Gowan. 3. On dolomite; ap.

P. FLAVOCOERULESCENS (Hornem.) Hertel & A. J. Schwab. 3. On dolomite; ap.

P. SPEIREA (Ach.) Kremp. 2, 3. On calcareous rocks, together with *Placynthium asperellum*; ap.

PROTOBLASTENIA CALVA (Dicks.) Zahlbr. 2, 3. On dolomite and limestone rocks, together with *Lecidea tessellata*, *Placynthium asperellum* and *Staurothele discedens*; ap.

P. INCRUSTANS (DC.) J. Steiner. 1, 2, 3. On dolomite and limestone rocks, together with *Cephalophysis leucospila*, *Placynthium asperellum*, *Staurothele discedens* and *S. fuscocuprea*; ap; common.

P. RUPESTRIS (Scop.) J. Steiner. 1, 3. On dolomite and limestone rocks, together with *Ionaspis suaveolens* and *Staurothele discedens*; ap.

P. TERRICOLA (Anzi) Lynge. 1, 2, 3. On soil and mosses, together with *Buellia elegans*, *Mycobilimbia lobulata*, *Toninia arctica* and *T. sedifolia*; ap; locally abundant; LGE No. 774.

PSEUDEPHEBE MINUSCULA (Nyl. ex Arnold) Brodo & D. Hawksw. 2. On siliceous boulder, together with *Rhizocarpon intermediellum* and *Xanthoria elegans*; st; rare.

PSORA DECIPIENS (Hedw.) Hoffm. 2, 3. On clayey and sandy soil, together with *Buellia elegans*, *Cladonia pocillum*, *Collema substellatum* and *Fulgensia bracteata*; ap; rare apart from Cass Fjord, where *Psora decipiens* occurs abundantly in some lowland patches; LGE No. 771.

RHIZOCARPON GEMINATUM Körb. 2, 3. On siliceous rocks and dolomite, together with *Dimelaena oreina*, *Placynthium asperellum*, *Rhizocarpon intermediellum*, *Sporastatia testudinea* and *Xanthoria elegans*; ap; common; LGE No. 776.

R. GRANDE (Flörke) Arnold. 2. On siliceous boulders, together with *Sporastatia testudinea* and *Xanthoria elegans*; ap; rare.

R. INTERMEDIELLUM Räsänen. 1, 2, 3. On siliceous rocks and dolomite, together with *Dimelaena oreina*, *Placynthium asperellum*, *Rhizocarpon geminatum*, *Sporastatia testudinea* and *Xanthoria elegans*; ap.

R. PUSILLUM Runemark. 2, 3. Parasitic on *Sporastatia testudinea* on siliceous rocks and dolomite; ap; common; LGE No. 760.

R. SUPERFICIALE (Schaer.) Vain. 2. On gneissic boulders, together with *Dimelaena oreina*, *Umbilicaria torrefacta* and *U. virginis*; ap.

RHIZOPLACA MELANOPHTHALMA (DC.) Leuckert & Poelt. 3. On calcareous birdstone, together with, for example, *Lecidea atrobrunnea*, *Physcia caesia* and *Xanthoria elegans*; ap; rare.

RINODINA CALCIGENA (Th. Fr.) Lynge. 1, 2, 3. On dolomite and limestone rocks, together with, for example, *Polysporina simplex*; ap.

R. ENDOPHRAGMIA I. M. Lamb. 1. On dolomite, together with *Candelariella aurella*; ap. Both *Rinodina calcigena* and *R. endophragmia* have previously been reported from Peary Land (E. S. Hansen, 1995)

R. MNIARAEA (Ach.) Körb. 2, 3. On sandy soil and mosses, together with, for example, *Caloplaca tiroliensis*, *Cladonia pocillum*, *Physconia muscigena* and *Toninia sedifolia*; ap.

R. ROSCIDA (Sommerf.) Arnold. On soil, mosses and plant remains and musk ox excrements, together with *Caloplaca cerina*, *C. saxifragarum*, *C. tiroliensis*, *Lecanora epibryon* and *Megaspora verrucosa*; ap; common.

SOLORINA BISPORA Nyl. 1, 2, 3. Among mosses and cyanobacteria on moist, clayey soil; ap.

S. SACCATA (L.) Ach. 3. On sandy soil; ap.

SPORASTATIA TESTUDINEA (Ach.) A. Massal. 1, 2, 3. On siliceous rocks and dolomite, together with *Aspicilia candida*, *Lecidea tessellata*, *Placynthium asperellum*, *Rhizocarpon intermediellum* and *Xanthoria elegans*; ap; common; LGE No. 759.

STAUROTHELE DISCEDENS (Nyl.) Zahlbr. 1, 2, 3. On temporarily moistened dolomite and limestone, together with *Ionaspis suaveolens* and *Protoblastenia calva*; pe; locally abundant. New to Greenland. *Staurothele discedens* is widely distributed in Alaska, but has not been reported from eastern North America (Thomson, 1997; Thomson & Murray, 1988).

S. FUSCOCUPREA (Nyl.) Zschacke. 1, 2, 3. On calcareous stones and dolomite moistened by melt water, together with, for example, *Caloplaca paulii* and *Ionaspis suaveolens*; pe; locally abundant.

THAMNOLIA VERMICULARIS (Sw.) Schaer. 2, 3. On soil and mosses among boulders, together with, for example, *Cladonia pocillum* and *Physconia muscigena*; locally abundant; LGE No. 781.

TONINIA ARCTICA Timdal. 1, 2, 3. On sandy and clayey soil, together with *Buellia elegans*, *Collema substellatum*, *C. undulatum* v. *granulatum*, *Fulgensia bracteata* and *Toninia sedifolia*; ap; common; LGE No. 761.

T. SEDIFOLIA (Scop.) Timdal. 1, 2, 3. On soil, mosses and plant remains, together with, for example, *Catapyrenium lachneum*, *Gypsoplaca macrophylla*, *Psora decipiens* and *Toninia arctica*; ap; common.

* TRIMMATOSTROMA LICHENICOLA M. S. Christ. & D. Hawksw. 1, 2, 3. In apothecia of *Candelariella aurella*, *C. placodizans* and *Lecidea atrobrunnea*.

UMBILICARIA DECUSSATA (Vill.) Zahlbr. 2. On siliceous boulder; st; rare.

U. LYNGEI Schol. 2. On siliceous boulders, together with *Pseudephebe minuscula*, *Sporastatia testudinea* and *Xanthoria elegans*; st.

U. TORREFACTA (Lightf.) Schrad. 2. On siliceous boulder, together with *Dimelaena oreina*, *Rhizocarpon superficiale* and *Umbilicaria virginis*; st.

U. VIRGINIS Schaer. 1, 2. On siliceous boulders, together with *Lecidea atrobrunnea*, *Sporastatia testudinea* and *Xanthoria elegans*; ap.

XANTHORIA BOREALIS R. Sant. & Poelt. 1, 2, 3. On birdstones composed of gneiss or dolomite, together with *Melanelia infumata*, *Physcia dubia* and *Xanthoria elegans*; also on mosses, soil and old bones of musk oxen, together with *Caloplaca cerina*, *C. tiroliensis*, *Candelariella aurella* and *Lecanora dispersa*; ap.

X. ELEGANS (Link) Th. Fr. var. ELEGANS. 1, 2, 3. On birdstones composed of gneiss or limestone, together with, for example, *Physcia caesia*, *P. dubia*, *Rhizocarpon geminatum*, *Rhizoplaca melanophthalma* and *Sporastatia testudinea*; also on soil, mosses and old bones of musk oxen; ap; common; LGE No. 752, 768, 778. *X. elegans* has previously been reported from Cass Fjord (E. S. Hansen, 1981)

X. ELEGANS (Link) Th. Fr. var. SPLENDENS (Darb.) Christ. ex Poelt. 2, 3. On mosses and soil in temporarily moistened riverbeds; ap; locally abundant.

X. SOREDIATA (Vain.) Poelt. 2, 3. On dolomite, together with *Candelariella aurella*; st.

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Distribution of the true dry rot fungus *Serpula lacrymans* in Latvia

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Abstract: Distribution of the true dry rot fungus *Serpula lacrymans* in Latvia was assessed in this study. *S. lacrymans* is economically most important destroyer of structural wood indoors, commonly in buildings in the moderate climate zone of Europe and some countries worldwide. Growth conditions, characteristic cases of occurrence as well as the collecting of infected materials have been estimated. It has been found, that the dry rot comprises about 40% of the total number of wood inhabiting fungi recorded. The maximum of the cases was observed from March to September, with a maximum in July. Most often damages occurred in floorings, doorposts or wooden walls under the plaster.
We conclude that the occurrence of dry rot in Latvia's buildings is high, although the correct number of cases is not estimated. Information on occurrence of dry rot is being recorded in 11 districts of Latvia, while about others the information is still limited. The assessment of dry rot frequency and distribution within Latvia will be continued also in future.

Kokkuvõte: I. Irbe, I. Andersone ja B. Andersons. Hariliku majavammi (Serpula lacrymans levikust Lätis.

Artiklis antakse ülevaade hariliku majavammi levikust Läti Vabariigis. Uuringute tulemused näitavad, et hariliku majavammi leiud moodustavad 40% puitulagundavate seente leidude koguarvust hoonetes. Enamik majavammi leide jäi vahemikku märtsist septembrini, kusjuures leidude maksimum oli juulis. Kokkuvõtvalt võib majavammi esinemissagedust Lätis pidada kõrgeks.

INTRODUCTION

The true dry rot fungus *Serpula lacrymans* (Wulfen: Fr.) J. Schröt. causes the brown cuboidal rot of interior construction wood. Fungus is the most dangerous destroyer of structural wood indoors in Europe. It is capable of spreading across the house in a very short period of time (a couple of years) causing enormous material losses. For example, in UK, the fungus causes destructions estimated at more than 100 million pounds per year (Jennings and Bravery, 1991).

The fungus in nature is found only in the Indian Himalayas, where the fruiting bodies have been collected near Narkanda, India by Singh (1994) and Bech-Anderson (1995). At our latitude *Serpula himantioides* (Fr.: Fr.) Bondartsev is encountered in nature, which is regarded as a separate species, and not a wild variety of *S. lacrymans* (Harmsen et al., 1958).

Owing to limited temperature range conductive to mycelial growth, the fungus is commonly found in buildings in the moderate climate of central, northern and eastern Europe, but does not occur in tropical or desert regions (Schmidt and Moreth-Kebernik, 1990). Dry rot is reported (Jennings and Bravery, 1991) to be common for the coolest regions of Japan and Southern Australia. In its turn, in the U.S.A. *Serpula incrassata* (Berk. & M.A. Curtis) Donk, a relative species to *S. lacrymans* is found, which is characterized by a distinct hymenophore configuration, a higher temperature optimum, i.e. 24–30° C and occurrence in nature (Jennings and Bravery, 1991).

Facts given above reflect the situation in Europe, and in the other parts of world. In this study we tried to find out more about the distribution of *S. lacrymans* in Latvia.

MATERIAL AND METHODS

The fungal material was obtained both by inspections of infected objects or samples supplied from different areas of Latvia. Inspection of object included looking for fungal growth in potential risk areas, recording of conditions for growth, characteristic cases of occurrence in buildings as well as the collecting of infected materials. Identification of the fungus was carried out according to the morphological features of fruiting bodies, mycelium, strands and appearance of decayed wood (Jennings and Bravery, 1991).

Light microscopy (LM) and scanning electron microscopy (SEM) methods were used for identification of the fungus. Fungal hyphae were stained with Cotton blue. For the staining of strands a mixture of Brilliant Congo blue and Cotton brown was used. For SEM studies samples of decayed wood was saturated with distilled water and cryosectioned with cryoultramicrotome. After this they were dried in air, glued with the carbon adhesive to the specimen stub and coated with gold by ion sputter. Samples were investigated in scanning electron microscope JEOL JSM 840A at the accelerating voltage 10 kV.

RESULTS AND DISCUSSION

Distribution of dry rot

According to our data, *S. lacrymans* has been found in territory of Latvia from the north (Valmiera) to the south (Bauska) and from the west (Ventspils) to the east (Daugavpils) (Fig. 1).

Fig. 1. Distribution of the dry rot fungus *S. lacrymans* in territory of Latvia (marked districts).

Under the effect of maritime factors, the climate in Latvia is temperate but changeable. The average temperature in January ranges from 3° C below zero in the west to 7° C below zero in the inland, while the mean summer temperature is 20° C. The climatic conditions are proved to be suitable for the occurrence of dry rot in houses.

40 cases of dry rot obtained from 11 districts of Latvia were examined. These made up about 40% from the total number of wood inhabiting fungi recorded. This percentage varied from year to year owing to fluctuations in climatic conditions. The occurrences of *S. lacrymans* grew especially in humid summers, when the wetting capability of building structures tended to increase. Most of the cases were observed from March to September, with a maximum in July. In this period the fungal development was particularly active and easily observable. The cases of dry rot among the other fungal damages in buildings have been reported at 45% in Switzerland and 20% in Denmark (Jennings and Bravery, 1991), while in Finland at about 50% (Paajanen and Viitanen, 1989).

Morphological characters

Strands of *S. lacrymans* are composed of at least four distinct hyphal types. Undifferentiated hyphae (ca 3.5 µm) are the basic type of hyphae and produce all other hyphal types. Tendril hyphae (ca 2.3 µm) envelop the vessel hyphae; fibre hyphae (ca 3–6 µm) are thick walled with a small lumen and without clamp connections; vessel hyphae (5–60 µm) are characterized by a very wide diameter, thin walls and the beams inside (Hornung and Jennings, 1981). Our microscopic analyses generally confirmed the measures obtained by other authors (Fig. 2). Strand elements coloured with a mixture of Brilliant Congo blue and Cotton brown were differentiated by the colour: ordinary hyphae turned brown, fibre hyphae dark blue and vessel hyphae violet.

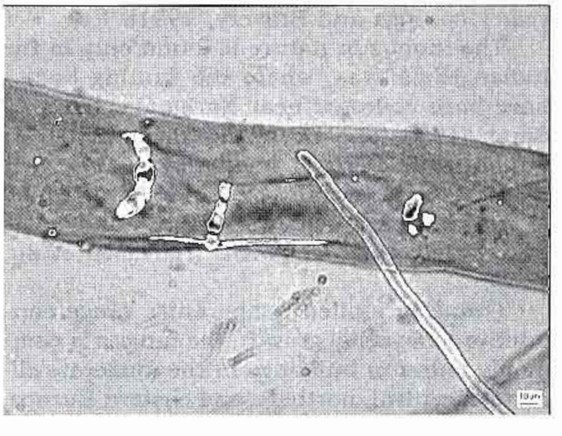

Fig. 2. Water transporting vessel and fibre hyphae in the strand of *S. lacrymans* (LM).

The hyphae of the substrate mycelium growing inside the wood were about 2 μm wide, often with medallion clamp connections having an opening in the centre. Branching of the hyphae had an irregular character (Fig. 3). The hyphae in wood were appressed to the cell wall and the grooves were formed, which indicated an advanced wood breakdown stage.

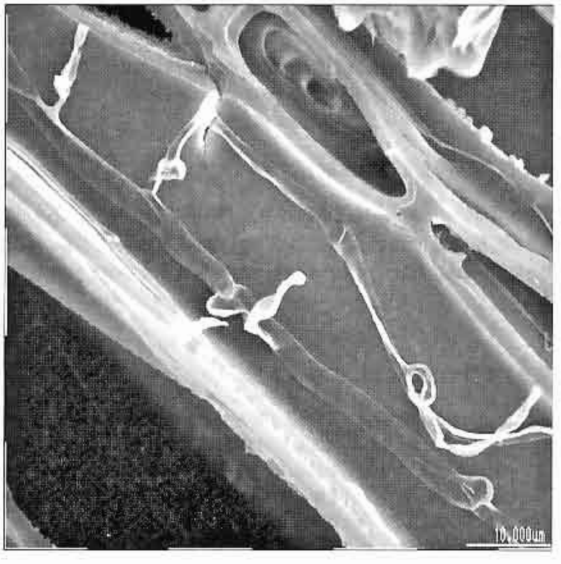

Fig. 3. *S. lacrymans* hyphae inside the wood cell lumen (SEM).

S. lacrymans produces two morphologically and physiologically different types of mycelium: one has the potential to produce strands and the other to transform into fruiting body. Environmental conditions, especially humidity, play a major part in the triggering of the initiation, although the genetic basis also may affect the differentiation (Jennings and Bravery, 1991). Fruiting bodies found during our inspections were up to 2 cm thick, resupinate to the substrate. In the fruiting bodies typical L-shaped skeletoid hyphae were found (Fig. 4).

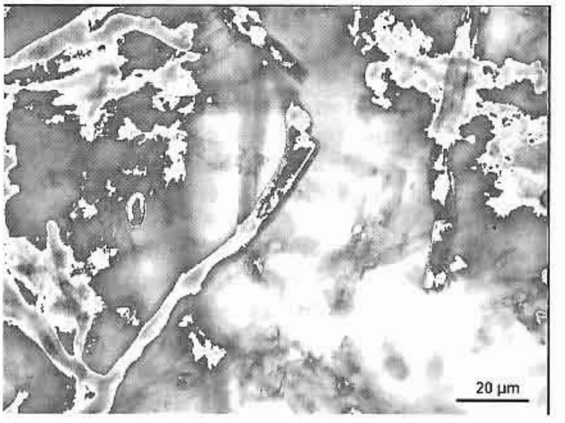

Fig. 4. L-shaped hyphae characteristic to the dry rot fungus (LM).

The surface of hymenium was folded, reddish yellow because of spores, with a white margin in periphery. Basidiospores were smooth, bean-shaped, usually with granulose contents, 9–10 μm in length and 4.5–6 μm in breadth (Fig. 4). Despite the opinion that only 30% of spores germinate, this circumstance by no means affects the dry rot spreading, since the fruiting bodies form billions of spores.

Occurrence in houses

In a short period of time, the fungus degrades a whole range of cellulose-containing materials such as wood, paper, particleboards, insulation materials and textiles. Usually, conifers are degraded, although the fungus infects hardwood species, too. The high predominance is probably determined by a wider aplication of conifers in construction. Our experience showed that, in 1–2 years, the fungus is capable of destroying fully the available nutrition materials. Most often damages occurred in floorings, doorposts or wooden walls under the plaster. Characteristic cases in our practice, which had favoured the dry rot infection were: unproper masonry construction around wood constructions; new annexes to old houses; a high ground water level; infested firewood in damp premises;

application of infested building materials; unproper interior finishing materials; water accumulation outside the building, e.g. damaged drainpipes or overflown water-storage reservoirs; long-term accumulation of water, e.g. in kitchens, bath-rooms, WC; flooding of premises, e.g. damaged sewage system or overflown water-storage basins (rivers); floor boards directly on the ground; damp cellars; water-pipes installed in long-standing houses; leaking roofs; fire eliminating consequences.

As can be seen from the above mentioned, in the majority of cases, improvements were made that worsened ventilation or promoted moisture accumulation in the premises. As a result, a favorable microclimate for the development of fungus was created.

The special economic significance of the fungus in contrast to other house fungi is determined not only by the capability of infesting relatively dry wood, but rather the rapid spreading from one construction site to another *via* inert materials such as masonry (Schmidt and Moreth-Kebernik, 1990). The objects examined by us testified that the fungus always was found in the vicinity of the calcium source – on the masonry, plaster, concrete or ground. Apart from the temperature and humidity, the calcium is considered to be an essential factor for a successful destructive activity of dry rot. Calcium is necessary for the neutralization of the oxalic acid released by the fungus (Bech-Anderson, 1995). Several cases examined by Bech-Anderson (1985) have showed, that the fungus was always found near a source of moisture and alkaline building materials, such as mortar, clay, concrete at a distance of 14–100 cm. Another problem is the unproperly performed repair of the premise, which can cause the re-occurrence of the fungus in the building. In our practice, there is a case when the owners of a house have replaced the floor 5 times, and then applied to us for assistance.

Almost in all cases, the buildings attacked by the dry rot have been the private ones. The houses were built mainly in the first half of this century. In the newer ones the fungal occurrence was rare, certainly if appropriate construction standards were met.

For a long period of time, the majority of buildings in Latvia have been the state property, which was characterized by their poor maintenance. Recently, as a result of political and economic changes in the state, there is a growing tendency to get back the properties. As a result, the reconstruction of old buildings becomes very simple and often nonprofessional. At the same time, many buildings are abandoned, while others are not maintained properly. The above factors often cause the dry rot infestation.

We can conclude that the occurrence of dry rot in Latvia's buildings is high, although the correct number of cases is not estimated as well as information on occurrence in other districts of country is not complete.

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Taxonomy and ecology of the species of the *Tricholoma equestre* group in the Nordic and Baltic countries

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Abstract: On the basis of basidiospore measurements, the macromorphological features of basidiomes, and the ecology of taxons in the *Tricholoma equestre* group in the Nordic and Baltic countries, two new species, *T. frondosae* Kalamees & Shtshukin sp. nova, and *T. ulvinenii* Kalamees sp. nova, are described, and *T. equestre* (L.: Fr.) P. Kumm. s.str. is discussed. For the latter species a neotype is suggested.

Kokkuvõte: K. Kalamees. *Tricholoma equestre* rühma liikide taksonoomia ja ökoloogia Põhjamaades ja Baltimaades.

Kandeoste mõõtmete, viljakehade makromorfoloogiliste tunnuste ja taksonite ökoloogia alusel kirjeldatakse *Tricholoma equestre* rühmas Põhjamaade ja Baltimaade materjali põhjal kaks teadusele uut liiki – *T. frondosae* Kalamees & Shtshukin sp. nova ja *T. ulvinenii* Kalamees sp. nova. Uues, kitsamas mahus käsitletakse liiki *T. equestre* (L.: Fr.) P. Kumm. s.str., viimase jaoks püstitatakse neotüüp.

INTRODUCTION

Taxonomic problems related to the "*Tricholoma equestre* group" have remained a matter of debate for agaricologists in Europe (cf. Korhonen & Kytövuori, 1998; Christensen & Noordeloos, 1999; Galli, 1999; Noordeloos & Christensen, 1999). The taxons of this group are macromorphologically quite similar and have a very wide ecological range – they are growing in coniferous, deciduous and mixed forests on sandy, humus-rich, calcareous and swampy soils.

In classical literature this group comprises four different taxons:

(1) *Agaricus equestris* L. 1753: Fr. 1828. Linné's fungus is growing in meadows and forests (Linné, 1753). In Fries (1828) no sites are presented. In his later works (cf. Fries, 1838, 1857, 1874) the presented sites are pine forests, especially on sandy soils. Fries characterized this species as a fleshy compact fungus with a thick stem.

(2) *Agaricus equestris* ssp. *pinastreti* Alb. & Schwein. This taxon is presented by Fries (1838) as a subspecies, but identified by him later as the variety *A. equestris* var. *pinastreti* (cf. Fries, 1857, 1874). The sites presented by Fries are also pine forests. Macromorphologically, this taxon is characterized by Fries as having more slender and fewer fleshy basidiomes compared with *Agaricus equestris*.

(3) *Agaricus flavovirens* Pers. 1801: Fr. 1821. Both Persoon (1801) and Fries (1821) characterize this species as a fleshy compact fungus with a thick stipe. According to Persoon, it is growing in pine and beech forests, while according to Fries, it occurs in dry pine forests. As a synonym of *A. flavovirens*, Fries (1821) refers to *A. equestris*. In his later works (1838, 1857, 1874) Fries himself presents this fungus under the name *A. equestris* and indicates *A. flavovirens* as its synonym.

(4) *Agaricus auratus* Fries 1838. This is a compact fleshy mushroom with a solid thick stipe, which is growing in pine forests (Fries, 1838), particularly on sandy coasts (Fries, 1874).

By the present time, the first three (or even all four) taxons have been synonymized by most investigators and grouped, according to the international code of botanical nomenclature (cf. Greuter et al., 2000), under the official name *Tricholoma equestre* (L.: Fr.) P. Kumm. (s.l.). Only *Agaricus auratus* is interpreted by several authors today as the independent species *T. auratum* (Fr.) Gill. One of the fungal taxons in the "*T. equestre* group", characteristic of deciduous and mixed forests on humus-rich fresh, moist and wet soils, often with poplars (*Populus* spp.), was named *Tricholoma frondosum* Kalamees & Shtshukin nom. prov., ined. (cf. Korhonen & Kytövuori, 1998; Galli, 1999) but is now described by Christensen & Noordeloos (1999) as the variety *T. equestre* var. *populinum* M. Christensen & Noordel.

The goal of this study was to attempt to solve the taxonomic problems, related to "*T. equestre* group", proceeding from basidiospore measurements, character of sites and the macromorphological features of basidiomes on the basis of materials from Northern Europe (Finland, Sweden, Norway, Denmark, Russia: Murmansk distr.) and the Baltic region (Estonia, Latvia, Lithuania, Russia: Leningrad distr.).

MATERIAL AND METHODS

A total of 111 specimens of *T. frondosae*, 14 specimens of *T. ulvinenii* and 87 specimens of *Tricholoma equestre* s. str. from the fungal collections of Estonia (TAA), Lithuania (BILAS), Finland (H, KUO, OULU), Denmark (C), Sweden (S) and Russia (LE) served as the study material.

Microscopic investigations were carried out using the microscope SWIFT M4000-D. Basidiospores were studied at immersion magnification 1000x; pileipellis, hymenophoral trama and basidia were studied at magnification 600x; preparations were studied in 3% KOH.

Spore measurements were analyzed on the basis of the arithmetic means of spore length and width and the quotient (Q) of spore length by spore width for 20 spores in a single specimen.

RESULTS

Observation of habitats in the forest and analysis of ecological data in the case of herbarium specimens, combined with study of the micro- and macromorphological characteristics of basidiospores, allow to distinguish two essentially different groups of taxa in the *Tricholoma equestre* group: (I) fungi growing on dry sandy and rocky ground in oligotrophic and oligo-mesotrophic boreal coniferous and mixed forests with pine (*Cladina, Calluna, Vaccinium vitis-idaea* and *Vaccinium myrtillus* site types) as well as in forest-tundra and forming their mycorrhiza probably with pine (*Pinus sylvestris*); (II) fungi growing on humus-rich fresh, moist and wet as well as on calcareous ground in mesotrophic, meso-eutrophic and eutrophic (*Hepatica, Aegopodium, Oxalis*, alvar site types) as well as on paludifying and drained peatland deciduous, mixed and *Picea*-dominated coniferous forests, forming their mycorrhiza most likely with deciduous trees (*Betula pendula, B. pubescens, Populus tremula, Alnus incana, A. glutinosa, Quercus robur*) but also with spruce (*Picea abies*).

The species characteristics of these fungal groups are the following: (I) 1) *Tricholoma equestre* s.str. with mean basidiospore measurements falling in range of (6.3–)6.8–7.6(8.2) x (3.6–)4.2–4.7(–5.1) µm; 2) *Tricholoma ulvinenii* with mean basidiospore measurements falling in the range of (6.1–)6.2–6.8(–6.9) x 4.3–4.8(–4.9) µm; (II) *Tricholoma frondosae* with mean basidiospore measurements falling in the range of (4.9–)5.0–5.9(–6.2) x (3.2–)3.4–4.0(–4.2) µm (Fig. 1).

Tricholoma frondosae Kalamees & Shtshukin sp. nova

Figs. 1 & 2

(*T. auratum* ss.auct. pl. p.p.; *T. equestre* ss. auct. pl. p.p.; *T. equestre* var. *populinum* M. Christensen & Noordel.; *T. flavovirens* ss. auct. pl. p.p. non ss. Bon; *T. frondosum* nom. prov. K. Kalamees & G. Shtshukin, ined.).

Icon.: Riva (1988), tab. 47c (as *T. equestre*); Korhonen & Kytövuori (1998), Sienilehti 50 (1), cover picture; Galli (1999) 167 (as *T. equestre*).

Pileus 3–12 cm latus, late campanulatus dein convexo-expansus, in centro late et humile umbonatus, concentrice tenuiter fusco-squamulosus, parse radialiter fibrillosus, mucosus, vive chromo-flavus, in centro griseofuscus. Lamellae sinuatae, angustae, densae, acriter sulfureae. Stipes 5–15 cm longus, 1–3 cm crassus, glaber, siccus, cylindraceus, clare sulfureus. Caro alba. Odor et sapor farinacei, sapor mitis. Sporae ellipsoideae, laevigatae, inamyloideae, hyalinae, in cumulo albae, (4.6–)4.8–6.4(–7.2) x (3.0–)3.2–4.0(–4.6) µm. Hyphae afibulatae. Hymenocystidia nulla. In silvis frondosis, mixtis et coniferis, sub Betula spp. Populus spp., Alnus spp., Quercus robur, Picea abies), autumnalis. Holotypus: Estonia, Võrumaa Co., Pähni, in populeto-betuleto aegopodioso, 5.9.1985, K. Kalamees et M. Vaasma legunt (TAA 124177).

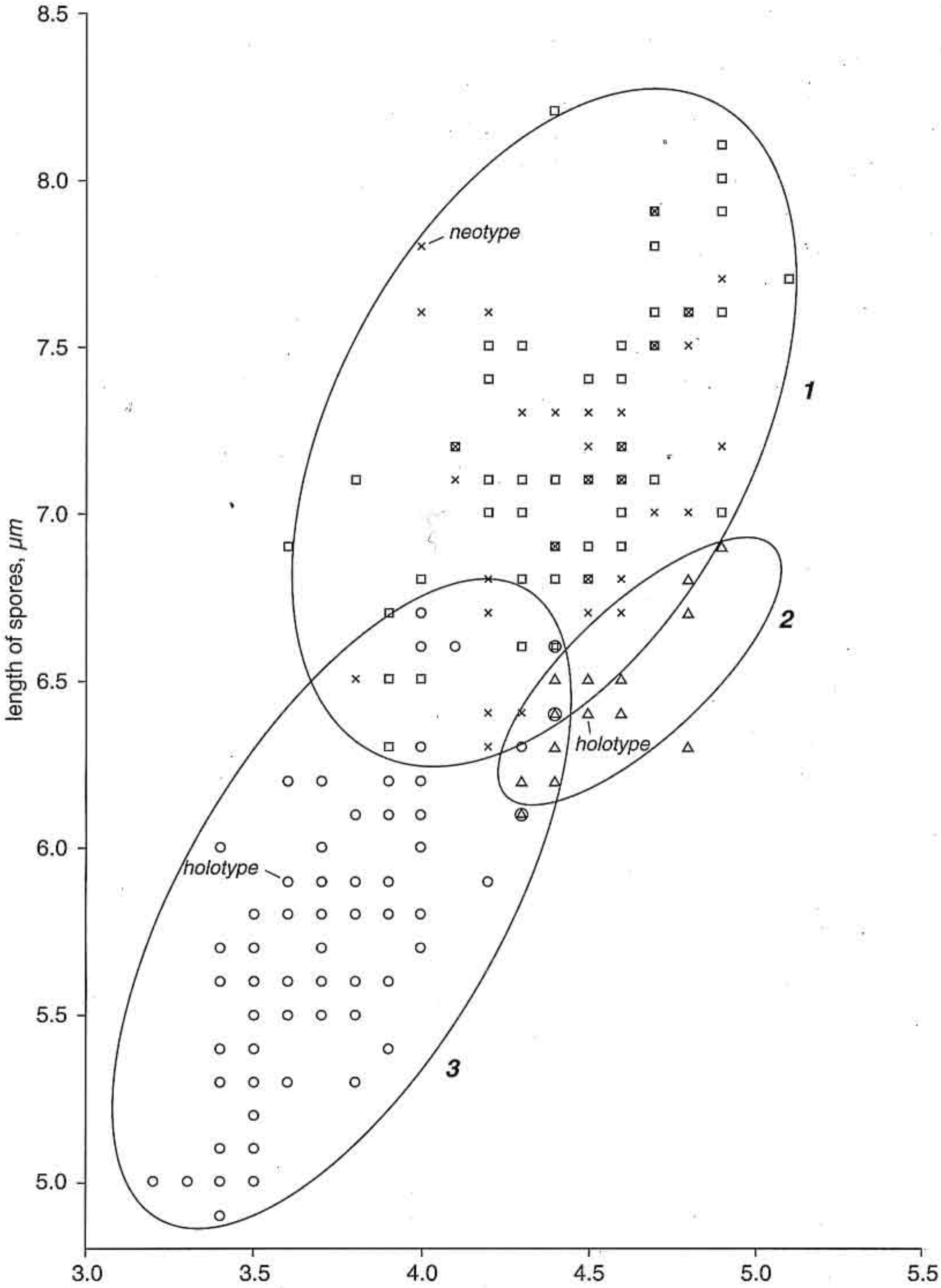

Fig. 1. Mean spore size of *Tricholoma equestre* s.str. (*T. flavovirens*) (□) and *T. auratum* (x) (spore cluster 1), *T. ulvinenii* (△) (spore cluster 2) and *T. frondosae* (O) (spore cluster 3).

Pileus (3–)6–12 cm, broadly campanulate when young, plano-convex to plane with obtuse umbo with age; margin slightly incurved and felty at first, becoming lobed and flexuous with age; fine, often concentric brown or greyish olivaceous scales all over or up to two-thirds from centre; mostly slightly radial by fibrillose; glutinous or viscid; bright chrome, sulphureous or olivaceous yellow at margin, with "warm" tint; greyish brown, sometimes with slightly reddish shade on disc. Lamellae narrow, crowded (L = 170, l = 390), deeply emarginate with decurrent tooth, bright sulphureous yellow. Stipe 5–10(–15) x 0.8–2(–3) cm, tall and relatively thick, cylindric to slightly thickening downwards, sometimes rooting, often curved, fibrillose, glabrous or minutely brown scaly below, dry, light to bright sulphureous yellow. Context pure white, strongly fibrillose in stem. Smell and taste strongly farinaceous, taste mild. Spore print white.

Spores (4.6–)4.8–6.4(–7.2) x (3.0–)3.2–4.0(–4.6) µm, mean spore size 5.73 x 3.75 µm, mean Q value1.54; ellipsoid, thin-walled, acyanophilic, inamyloid, smooth, hyaline (Fig. 2). Basidia 24–33 x 5–6.5 µm, slender, subcylindric, 4-spored. Cheilo- and pleurocystidia absent. Pileipellis a cutis, hyphae 3.5–5 µm diam., of hyaline, thin-walled, non or hardly incrusted cylindric cells. Pileus trama interwoven, hyphae as in hymenophoral trama. Hymenophoral trama regular, hyphae (3.5–)6.5–15(–34) µm in diam., of hyaline, thin-walled, non-incrusted, cylindric to slightly inflated cells (Fig. 2). Clamps absent.

Habitat and distribution. In deciduous, mixed and *Picea*-dominated coniferous forests in the vicinity of *Betula pendula, B. pubescens, Populus tremula, Alnus incana, A. glutinosa, Quercus robur* and *Picea abies*, on humus-rich fresh, humid, moist and calcareous ground, at *Hepatica, Aegopodium, Oxalis,* alvar and paludifying sites. Common in the Nordic and Baltic countries: Denmark, Sweden, Finland, Russia (Leningrad Distr.), Estonia, Latvia, Lithuania. August to October.

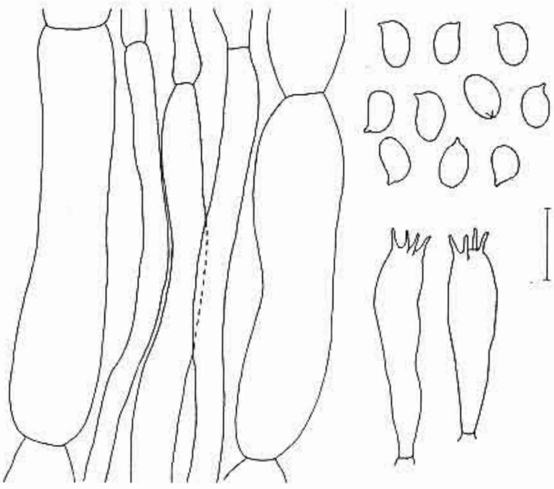

Fig. 2. *Tricholoma frondosae*: basidiospores, basidia and hyphae of hymenophoral trama. Bar = 10 µm.

Material examined. **Denmark:** E-Jylland: Flojstrup Skov, 1986, J. Vesterholt, JV 86621 (C); Klattnepp, 25.9.1986, J. Vesterholt JV86-769 (C, as *T. flavovirens*); Porsbakkerne ved Auning, 26.9.1994, M. Christensen MC94-048 (C, as *T. flavovirens*); Svampedamvej, Femmøller, 1995, C. Brandt & M. Christensen MC95-179 (C, as *T. frondosum*). **Estonia:** Järvamaa Co.: Neeruti, 7.9.1962, K. Kalamees (TAA 73310, as *T. flavovirens*): Hiiumaa Co.: Mäeselja, Põdrapao, 8.10. 1994, K. Kalamees (TAA 146316, 146318, as *T. frondosum* ined.); Läänemaa Co.: Island of Vormsi, Förby, 19.9.1986, K. Kalamees (TAA 143370, as *T. auratum*); same island, between Hullo and Borrby, 22.9.1986, K. Kalamees (TAA 143507, as *T.* sp.). Lääne-Virumaa Co.: Vaeküla-Liiva, 11.9.1963, K. Kalamees (TAA 74743, as *T. flavovirens*). Pärnumaa Co.: Kaubaaru, Nigula Nature Reserve, 19.9.1982, K. Kalamees (TAA 122523, as *T. flavovirens*). Raplamaa Co.: Märjamaa forestry, Virita, 23.9.1994, K. Kalamees & I. Saar (TAA 146369a, as *T. frondosum* ined.). Saaremaa Co.: Viidumägi Nature Reserve, Audaku, 17.8.1984, M. Reitalu (TAA 123631, as *T.* sp.); island of Abruka, 14.9.1993, I. Kytövuori 931184 (H, as *T. flavovirens*); Mustjala, Võhma, 16.9.1993, I. Kytövuori 931323 (H, as *T.* cf. *auratum*). Valgamaa Co.: Lüllemäe, 8.9.1986, S. Veldre (TAA 143278, as *Tricholoma frondosum* ined.). Tartumaa Co.: Kurista, Mõisamaa, 6.9.1960, 24.9.1960, K. Kalamees (TAA 71740, 71870, as *T. flavovirens*); Märja, 15.8.1998, A. Kollom (TAA 128128, as *T. frondosum* ined.). Võrumaa Co.: Pähni, 5.9.1985, K. Kalamees

& M. Vaasma (TAA 124177, holotype; as *Tricholoma flavum* ined.). **Finland:** Åland (Ahvenanmaa): Jomala, Ytterby, Jomalön, 11.9.1991, K. Kalamees (TAA 145081, 145082, as *Tricholoma frondosum* ined.); Sund, Lövvikberget, 28.8.1984, J. Vauras 1733F (KUO 0014875, as *T.* cf. *auratum*); Sund, Strömsang, 12.9.1991, K. Kalamees (TAA 145100, as *T. frondosum* ined.). Etelä-Häme: Heinola, Tähtiniemi, Apajalahti, 25.8.1984, V. Haikonen 4837 (H, as *T. auratum*?); Kärkölä, 11.9.1985, V. Haikonen 6332 (H, as *T.* cf. "*flavovirens*"). Etelä-Pohjanmaa: Kurikka, Myllykylä, 27.8.1983, I. Kytövuori 83068 (H, as *T.* cf. *flavovirens*). Etelä-Savo: Mäntyharju Comm., Karnkamäki, between Lahti and Kurkivuori, 29.9.1994, I. Kytövuori 941082 (H, as *T.* cf. *auratum*). Kainuu: Sippola, Ruotila, 26.8.1952, V. Kujala (H, as *T. equestre*); Paltamo, Kivesjärvi, 26.9.1979, E. Ohenoja (OULU, as *T. flavovirens*); Paltamo, N of Oikarila, Hautala, 10.9.1983, I. Kytövuori 83288 (H, as *T. flavovirens*); Luopiainen, Kuohijoki, SW of Kipparinlahti, Kytöniitty, 9.9.1984, I. Kytövuori 84449 (H, as *T. flavovirens*); Savonlinna town, Haapalahti, Pyörissalo, Pyörismäki, 25.8.1987, I. Kytövuori 87668 (H, as *T.* cf. *auratum*) Keski-Pohjanmaa: Alajärvi Comm., Ukonmäki, 4.9.1990, I. Kytövuori 901194 (H, as *T. flavovirens*). Perä-Pohjanmaa: Tervola Comm., Peura, Hosionlampi, Pukinselkä, 5.9.1992, I. Kytövuori 921756 (H, as *T.* cf. *auratum*?). Pohjois-Häme: Virrat, Hauhuu, Hauhuunvesi, 16.9.1979, I. Kytövuori 79823 (H, As *T. auratum*). Pohjois-Karjala: Juankoski Comm., Säyneinen, Ala-Siikajärvi, Huosiaisniemi, 8.9.1988, I.Kytövuori 881518 (H, as *T.* cf. *flavovirens*); Outukumpu Kiimamäki, 27.8.1989, M. Kirsi 280 (H, as *T. flavovirens*). Pohjois-Savo: Siilinjärvi, Toivala, 26.8.1977, J. Vauras 187 (KUO 0014319, as *T. flavovirens*); Maaninka, Vianta, Viannan kanava, 9.9.1983, I. Kytövuori 83250 (H, as *T. flavovirens*); Joroinen, Maavesi, Italiankylä, 31.8.1985, I. Kytövuori 85589 (H, as *T. flavovirens*); Kuopio, Pitkälahti, 2.9.1987, I. Kytövuori 87985 (H, as *T.* cf. *auratum*). Sompion Lappi: Pelkosenniemi Comm., Savukoski, Nivantunturi, 28.8.1992, I. Kytövuori 921200 (H, as *T.* cf. *auratum*). Uusimaa: Helsinki, Vuosaari, 11.9.1966, T. Ahti 22941 (H, as *T.* cf. *flavovirens*); Helsinki, Vanhakaupunki, Annala, 31.7.1973, 23.9.1975, R. Saarenoksa 06375 & 27379 (H, as *T.* cf. *flavovirens*); Helsinki, Kumpula-Toukola, 27.8.1977, 2.8.1979, 14.8.1987, R. Saarenoksa 20377, 28879 & 14878, (H, as *T.* cf. *flavovirens*); Nurmijärvi, Uotila, Raivon talo, 27.8.1977, P. Askola 211b (H, as *T. flavovirens*); Nurmijärvi, Röykkä, 7.10.1979, R. Tuomikoski (H, as *T. flavovirens*?); Artjärvi, Ratula, 29.8.1981, V. Haikonen 1663b & 1669 (H, as *T. flavovirens*); Espoo, Nuuksio, 7.10.1978, M. Härkönen (H, as *T. flavovirens*?); Espoo, Perinki, Järpbacke, 22.9.1981, M. Korhonen 4263 (H, as *T. flavovirens*); Vantaa, Mustavuori, 18.9.1983, R. Saarenoksa 40283 (H, as *T. flavovirens*); Vantaa, Westersundom, 7.9.1987, I. Kytövuori 871229 (H, as *T. flavovirens*); Vantaa, Pitkäkoski, 6.9. 1993, I. Kytövuori 93755(H, as *T. flavovirens*); Sipoo, Hindsby, 8.9.1985, R. Saarenoksa 35685 (H, as *T. flavovirens*); Nurmijärvi, 18.9.1985, P. Askola 1797 (H, as *T. flavovirens*); Porvoo rural Comm., Ilola, 13.9.1989, I. Kytövuori 89691 (H, as *T. flavovirens*); Kirkkonummi, Änguslandet, 11.10.1979, I. Kytövuori 791076 (H, as *T. flavovirens*); Kirkkonummi Comm., Vols, Nydalsviken, 19.9.1989, P. Kytövuori (H, as *T. flavovirens*); Lapinjärvi Comm., S share of the lake of Lapinjärvi, 14.9.1989, I. Kytövuori 89739 (H, as *T. flavovirens*); Rutsinpyhtää (Strömfors) Comm., island of Vahterpää, Jomalsundet-Sotarviken, 18.9.1989, I. Kytövuori 891027 (H, as *T. flavovirens*); same Comm., Kulla, Mustamäki-Smalkärret, 10.10.1992, I. Kytövuori 922976 (H, as *T.* cf. *flavovirens*); Tuusula, Ruotsinkylä, Metsäkylä, 4.9.1988, T. Ahti 47494 (H, as *T. flavovirens*); Hanko, Lappohja, road to Tenhola, Näset, between Näsiträsket and Stagsundet, 4.10.1992, I. Kytövuori 922958 (H, as *T.* cf. *flavovirens*); Kirkkonummi Co., Danskarby, 23.9.1993, I. Kytövuori 931486 (H, as *T. flavovirens*). Varsinais-Suomi: Tenhola, Bromarv, Solböle, 20.8.1977, 3.10.1977, M. Korhonen & R. Tuomikoski 2083 (H, as *T. flavovirens*?); Vihti, Vihtijärvi, 14.8.1979, M. Korhonen & R. Tuomikoski 2787 (H, as *T, flavovirens*); Karjalohja, Karkali, 28.9.1979, I. Kytövuori 79956 (H, as *T. flavovirens*); Kisko, Toija, Kelleri-Nikula, 2.10.1980, I. Kytövuori 801303 (H, as *T. flavovirens*); Paimio, Huso, Kalkkimäki, 6.10.1985, I. Kytövuori 851533 (H, as *T. flavovirens*); Naantali town, Ruona, E part of Maijamäki, 10.9.1987, I. Kytövuori 871237

(H, as *T. flavovirens*); Halikko Comm., Viurila, Vuorentaka, Vaisakko, 11.9.1988, I. Kytövuori 881636 (H, as *T. flavovirens*); same Comm., Märy, Tavola, 7.9.1990, I. Kytövuori 901246 (H, as *T. flavovirens*); Perniö Comm., Yliskylä, Ristinkulma, 29.8.1990, I. Kytövuori 90786 (H, as *T.* cf. *flavovirens*); Suomusjärvi Comm., Kiikala, Salmijärvi, 17.9.1990, I. Kytövuori 901737 (H, as *T.* cf. *auratum*); Parainen Comm., Ålön, Petteby, Lillnäset, 28.9.1990, I. Kytövuori 902121 (H, as *T. flavovirens*); same locality, 28.9.1990, I. Kytövuori 902123 (H, as *T.* cf. *auratum*?); Kemiö Comm., Pedersâ, 21.9.1990, I. Kytövuori 901772 (H, as *T.* cf. *flavovirens*); Dragsfjärd Comm., Ekhamn, NW end of Purunpääviken, 22.9.1990, I. Kytövuori 901859 (H, as *T.* cf. *flavovirens*); Särkisalo Comm., Nixor (Niksaari), 23.9.1990, I. Kytövuori 901954 (H, as *T.* cf. *flavovirens*); Hiittinen Comm., Högsåra, 28.9.1990, I. Kytövuori 902080 (H, as *T. flavovirens*); Lohja rural Comm., Torhola, Torholanluola, 24.9.1992, I. Kytövuori 922766 (H, as *T.* cf. *flavovirens*). **Latvia:** Madona Distr.: Krustkalne Nature Reserve, 14.9.1985, K. Kalamees (TAA 124282, as *Tricholoma flavum* ined.). **Lithuania:** Alytus Distr.: Alytus, 13.9.1954, J. Mazelaitis (BILAS 1370, as *T. equestre*). Kaišiadoriai Distr.: Gegu□inës ap., 24.8.1965, J. Mazelaitis (BILAS 9022, as *T. flavovirens*). Moletai Distr.: Avilèiai, 24.9.1965, V. Urbonas (BILAS 8744, as *T. flavovirens*). Neringa Distr.: Kuršiuneria, Pervalka, 7.9.1970, V. Urbonas (BILAS 11558, as *T. flavovirens*). Vilnius Distr.: □alieji E□erai, 7.9.1950, J. Mazelaitis (BILAS 1363, as *T. equestre*). **Russia:** Leningrad Distr.: Otradnoje, 13.9.1986, K. Kalamees (TAA 143329, as *T.* sp.); same locality, 15.9.1986, S. Veldre (TAA 143357, as *T.* sp.). **Sweden:** Västmanland: Norberg Comm., Norberg Parish, Klackberg, 12.9.1987, I. Kytövuori 871301 (H, as *T. flavovirens*). Dalsland: Mellerud Comm., Skallerud Parish, Svansfjorden, the Ryr Peninsula, Rälnäbbe and Rönninge, 11.9.1990, I.. Kytövuori 901385 (H, as *T. flavovirens*); same Comm. and Parish, between Edet and Svankilaviken, 13.9.1990, I. Kytövuori 901544 (H, as *T.* cf. *flavovirens*); Bengtsfors Comm., Tisselskog Parish, Dackehöhen, 14.9.1990, I. Kytövuori 901591 (H, as *T.* cf. *flavovirens*). Medelpad: Lombäcken-Harran, 11.9.1995, P. Kytövuori (TAA 146634, as *T. frondosum* ined.); Borgsjöbyn, Bergåsen, 13.9.1995, P. & I. Kytövuori 951246, 951247 (H, as *T. flavovirens* & as *T.* cf. *auratum*); same locality, 13.9.1995, P. Kytövuori (TAA 146659, as *T. frondosum* ined.); Borgsjö, 15.9.1995, 16.9.1995, K. Kalamees (TAA 146801, 146703, as *T. frondosum* ined.). Närke: Tysslinge Comm., Tysslinge Parish, near the road from Egersta to Latorp, 13.9.1987, I. Kytövuori 871340 (H, as *T. flavovirens*); same locality, 10.9.1990, I. Kytövuori 901339 (H, as *T. flavovirens*); Örebro Comm., Hidinge Parish, NW of Tovetorp, Garphyttan National Park, 15.9.1990, I. Kytövuori 901653 , (H, as *T.* cf. *flavovirens*), I. Kytövuori 901654 (H, as *T.* cf. *auratum*); same Comm. and Parish, NW of Latorp, Ingelsgard, 16.9.1990, I. Kytövuori 901676 (H, as *T.* cf. *flavovirens*). Uppland: Häverö Comm., E of Häverödal, 25.8.1979, I. Kytövuori 79629 (H, as *T. flavovirens*). Östergötland: Ödenshög Comm., V.Tollstad Parish, Omberg, 15.10.1994, P.& I. Kytövuori 941348 (H, as *T. flavovirens*).

Notes. *Tricholoma frondosae* is characterized by "warm" tinged bright chrome to sulphureous yellow basidiomes, fine brown concentric scales on pileus, pure white context, and short and relatively broad spores (Figs. 1 & 2) as well as by habitats with deciduous trees and *Picea abies* on humus-rich fresh, humid, moist and paludified as well as on calcareous soils. The species is associated with *T. equestre* (L.: Fr.) P. Kumm. s.str. It differs from *T. frondosae* in "cold" tinged lemon-yellow basidiomes, usually non-concentric scales on pileus, longer, more slender cells of hyphae of hymenophoral trama, and bigger, more slender spores (Figs.1 & 4) as well as in that it grows at dry sandy and rocky sites with pines.

TRICHOLOMA ULVINENII Kalamees sp. nova

Figs. 1 & 3

(*T. auratum* ss. auct.; *T. equestre* ss. auct.; *T. flavovirens* ss. auct.; *T. citrinum* nom. prov. T. Ulvinen, ined.).

Icon.: Korhonen & Kytövuori (1998) Sienilehti 50 (1), kuva 2.

Pileus 5–10 cm latus, plano-convexus dein applanatus, non umbonatus, mucosus, glaber, pallide citrinus, in centro saepe subbrunnescens, tenuiter squamulosus. Lamellae sinuatae, latae, e albido-flavo ad pallide citrino. Stipes 8–10 cm lon-

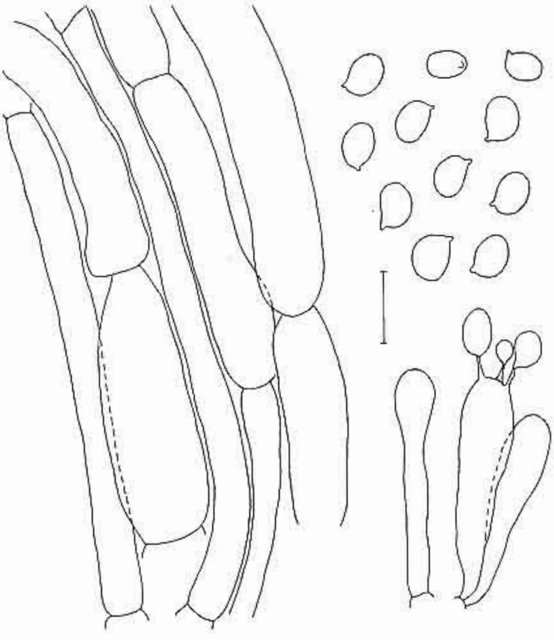

Fig. 3. *Tricholoma ulvinenii*: basidiospores, basidia and hyphae of hymenophoral trama. Bar = 10 µm.

gus, 0.8–1.5 cm crassus, glaber, siccus, cylindraceus vel deorsum parse incrassatus, e subalbo ad albido-citrino. Caro alba. Odor et sapor farinacei, sapor mitis. Sporae late ellipsoideae, laevigatae, inamyloideae, hyalinae, in cumulo albae, 5.6–7.2(–8.0) x (3.7–)4–5.3 µm. Hyphae afibulatae. Hymenocystidia nulla.In pinetis arenosis, autumnalis. Holotypus: Finland, Koillismaa, Posio, Livojärvi; in pineto arenoso; 20.9.1981, leg. T. Ulvinen (OULU). *Isotypus*: TAA 122081.

Etymology: Dr. Tauno Ulvinen, Finnish botanist and mycologist.

Pileus 5–10 cm, plano-convex to plane, not umbonate, glutinous to viscid, shiny, smooth, either glabrous or mostly with fine scanty scales at the centre, pale to light pure yellow or pale lemon-yellow, often tinged slightly greyish, brownish or reddish on disc. Lamellae rather broad (up to 1 cm), deeply emarginate with decurrent tooth, whitish-yellow, pale to light pure yellow or pale lemon-yellow, becoming slightly brownish with age. Stipe (4–)8–10 x 0.8–1.5 cm, tall and relatively slender, cylindric to slightly thickening downwards, more rarely with conically swollen base (up to 3.5 cm), smooth and glabrous, dry, concolorous with lamellae, or mostly lighter, often nearly white, sometimes tinged slightly reddish at base. Context pure white but mostly narrowly (1–2 mm) pale yellow to slightly lemon yellow under pileus and stipe cuticle, at least at the centre of pileus. Smell and taste slightly or strongly farinaceous, taste mild. Spore print white.

Spores 5.6–7.2(–8.0) x (3.7–)4–5.3 µm, mean spore size 6.47 x 4.56 µm, mean Q value 1.41; broad-ellipsoid, thin-walled, acyanophilic, inamyloid, smooth, hyaline (Fig. 3). Basidia 22–37 x 5.5–6.5 µm, slender, subcylindric, to slightly clavate, 4-spored. Cheilo- and pleurocystidia absent. Pileipellis a cutis; hyphae 3.5–6.5 µm in diam., of hyaline, thin-walled, non or hardly incrusted cylindric cells. Pileus trama interwoven; hyphae as in hymenophoral trama. Hymenophoral trama regular; hyphae (5–)8–17(–20) µm in diam., of hyaline, thin-walled, non-incrusted, cylindric to slightly inflated cells (Fig. 3). Clamps absent.

Habitat and distribution. On sandy soils in dry pine and pine dominated boreal heath forests (*Cladonia, Calluna* and *Vaccinium vitis-idaea* site types), not common in Finland (only 8 localities); very rare on fresher sandy soil in pine dominated coniferous forest (*Vaccinium myrtillus* site type) in Estonia (1 locality). In September and October.

Material examined. Finland: Koillismaa: Posio, Livojärvi, 23.9.1979, T. Ulvinen (OULU, as *T. flavovirens* s.l.); Posio, Livojärvi, 20.9.1981, T. Ulvinen (OULU, as *T. citrinum*; holotype); Salla, 26.9.1980, T. Ulvinen (OULU); Oulanka, 9.9.1981, K. Kalamees, E. Ohenoja & T. Ulvinen (TAA 122081, as *T. citrinum* ined.); Pudasjärvi, 12.10.1981, E. Ohenoja (OULU). Oulun Pohjanmaa: Oulu, 6.10.1982, T. Ulvinen (OULU); Kolari, 9.9.1983, T. Ulvinen (OULU); same locality, 11.9.1983, T. Ulvinen (OULU); same locality, 14.9.1983, T. Ulvinen (OULU). Perä-Pohjanmaa: Kemi, 29.9.1979, T.Ulvinen (OULU, as *T. citrinum* ined.). Kittilän Lappi: Kittilä Comm., Vesmajärvi, 1.9.1988, I. Kytövuori 881151 (H, as *T.* cf. *auratum*); Kittilä, 13.9.83., T. Ulvinen (OULU). Uusimaa: Hanko, Krogars, 3.10.1990, M. Korhonen 10045 (H, as *T.* cf. *equestre*). **Estonia:** Saaremaa Co.: Pammana, Oct.1966, K. Kalamees (TAA 76632, as *T.* sp.).

Notes. *Tricholoma ulvinenii* is characterized by very pale lemon-yellow basidiomes and small, relatively broad spores (Figs. 1 & 3) and by very dry sandy site types in boreal heath pine forests. The species is associated with *T. equestre* (L.: Fr.) P. Kumm. s.str. The latter species differs from *T. ulvinenii* in bright to dark lemon-yellow basidiomes, longer, more slender cells of hyphae of hymenophoral trama and bigger, more slender spores (Figs. 1 & 4).

Tricholoma equestre **(L.: Fr.) P. Kumm. s.str.**

Figs. 1 & 4

(*T. arenarium* (Lev.) Gill.; *T. auratum* (Fr.) Gillet; *T. equestre* ssp. *pinastreti* Alb. & Schwein.; ?*T. equestre* var. *equestre* ss. M. Christensen & Noordel.; *T. flavovirens* (Pers.: Fr.) Lundell ss. auct. pl. p.p. non ss. Bon).

Icon.: Riva (1988) tab. 45, 45b; Korhonen & Kytövuori (1998) kuva 1; Galli (1999) 165, 166.

Type specimen (neotype, designated here): Småland: Femsjö, 18.07.1948, G. Hagel & S. Lundqvist (S).

Pileus 4–13(–18) cm, convex to broadly campanulate when young, turning convex-plane to plane with age, often with low and broad umbo; margin slightly incurved and felty at first, becoming lobed and flexuous with age, sometimes fissured; finely brown scaly at least at the centre but often evenly all over (not concentric), glutinous to viscid; olivaceous, sulphureous to golden yellow, with "cold" tint; dark brown, orange brown or reddish brown at the centre. Lamellae rather broad and crowded, thick, emarginate with tooth, sometimes sporadically anastomosing, bright sulphureous yellow at first, becoming dirty yellow with age, sometimes with greenish tint. Stipe 4–10(–12) x 0.8–3 cm, cylindric or slightly thickening below to swollen in the middle, fibrillose to minutely scaly, dry, light to sulphureous yellow. Context whitish to pale yellowish, often light yellowish under pileo- and stipitopellis. Smell and taste farinaceous, taste mild, sometimes almost without smell. Spore print white.

Spores (4.8–)6.4–8(–9.6) x (3.2–)4–4.8(–5.6) µm, mean spore size 7.14 x 4.44 µm, mean Q value1.6, ellipsoid, thin-walled, acyanophilous, inamyloid, hyaline (Fig. 4). Basidia 29–34 x 6–6.5 µm, slender, subcylindric, 4-spored. Cheilo- and pleurocystidia absent. Pileipellis a cutis; hyphae 3.5–5 µm in diam., of hyaline, thin-walled, non or hardly incrusted cylindric cells. Pileus trama interwoven; hyphae as in hymenophoral trama. Hymenophoral trama regular; hyphae (3.5–)6.5–12(–15) µm in diam., of hyaline, thin-walled, non-incrusted, very long cylindric to slightly inflated cells (Fig. 4). Clamps absent.

Habitat and distribution. In pine and pine dominated mixed forests on dry sandy and rocky ground, and in forest-tundras. September to November, particularly in late autumn. Very common in all Nordic and Baltic countries.

Material examined. Estonia: Harjumaa Co.: Pirga, 15.9.1959, U. Kalamees & K. Kalamees (TAA 71552, as *T. flavovirens*); Hiiumaa Co.: Tahkuna, 7.10.1967, K. Kalamees & A. Kollom (TAA 77224, as *T. flavovirens*); Kärdla Forestry, Mäeselja, 7.10.1994, K. Kalamees & L. Järva (TAA 146304); Tornimäe Forestry, block 67,

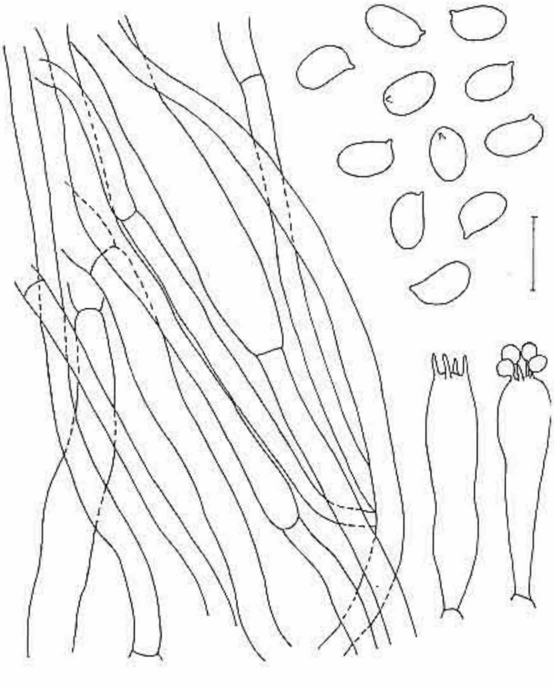

Fig. 4. *Tricholoma equestre*: basidiospores, basidia and hyphae of hymenophoral trama. Bar = 10 µm.

Kõpu, K. Kalamees (TAA 146331, as *T. auratum*). Jõgevamaa Co.: Kaiu, 28.9.1992, Külli Kalamees (TAA 142138, as *T. auratum*). Läänemaa Co.: Dirhami, 6.10.1993, K. Kalamees (TAA 147117; TAA 146118, as *T. auratum*). Lääne-Virumaa Co.: Võsu, 3.10.1958, U. Haug (TAA 50667, as *T. flavovirens*); Koljaku, 15.9.1959, U. Kalamees (TAA 51275, as *T. flavovirens*). Pärnumaa Co.: Valgerand, 17.10.1983, K.Kalamees & M. Vaasma (TAA 123473, as *T. auratum*); Rannametsa, 18.10.1983, K. Kalamees & M. Vaasma (TAA 123502, as *T. auratum*); same locality, 11.10.1988, K. Kalamees & M. Vaasma (TAA 144100, as *T. auratum*; TAA 144102, as *T. flavovirens*); Kabli, 23.9.1990, K. Kalamees (TAA 144775); Varbla Forestry, block 145, Mereäärse, 27.9.1994, K. Kalamees & M. Vaasma (TAA 14227, as *T. auratum*). Põlvamaa Co.: Kiidjärve Forestry, Saesaare, 6.11.1955, K. Kalamees (TAA 70235); Orava Forestry, block 142, 22.9.1956, K. Kalamees (TAA 70460, as *T. flavovirens*); Saesaare, 8.11.1990, K. Kalamees (TAA 144922); Taevaskoja, 7.10.1995, 2.11.1996, K. Kalamees (TAA 146710, 147559). Saaremaa Co.: Kihelkonna 7.9.1979 (TAA 113378a, 113399, as *T. flavovirens*); Kuremetsa, 4.101996, N. Lundquist, (TAA 147152); Pidula, 11.10.1983, K. Kalamees (TAA 123357, 123358b, as *T. auratum*); same locality and time, G. Shtshukin, K. Kalamees, M. Vaasma, A. Kovalenko & S. Veldre (TAA 123358a, as T. auratum). Tartumaa Co.: Elva, by the lake Vaikne, 17.10. 1959, U. Kalamees (TAA 51380, as *T. flavovirens*); Ihaste, 24.10.1985, K. Kalamees (TAA 124542, 124551, as *T.* sp.); Aardlapalu, 22.10.1993, K. Kalamees (TAA 146166). Valgamaa Co.: Karula Forestry, by the lake Kallete, 3.11.1983, S. Veldre 83247 (TAA 141208, as *T. auratum*); Lüllemäe, 8.9.1986, K. Kalamees (TAA 143279, as *T. auratum*). Võrumaa Co.: Kliima, 23.10.1985, K. Kalamees (TAA 124539, as *T. auratum*). **Finland:** Etelä-Häme: Jokioinen, Rehlijärvi, 20.10.1974, E. Ohenoja (OULU, as *T. flavovirens*); Somero, Somerniemi, Kaskisto, Yrttikorpi, 24.9.1978, I. Kytövuori 9529 (H, *as T. flavovirens*); Janakkala, Vanaja, Koljala, 19.9.1979, I. Kytövuori 79838 (H, as *T. flavovirens*); Leivonmäki Comm., Selanpohja, 10.8.1996, I. Kytövuori 96428 (H, as *T.* cf. *auratum*). Etelä-Savo: Taipalsaari Comm., Pönniälä, Karhunpää, Ruokaniemi, 16.9.1989, I. Kytövuori 89885 (H, as *T.* cf. *auratum*). Inarin-Lappi: Kevo, Jesnalvarri, 16.8.1995, K. Kalamees & M. Vaasma (TAA 146598); same locality and time, I. Kytövuori 95483 (H, *as T.* cf. auratum); same locality, 17.8.1995, E. Ohenoja (TAA 142663, as *T. auratum*); Kevo, Tšarsjokskaidi, 17.8.1995, K. & M. Kalamees (TAA 146603, as *T. equestre*). Koillismaa: Kuusamo, 24.8.1974, T. Ulvinen (OULU, as *T. flavovirens*); Oulanka, 9.9.1981, K. Kalamees, E. Ohenoja & T. Ulvinen (TAA 122059, as *T. auratum*). Oulun Pohjanmaa: Oulu, Nokela, 30.9.1965, T. Ulvinen (OULU, as *T. flavovirens*); Kiiminki, 19.9.1970, M. Ohenoja (OULU, as *T. flavovirens*); same locality, 18. 9.1984, E. Ohenoja (TAA 123670, as *T. auratum*). Pohjois-Häme: Ähtäri, Kivijärvi, 9.10.1967, P. & I. Kytövuori 2007 (H, as *T. flavovirens*); Virrat, 15.9.1979, I. Kytövuori 79781 (H, as *T. flavovirens*). Pohjois-Karjala: Lieksa, Ruunaa, Käpykoski, 12.9.1951, E. Lappi (H); Ilomantsi, Patrikka, 18.9.1987, K. Salo (JOENSUU, as *T. flavovirens*). Pohjois-Savo: Virtasalmi, Ankele, 6.9.1983, J. Issakainen & I. Kytövuori 83163 (H, as *T. flavovirens*). Satakunta: Ikaalinen Comm., Vatula, Ulvaanharju, Murha-ahde, 9.10.1993, I. Kytövuoro 931597 (H, as *T.* cf. *auratum*). Sompion-Lappi: Savukoski Comm., Martti, Sarviselkä, 30.8.1988, I. Kytövuoro 88980 (H, as *T.* cf. *auratum*). Uusimaa: Järvenpää, 7.11.1965 (H, as *T. flavovirens*); Nurmijärvi, Pitkämäki, 8.9.1975, P. Askola 211b (H, as *T. flavovirens*); Nurmijärvi, Röykkä, 23.9.1978, M. Korhonen & R. Tuomikoski 2398 (H, as *T. flavovirens*); Hanko, Tvärminneby, 28.9.1991, M. Korhonen 10557 (H). Varsinais-Suomi: Bromarv, Framnäs, 3.10.1977, R. Tuomikoski (H, as *T. flavovirens*); Kuusjoki, Impola, 29.9.1979, 30.9.1979, I. Kytövuori 79975 & 79985 (H, as *T. flavovirens*); Halikko, Sampaa, 30.9.1979, I. Kytövuori 79994 (H, as *T. flavovirens*); Lohja rural Comm., Kirkniemi, Maarpakka, 6.10.1979, I. Kytövuori 791060 (as *T. flavovirens*), 791061 (as *T. auratum*) (H); Parainen, Laplahti, 7.10.1979, M. Korhonen 3020 (H, as *T. auratum*); Rymättylä, Raulahti, Raula, 24.10.1981, R. Tuomikoski (H, as *T. flavovirens* coll.). **Latvia:** Jurmala, Kauguri, 16.10.1993, K. Kalamees, E. Vimba & I. Avota (TAA 146135); Valka Comm., Saule, 8.10.1997,

K. Kalamees (TAA147889). **Lithuania:** Varênos raj.: Merge⁻eris apyl., 28.9.1962, V. Urbonas (BILAS 5083). **NORWAY:** Troms: Storfjord Comm., Skibotn, 17.8.1992, I. Kytövuori 92436 (H, as *T.* cf. *auratum*). Finnmark: Rastiggaissen tundra, 18.8.1995, M. Vaasma (TAA 142662, as *T. equestre*). **Russia:** Leningrad Distr.: Motornaja, 13.9.1986, K. Kalamees (TAA 143337, as *T. auratum*; TAA 143338, as *T.* sp.); same locality, 14.9.1986, K. Kalamees (TAA 143348, as *T. auratum*); Lodejnopol'skij Distr.: Nizhne-Svirskij State Nature Reserve, Kuta Lahty, 11.9.1988, M.V. Stoljarskaja (LE 24723, as *T. auratum*). Murmansk Distr.: Hibiny, Paikunjavr, 12.8.1936, M.H. Katšurin (LE, as *T. equestre*); Hibiny, 26.12.1974, L.Mihailovskij (LE 5976, as *T. flavovirens*); Hibiny, Tul'jok, 26.12.1974, L. Mihailovskij (LE 5982, as *T. flavovirens*). **Sweden:** Hälsingland: Ovanåker Comm., Voxna Parish, at the crossing of the roads of Edsbyn and Los, 10.9.1995, P. & I. Kytövuori 951020 (H, as *T.* cf. *auratum*); Ljusdal Comm., Färila Parish, Kårböle, 10.9.1995, P. & I. Kytövuori 951063 (H, as *T.* cf. *auratum*). Medelpad: Lombäcken-Harran, 11.9.1995, K. Kalamees (TAA 146629, 146630); same locality and time, I. Kytövuori (TAA 146633); same locality and time, P. & I. Kytövuori 951112 (H, as *T.* cf. *auratum*); Borgsjö, St. Olof Källa, 13.9.1995, N. Lundquist (TAA 146800, as *T. auratum*); Björkvig, SE of Sundsvall, 14.9.1995, M. Christensen (TAA 146789, as *T. auratum*). Närke: Lerbäck Comm., Lerbäck Parish, Vissbodamon, 26.9.1988, I. Kytövuori 882033 (H, as *T.* cf. *auratum*). Småland: Femsjö, 18.07.1948, G. Hagel & S. Lundquist (S; as *T. auratum*; lectotype). Västmanland: Västerfärnebo Comm., Västerfärnebo Parish, Sala-Avesta, Nykrogen, 15.9.1988, I. Kytövuori 881692 (H, as *T.* cf. *auratum*).

Notes. *Tricholoma equestre* is characterized by bright sulphureous yellow basidiomes, and big, relatively slender spores (Figs. 1 & 4); it grows at dry sandy and rocky sites in pine and pine dominated mixed forests, more rare in tundras. The species is associated with *T. ulvinenii* Kalamees. The latter species differs from *T. equestre* in very pale lemon-yellow basidiomes, shorter, more broad cells of hyphae of hymenophoral trama and in smaller, relatively broad spores (Figs. 1 & 3).

CONCLUSIONS

The results of the spore measurement analysis of the investigated specimens are presented in the form of a graph (Fig. 1). The vertical line indicates mean spore length and the horizontal line denotes mean spore width. The graph reveals three different spore clusters (1–3) based on mean values. Fungi are described from two extremely different sites: dry sandy and rocky pine forests and tundras (spore clusters 1 and 2), and humus-rich fresh to paludified or alvar deciduous and mixed, more rarely coniferous (spruce dominated) forests (spore cluster 3).

According to spore cluster 1, the specimens of *T. equestre*, growing in sandy and rocky pine forests and in tundras and having a bright sulphur-yellow stout (*T. auratum-type*) or slender (*T. equestre* ssp. *pinastreti-type*) basidiomes, are not defined. Examination of the mean spore measurements of these two specimen types with different basidiome stoutness shows that they cannot be discriminated, because the mean values of their spore measurements are completely mixed up. Macromorphologically, the same stout and slender specimens are hard to distinguish in the nature: they often grow randomly at one and the same site. Therefore, since *T. auratum* cannot be distinguished as a separate taxon, the species determined on the basis of mean spore values in spore cluster 1 can be named *T. equestre* (L.: Fr.) P. Kumm. s.str. *T. equestre* is an obligatory mycorrhizal fungus growing with *Pinus sylvestris* (cf. Kalamees, 1980).

According to spore cluster 2, specimens with very pale citrin-yellow slender or medium fleshy basidiomes all over, growing also in sandy pine forests, are indistinguishable. The spores of this taxon are smaller and relatively wider than those of *T. equestre* s.str., and they form a distinct small cluster in the graph. The taxon is macromorphologically very easily recognized already in the forest and can be considered a separate species, *T. ulvinenii*. Like *T. equestre* s.str., *T. ulvinenii* is an obligatory mycorrhizal species growing with *Pinus sylvestris*.

According to spore cluster 3, the number of specimens growing on humus-rich fresh to paludified soils in deciduous, mixed or *Picea*-

dominated coniferous forests and having bright chrome-yellow fleshy basidiomes is limited. The mean spore measurements of this taxon are considerably smaller compared with those of two previous taxons, *T. equestre* and *T. citrinum*. It is clearly evident that it is a new species, *T. frondosae*. Obviously, *T. frondosae* is associated with many deciduous trees (birches, poplars, alders, oaks) and with *Picea abies*, its mycorrhiza formation with these trees is also evident.

The analysis of the studied materials allows to conclude that the *T. equestre* group comprises three different species: *T. equestre* s.str., *T. ulvinenii* and *T. frondosae*.

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New and noteworthy lichenized and lichenicolous fungi to Estonia

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Abstract: The paper presents the new localities of new and noteworthy lichens and lichenicolous fungi to Estonia.*Pezizella epithallina* and *Tremella cladoniae* are reported for the first time for the country.

Kokkuvõte: M. Kukwa. Uued ja tähelepanuväärsed samblikud ja lihhenikoolsed seened Eesti lihhenoflooras.

Töös esitatakse mõnede Eestile uute ja tähelepanuväärsete samblike ning lihhenikoolsete seente leiukohtade andmed. Teavitatakse *Pezizella epithallina* ja *Tremella cladoniae* Eesti esmasleiust.

INTRODUCTION

During the field trips of the X1V Symposium of Baltic Mycologists and Lichenologists (September 3–8, 1999, Järvselja, SE Estonia) the author had an opportunity to collect lichens and lichenicolous fungi in Estonian biota. Most of the species were presented by Halonen et al. (2000), but a part of specimens remained unidentified. They were recently determinated. Two lichenicolous fungi, *Pezizella epithallina* (W. Phillips & Plowr.) Sacc. and *Tremella cladoniae* Diederich & M. S. Christ., appeared to be new to Estonia while four lichens belonged to the group of rare species (Randlane & Saag, 1999).

Taxa were determined using traditional methods. For identification of two species thin layer chromatography (TLC) was performed in solvent system C (following White & James, 1985). The abbreviations of authors names follow Brummitt and Powell (1992). All herbarium specimens are kept in Lichen Herbarium of University of Gdansk (UGDA-L). Lichenicolous fungi are marked with #; taxa new to Estonia are typed in **bold**.

LIST OF SPECIES

BIATORA EFFLORESCENS (Hedl.) Räsänen – This taxon was regarded as rather rare in Estonia (Randlane & Saag, 1999); according to the latest data (Jüriado et al., 2000) it belongs to the class of frequent species. Locality: Tartumaa County, the vicinity of Järvselja Virgin Forest Nature Reserve, forest section No 242 (58°16'50"N, 27°19'18"E), on bark of *Tilia* in old-growth forests, 4 Sept 1999.

OCHROLECHIA MICROSTICTOIDES Räsänen – This species was also regarded as rather rare in Estonia (Randlane & Saag, 1999) but now is known as a frequent lichen (Jüriado et al., 2000). Substances detected by TLC: variolaric and lichesterinic acids. Locality: Tartumaa County, Järvselja to Rõkka (58°15'N, 27°18'E), forest section No 260, on bark of *Pinus*, 5 Sept 1999.

PACHYPHIALE FAGICOLA Lönnr. – This taxon is considered to be rather rare lichen in Estonia (Randlane & Saag, 1999). Locality: Tartumaa County, Järvselja village (58°16'02"N, 27°18'06"E), on *Salix* at the edge of the forest, 4 Sept 1999.

PEZIZELLA EPITHALLINA (W. Phillips & Plowr.) Sacc. – Locality: Põlvamaa County, ca 3 km SE of Kiidjärve (58°08'N, 27°02'E), Taevaskoja Landscape Reserve, Ahja River valley, on thallus of *Peltigera canina* (L.) Willd., growing on siliceous boulders, 6 Sept 1999.

ROPALOSPORA VIRIDIS (Tønsberg) Tønsberg – The species is known as very rare in Estonia and has been reported only from NW and NE parts of the country (Randlane & Saag 1999; Jüriado et al., 2000). The present report, the third locality in Estonia, is from SE part of Estonia and changes the frequency class of the taxon from very rare to rare. Substances detected by TLC: perlatolic acid with satellites. Locality: Tartumaa County, Järvselja village (58°16'02"N, 27°18'06"E), on *Salix* at the edge of the forest, 4 Sept 1999.

TREMELLA CLADONIAE Diederich & M. S. Christ. – It is the third lichenicolous species of the genus *Tremella* Pers. in Estonia (Halonen et al., 2000). Locality: Tartumaa County, in the vicinity of Järvselja Virgin Forest Nature Reserve, forest square No. 242 (58°16'50"N, 27°19'18"E), on squamules of epiphytic *Cladonia* sp., 4 Sept 1999.

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Three ectomycorrhiza with cystidia formed by different *Tomentella* species as revealed by rDNA ITS sequences and anatomical characteristics

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Abstract: Based on parsimony and distance analyses of fungal rDNA ITS sequences it was possible to identify three ectomycorrhiza as being formed through association with fungi of the genus *Tomentella.* The fungal partner of the ectomycorrhiza *"Quercirhiza fibulocystidiata"*, described earlier, has been identified as *Tomentella galzinii* and two other similar ectomycorrhiza as *T. pilosa* and *T. subtestacea,* respectively. The molecular identification is also supported by anatomical characters: fruitbodies of all these *Tomentella* species have species-specific cystidia in their hymenium. Cystidia with near identical morphology could be observed on the mantle of the corresponding ectomycorrhiza. The possible application of cystidia for identification of ectomycorrhiza is discussed. The known distribution and frequency of *T. galzinii, T. pilosa,* and *T. subtestacea,* based on fruitbodies, are discussed regarding forest types and host trees.

Kokkuvõte: U. Kõljalg, E. Jakucs, K. Bóka ja R. Agerer. Molekulaarsete ja anatoomiliste tunnuste põhjal moodustuvad kolm tsüstiididega ektomükoriisa morfotüüpi seente perekonda *Tomentella* kuuluvate liikidega.

Kolmest erinevast ektomükoriisast eraldatud seensümbiondi rDNA ITS lõikude nukleotiidsete järjestuste fülogeneetilise analüüsi põhjal määrati need seente perekonda Tomentella kuuluvaiks. Nende kolme seensümbiondi kuulumist eri seeneliikidesse, s.o. taksonid T. galzinii, T. subtestacea ja T. pilosa, toetavad ka anatoomilised tunnused. Kõigi kolme liigi viljakehade hümeeniumis esinevad liigispetsiifilised tsüstiidid. Sarnase morfoloogiaga tsüstiidid tekivad ka nende liikide poolt moodustatud ektomükorisa mantlil. Artiklis antakse lühiülevaade nende kolme liigi levikust ja sagedusest seostatuna metsatüüpide ja peremeestaimedega.

INTRODUCTION

The genus *Tomentella* belongs to the order Thelephorales Corner ex Oberw. (Hymenomycetes, Basidiomycota) which, in addition to *Thelephora*, includes the well-known ectomycorrhizal genera *Hydnellum, Sarcodon* as well as *Thelephora*. Species in these genera have, as a rule, pileate fruitbodies while those within *Tomentella* are always completely resupinate. Their ca. 1 mm thick fruitbodies usually appear beneath dead plant material/litter or on fallen twigs, leaves, trunks and on all other kinds of debris. Sometimes ascribed fruitbodies also develop on roots present in the upper layers of the soil or even on stones.

Tomentella includes over 50 species and many of them have a world-wide distributed. The highest diversity of *Tomentella* spp. is found in temperate coniferous and broad-leaved forests (Kõljalg, 1996). Thelephorales include three other genera with resupinate fruitbodies represented by some 20 spp., i. e. *Amaurodon, Pseudotomentella,* and *Tomentellopsis* species (Kõljalg, 1996). In the last few years it has become clear that many resupinate species of Thelephorales are potential ectomycorrhiza formers.

Some anatomical characteristics of ectomycorrhiza strongly support involvement of *Tomentella* species (Danielson et al., 1984; Danielson & Pruden, 1989; Danielson & Visser, 1989). The following characteristics, realized in different combinations, are indicative of a *Tomentella* ectomycorrhiza: colour light or dark brown, presence of cystidia, blue granules, and amyloid patches on hyphae (Agerer, unpubl.). Kõljalg (1992) synthesized ectomycorrhiza of *Tomentella crinalis* (Fr.) M.J. Larsen on *Pinus sylvestris* L. via spore inoculation under sterile conditions. Later, connections between mycorrhizal root tips and fruitbodies of *Pseudotomentella tristis* (Agerer, 1994), *Tomentella albomarginata* (Bourdot & Galzin) M.J. Larsen (=*T. sublilacina* (Ellis & Holw.) Wakef.) (Agerer, 1996) and *T. ferruginea* (Pers.: Fr.) Pat. (Raidl & Müller, 1996) were used to identify and describe ectomycorrhiza.

Recently, a number of papers have been published where molecular methods have been used to show that many ectomycorrhizal as well as orchid root symbionts belong or may belong to the genus *Tomentella*, *Tomentellopsis* and *Pseudotomentella* (Chambers et al., 1998; Gardes & Bruns, 1996; Kõljalg et al., 2000; Kõljalg & Dunstan, 2001; Kõljalg et al., 2002; Tammi et al., 2001; Taylor & Bruns, 1997). In the last few years molecular methods, mainly based on rDNA-ITS sequencing, have been widely applied to directly identify the fungal symbiont from ectomycorrhizal roots. The main drawbacks for proper identification of ectomycorrhiza through DNA-sequence analysis is, however, the limited molecular databases for fungal species. Therefore the ectomycorrhizal samples can only be compared with fruitbody data from a limited number of species. But there is a database, targeting conservative Hymenomycetes at higher taxonomic levels (Bruns et al., 1998). The identification of fungal DNA at genus or species level needs larger reference libraries of more variable DNA regions of known taxa. The compilation of a reference library of the fungal order Thelephorales (Hymenomycetes) is now being developed (Kõljalg et al., 2000) and at present it includes sequences of the nuclear ribosomal DNA ITS region of more than 60 taxa.

Brown ectomycorrhiza have already been shown to be formed by *Tomentella* species, for instance "*Piceirhiza nigra*" (Agerer et al., 1995) and "*Quercirhiza fibulocystidiata*" (Jakucs et al., 1997). This paper provides unequivocal identification of the latter ectomycorrhiza and confirms that the fruitbodies of *T. galzinii*, *T. pilosa* and *T. subtestacea* display unique cystidia in the hymenium that are similar to the cystidia present on the ectomycorrhizal fungal mantle. The taxonomic value of using cystidia for identification of the ectomycorrhiza is discussed with special emphasis on the distribution of these ectomycorrhizal species on a world-wide scale. Detailed morphological descriptions of ectomycorrhiza formed by *T. pilosa* and *T. subtestacea* were published earlier (Jakucs & Agerer, 1999, 2001).

MATERIAL AND METHODS

Ectomycorrhiza studies

Ectomycorrhiza were collected in mixed deciduous forests of the Hungarian Plain, at 300–400 m above see level, from the organic layer of sandy loess soils, under *Populus alba* L. and *Quercus cerris* L. Isolation of mycorrhiza from soil samples and characterisation follows Agerer (1991).

For light microscopy (LM), mantle preparations were mounted in lactic acid. Drawings were made with a drawing tube attached to a Leitz microscope, using a 100x Nomarski (DIC) objective. For scanning electron microscopy (SEM), ectomycorrhizal root tips were fixed in FEA. Subsequently the samples were postfixed for 3 h with 1% OsO_4 dissolved in 0.1 M K-Na phosphate buffer (pH 7.2). After rinsing with the same buffer, dehydration of the roots was performed by an upgrading ethanol series. Absolute ethanol was changed to amyl acetate. The latter was removed from the roots by critical point drying. Before investigation, a gold layer was sputtered onto the surface of the dry samples to protect them and improve image quality. Examinations and SEM-micrographs were taken using a Hitachi 2360 N scanning electron microscope at 20 and 25 kV accelerating voltage.

Ectomycorrhizal samples are deposited in the Hungarian Natural History Museum, Budapest (for herbarium numbers see Table 1).

Microscopy of fungal fruitbodies

For light microscopic studies, samples were mounted in 3% potassium hydroxide (KOH). For all measurements digital pictures of the samples were captured using Sony CCD Video Camera attached to a Nikon Labophot 2 microscope and analysed by Global Lab Image (Data Translation Inc.) software. Drawings were made using a Nikon drawing tube attached to a Nikon Labophot 2 microscope at magnifications 1250x and 750x. The taxonomy of *Tomentella* and *Thelephora* species follow Kõljalg (1996) and Corner (1968), respectively.

Molecular methods

Small fragments of the hymenium of four dried herbarium specimens have been used for DNA extraction. Hymenium fragments were sampled under a stereomicroscope and trans-

Table 1.

Fungal DNA source	Herbarium no	Locality	Host	Fruitbody supporting substrate	EMBL no
ectomycorrhiza	BP92154	Hungary	*Quercus cerris* L.	nonapplicable	AJ421251
ectomycorrhiza	BP92148	Hungary	*Populus alba* L.	nonapplicable	AJ421252
ectomycorrhiza	BP92153	Hungary	*Populus alba* L.	nonapplicable	AJ421250
T. subtestacea fruitbody	RH9567(in TAA)	France	unknown	Under decayed wood of *Salix*, 29. Oct. 1995, coll. R. Hentic	AJ421253
T. subtestacea fruitbody	TAA149885	Russia, Novosibirsk region	unknown	Under decayed log of *Picea*, autumn 1990, coll. E. A. Zhukoff	AJ421256
T. galzinii fruitbody	RS27093 (in H)	Finland	unknown	on *Heracleum* stems and twigs of deciduous trees, Helsinki ruderate grass-herb forest, 19.Aug. 1993, coll. R. Saarenoksa	AJ421255
T. atroarenicolor fruitbody	TAA149946	Russia, Caucasus	unknown	Under fallen decayed log of *Picea orientalis* in mixed forest, 8. Sept. 1991, coll. U. Kõljalg	AJ421254

ferred into 1.5 ml tubes containing 2% CTAB-buffer. A few fragments from each specimen were used to check for contamination of fruitbodies by foreign fungi. Three ectomycorrhizal root tips were also collected into 1.5 ml tubes with CTAB-buffer. DNA of both, ectomycorrhiza and fruitbody samples, were extracted with a modified CTAB method (Savolainen et al., 1995). After isolation the DNA was purified with the GeneClean kit (Bio 101 Inc.). PCR amplification was performed for the internal transcribed spacers (ITS1 and ITS2) and 5.8S regions of nuclear ribosomal DNA, using primers ITS1F and ITS4B (Gardes & Bruns, 1993). PCR conditions followed Gardes and Bruns (1993). Presence of ITS fragments was checked on a 0.6% SeaGem agarose gel and amplified products were purified with a QIAquick kit (Qiagen Inc.) according to the manufacturer's instructions. Direct DNA sequencing was performed on an ALFexpress (Pharmacia Biotech) automated sequencer. Thermo Sequenase fluorescent labelled primer cycle sequencing kit (Amersham Int.) and the primers ITS1, ITS2, ITS3, ITS4 for ITS regions of rDNA were used for cycle sequencing. Where ITS1 and ITS4 primers gave good, entirely overlapping sequences, amplification with the other primers was not carried out.

Analyses

Seven ITS sequences obtained from ALFexpress were edited and assembled with Sequencher (GeneCodes Inc.) for the Macintosh. These seven sequences aligned unambiguously with 32 sequences obtained from fruitbodies of *Tomentella* and *Thelephora* species. All 32 sequences were earlier published with GenBank accession numbers given in Kõljalg et el. (2000). Therefore, data presented in Table 1 refer only to sequences obtained in this study. Sequences were aligned by ClustalW and checked and improved manually. After alignment the dataset included 661 characters.

All phylogeny analyses were performed by using the version 4.0b8 (Altivec) of PAUP*, written by David L. Swofford. Parsimony and distance analyses were conducted as follows: parsimony analysis -heuristic search, addition sequence random, 1000 replications, tree bisection- reconnection (TBR) swapping, MULPARS ON, gaps were treated as missing, all characters were unordered and had equal weight; distance analyses –neighbour joining with Jukes-Cantor and Hasegawa-Kishino-Yano (HKY85) substitution model.

Support for branches was calculated by bootstrap and by Bremer support analyses. Bootstrap values > 60 from 1000 replications are indicated above the branch in Fig. 1. Decay indices (Bremer support) are shown below the branch and preceded by "d" (Fig. 1.). Bootstrap analyses were performed using the PAUP* and decay indices were calculated by the program AutoDecay 4.0.2 (Eriksson, 1998). The difference between samples was determined using the PAUP command "Pairwise Base Difference" under uncorrected distances.

RESULTS

Molecular identification of ectomycorrhiza

All root symbionts were identified as separate taxa; both parsimony and the distance analyses showed no discrepancy and confirmed the identity of all ectomycorrhiza (Fig 1.).

The ectomycorrhiza BP 92154 differed by 0.5% (3 transitions per 580 sites), 2.5% (12 transitions and 2 transversions per 558 sites) and 3.9% (19 transitions and 4 transversions per 580 sites.) from Finnish, Russian Far East and Estonian specimens of *Tomentella galzinii* respectively. Such intraspecific variation of ITS regions is rather common in resupinate thelephoroid fungi (Kõljalg et al., 2000; Kõljalg et al., 2002). The identification of BP 92154 as *T. galzinii* is further supported by anatomy.

The ectomycorrhiza BP 92153 was identified as *T. subtestacea* in all analyses. The differences between the ectomycorrhiza and two fruitbody specimens of this species were rather small. The Siberian specimen differed 0.6% (3 transitions per 550 sites) and the French the specimen 0.2% (1 transition per 547 sites) from the investigated root symbiont. The identification of BP 92153 is also well supported by bootstrap and decay indices and because the sister species of *T. subtestacea,* viz. *T. viridula* and *T. galzinii,* are quite distant from BP 92153 (more than 5.7%).

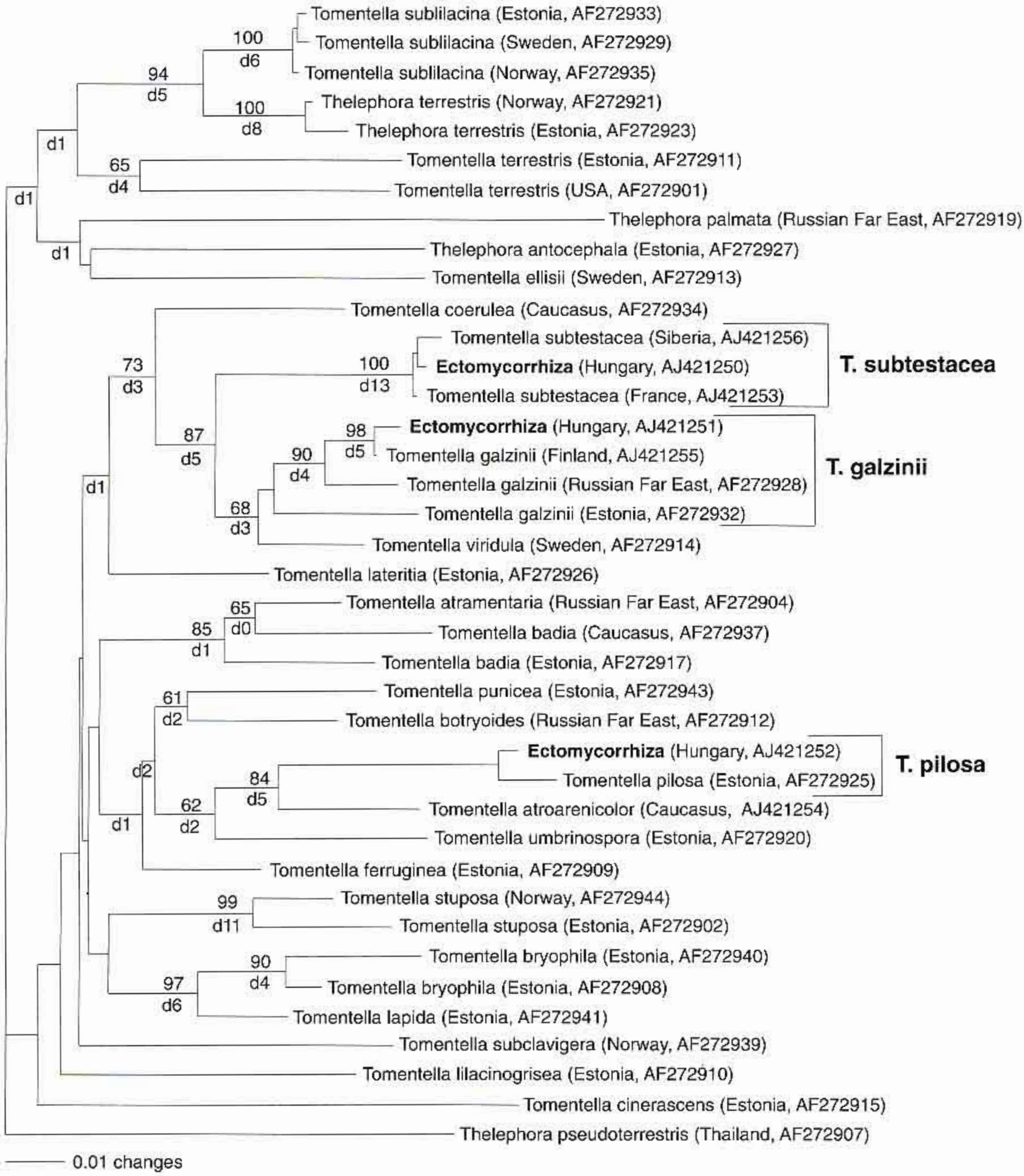


Fig. 1. Neighbour-joining tree demonstrating placement of the three ectomycorrhiza samples. Substitution model: HKY85 (Hasegawa-Kishino-Yano). Bootstrap values are shown above and decay indices below the branches. The origin and GenBank/EMBL codes of samples are indicated in the brackets.

Ectomycorrhiza BP 92148 was identified as being formed by *T. pilosa* which is only 1.3% (6 transitions and 1 transversions per 549 sites.) different from the fruitbody ITS-sequences. This identification is well supported by bootstrap and decay indices. *T. atroarenicolor*, the sister species of *T. pilosa*, was also included into analyses and it is 6.2% (24 transitions and 10 transversions per 547 sites) different from BP 92148. The mantle of BP 92148 has capitate cystidia very similar to those found in the hymenium of *T. pilosa*. *T. atroarenicolor* has another type of noncapitate cystidia.

Anatomy of ectomycorrhiza

Comprehensive anatomical and morphological analyses, drawings and photodocumentation of the three *Tomentella* ectomycorrhiza have been published (Jakucs et al., 1997; Jakucs et al., 1998; Jakucs & Agerer, 1999; Jakucs & Agerer, 2001). Here, only the main morphological and anatomical characteristics are shown and briefly delineated and it is focused only on those data which differ between the three *Tomentella* spp. or those which are similar in ectomycorrhiza and fruitbodies.

All ectomycorrhiza form dense, monopodial-pyramidal ramifying systems. The mantle is yellow-ochre with a somewhat olive colour when young and dark brown in older tissues. Rhizomorphs are yellow to dark brown. Cystidia can be easily observed under the dissecting microscope. The main anatomical characteristics of the three ectomycorrhiza are summarized in Table 2.

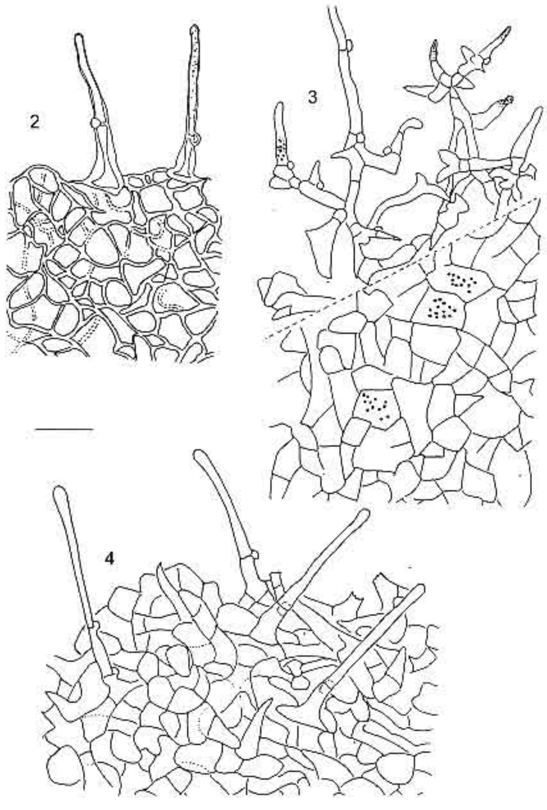
Table 2. Differences in the main morphological characteristics of the three ectomycorrhizae. Abbreviations: C=colourless, Y =yellow , BL=blue, B=brown, (* according to Agerer, 1991)

CHARACTERISTICS	*T. galzinii*	*T. pilosa*	*T. subtestacea*
MANTLE			
Type*	L	P	P
Angular net on surface	–	+	+
RHIZOMORPH			
Type*	A	C	C
Colour	H (or Y)	Y to B	Y to B
Thicker central hyphae	–	+	+
Tortuous peripherial hyphae	–	+	+
Nodia, conical side branches	–	+	+
Cystidia on rhizomorphs	–	+	+
CYSTIDIA			
Colour	Y(or H)	H (orY)	B
Lenght	48–50	55–60	25–30
Prox. diam.	5.6–6.0	5.0–6.0	4.0–5.0
Dist. Diam.	3.0–3.3	2.0–3.0	2.0–3.0
Cell wall thickness at basis	1.0–2.0	0.5 (1.0)	0.5
Apical cytoplasmic granula	– (or BL)	–	+ B

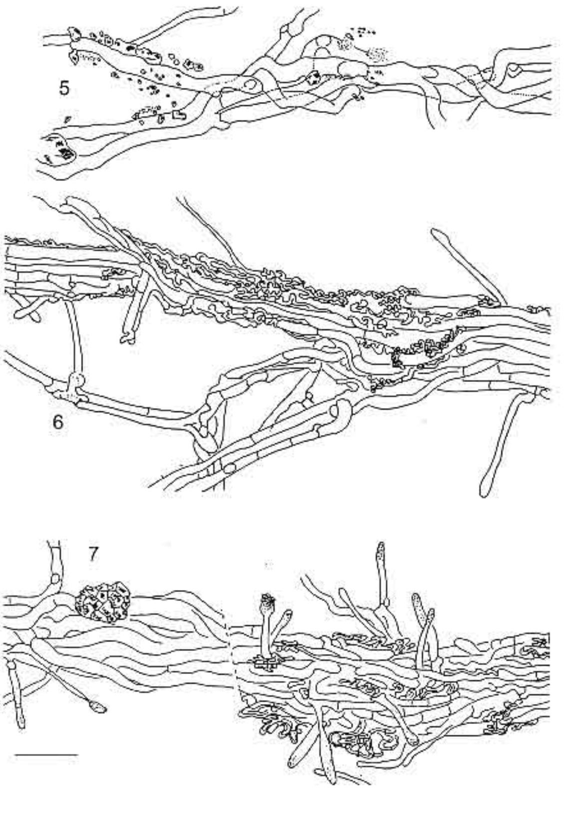
The structure of the mantle is pseudoparenchymatous in all species. The outer layer is formed by membranaceously yellow, angular cells, with a well-defined hyphal net of angular-triangular cells on the mantle surface in *T. pilosa* and *T. subtestacea* (Type P, Agerer, 1991), but without the surface net in *T. galzinii* (Type L, Agerer, 1991) (Figs 2–4; 8–13). Inner mantle layers are transient from angular or epidermoid to plectenchymatous.

Rhizomorphs are undifferentiated (Type A, Agerer, 1991), composed of loosely woven hyphae in *T. galzinii,* but differentiated in *T. subtestacea* and *T. pilosa* (Type C, Agerer, 1991) with thicker central hyphae and covered by highly specialized, dark yellow to brown, tortuous, repeatedly ramified, densely entwined and glued, thin peripherial hyphae forming a characteristic pattern on the rhizomorph (Figs 5–7).

The main characteristics of the ectomycorrhiza are the unique, so called "fibulocystidium-type", elongated and clamped cystidia, which abundantly cover the mantle surface of all three species, and they occur on the rhizomorphs of *T. subtestacea* and *T. pilosa* but not on that of *T. galzinii.* Although similar in their general shape, they are characteristically differ in size, cell wall thickness, number of septa and colour within the different species (see Table 2).



Figs 2–4. Mantle surface of the mycorrhizae with cystidia. Fig. 2. *Tomentella galzinii* (BP 92154). Fig. 3. *T. subtestacea* (BP 92153). Fig. 4. *T. pilosa* (BP 92148). Bar = 20 µm (Fig. 2 taken from Jakucs et al. 1997, fig. 3 from Jakucs and Agerer 2001, fig. 4 from Jakucs and Agerer 1999; with permission).



Figs 5–7. Rhizomorphs of the ectomycorrhizae. Fig. 5. *Tomentella galzinii* (BP 92154). Fig. 6. *T. pilosa* (BP 92148). Fig. 7. *T. subtestacea* (BP 92153). Bar = 20 µm (Fig. 5 taken from Jakucs et al. 1997, fig. 6 from Jakucs and Agerer 1999, fig. 7 from Jakucs and Agerer 2001; with permission).

The cystidia of *T. galzinii* are yellow, thick-walled at the base and thin-walled at the apical region. The cystidium is divided by a single clamp. Cytoplasmic contents of the cystidia are rarely detected, but in a few cases greenish blue cytoplasmic granula could be observed in some cystidia.

The cystidia of *T. pilosa* are similar in shape but more capitate and somewhat larger than those of *T. galzinii*. The cell wall is characteristically thin, except in some transient forms of emanating hyphae to cystidia. In addition to clamps, cystidia are often divided by simple septa. No cytoplasmic content was observed. Cystidia of *T. pilosa* originate from a hyphal surface net on the mantle, and also from emanating rhizomorphs.

The cystidia of *T. subtestacea* are greatly differ from counterparts in the two former species, being much smaller and typically brown with a brown to dark bluish brown granular or amorphous cytoplasmic content, often filling the apex of the cystidium. Although short, the cystidia are often divided by more than one septum. They emerge in a dense manner on the surface net of the mantle and also occur on the rhizomorphs.

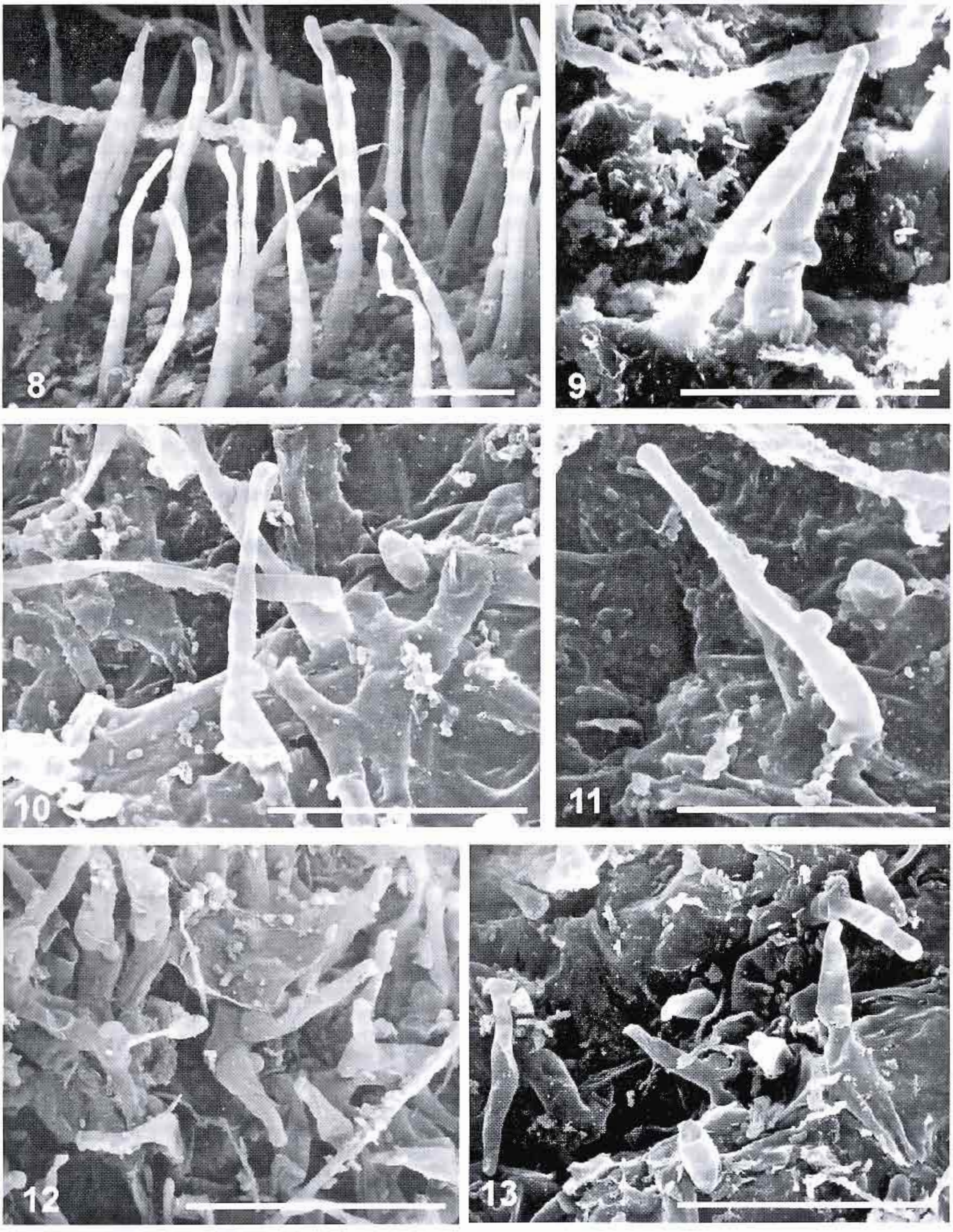
Differences between cystidia and mantle surface of the three ectomycorrhizas are shown also by scanning micrographs (Figs 8–13).

The common structural similarity between the cystidia of he ectomycorrhiza and of fruitbodies are clearly visible in Figs 14–23, and provide supporting evidence for identification based on the described ITS sequence phylogeny analyses.

DISCUSSION

Non-coding rDNA ITS sequences are usually quite variable and can hence be used to delimitate closely related species. However, ITS regions of species from sister genera, or even within the same genus, can on the other hand show enough sequence divergence to make unambiguous alignments impossible. For example, ITS regions of the species of the genera *Tomentellopsis, Pseudotomentella* and *Amaurodon,* closely related to *Tomentella,* are not alignable with each other and neither with *Tomentella* but certain other species of *Thelephora* are easily alignable with *Tomentella* species (Kõljalg et al., 2000). Therefore the ITS sequences of the three ectomycorrhiza types were checked against data sets of ITS sequences of all genera of Thelephorales. All three ectomycorrhiza sequences were aligned with *Tomentella* and *Thelephora* species but not with other genera of this order. Different phylogenetic analyses of the aligned taxa gave identical results for all three ectomycorrhiza. Therefore they most likely belong to *Tomentella galzinii, T. pilosa* and *T. subtestacea,* respectively. It is clear that the full extent of intraspecific variability could not be characterized due to the limited number of available sequences although we were able to show some variations within the species.

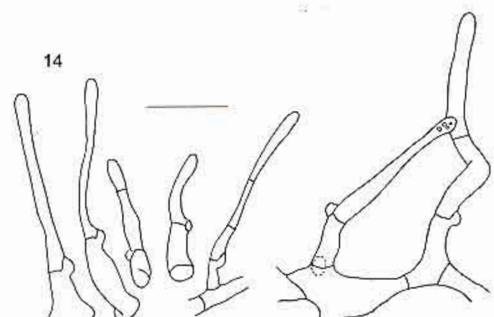
Based on anatomical characteristics of fruit bodies, *Tomentella galzinii, T. viridula* and *T. subtestacea* are sister species and were similary grouped together in all phylogenetic analyses (Fig. 1.). All produce mucedinoid and adherent fruitbodies with no rhizomorphs (Larsen, 1974; Kõljalg, 1996). The same applies to *T. pilosa, T. atroarenicolor, T. umbrinospora, T. punicea, T. botryoides* and *T. ferruginea* which grouped together in all analyses. The fruitbodies of all these species are arachnoid-byssoid, separable from the substratum and rhizomorphs present in subiculum and margins. However, in the Figs. 5 & 7 it is clearly shown that the *Tomentella galzinii* and *T. subtestacea* have chracteristic rhizomorphs associated with ectomycorrhiza. *T. galzinii* has simple aggregations of a few hyphae but *T. subtestacea* has rather unique rhizomorphs covered by the thin, tortuous, repeatedly ramified, densely entwined and glued marginal hyphae. Similar rhizomorph structure has also been found in *T. pilosa* (Fig. 6) and other species e.g. *T. ferruginea* (Raidl & Müller, 1996). It is possible to follow the formation of fruitbodies from rhizomorphs. Initially, rhizomorphs, which are covered by thick-walled hyphae, ramify and form branched rhizomorphs as in Figs 6 & 7. Finally generative hyphae born from rhizomorphs will give rise to a basal layer of hyphae and hymenium will subsequently develop on this layer. As indicated earlier, *T. subtestacea* fruitbodies do not display these type of development characters. It is possible, however, that *T. subtestacea* as well as *T. galzinii* produce rhizomorphs at some distance

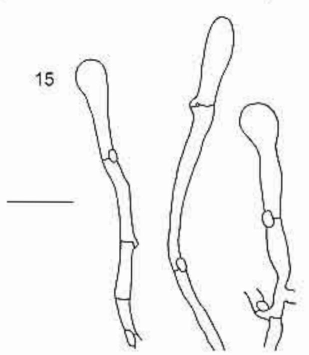


Figs. 8–13. Cystidia on the ectomycorrhizal mantle (SEM). Figs. 8, 9. *Tomentella galzinii* (BP 92154). Figs 10, 11. *T. pilosa* (BP 92148). Figs 12, 13. *T. subtestacea* (BP 92153). Bar = 20 µm.

from identified fruitbodies. Even if the tree shown on Fig. 1. is mostly congruent with morphological classification of *Tomentella* species by Larsen (1974) and Kõljalg (1996), we do not feel there is enough information as yet to confirm or deny whether the tree provides absolute species relationships or not. In our opinion more data are needed for phylogeny studies, especially knowledge on rhizomorphs connecting fruitbodies with mycorrhiza as well as on biology of *Tomentella* species.

As mentioned earlier there is high intraspecific similarity of cystidia between ectomycorrhiza and the fruitbodies. This gives excellent support for the molecular identification. The cystidia of *T. subtestacea* (Figs 21–23) are rather short, mostly colourless but often encrusted with brownish deposits. Mature cystidia usually turn brown either completely or only in the upper portions and a brown cap can be formed on the tip of the cystidium (Fig. 23). The ectomycorrhiza BP92153 has mature cystidia with nearly the same shape and colour (Fig. 21).





Figs 14, 15. Cystidia of *Tomentella pilosa*. Fig. 14. Cystidia of the ectomycorrhizae (BP 92148). Fig. 15. Cystidia of the fruitbody (TAA 152428). Bar = 20 µm (Fig.14 taken from Jakucs and Agerer 1999; with permission).

The fruitbodies of *T. galzinii* often have quite dense layer of cystidia in the hymenium. The cystidia are colourless, long and comparatively narrow with an enlarged base (Figs 18–19). The cystidia of the ectomycorrhiza have the same featrures (Fig. 17). The hymenium of *T. galzinii* (TAA 149734, Fig. 19), very close to the ectomycorrhiza BP92154 according to the phylogenetic ITS sequence analyses, possesses proximally thick-walled cystidia on its ectomycorrhiza (Fig. 17). However, another specimen of the same species with differing ITS sequences, has mostly thin-walled cystidia (Fig. 18). The cystidia of the fruitbodies are sometimes encrusted with brownish or greenish yellow deposits which did not occur on the cystidia of the ectomycorrhiza. *T. viridula* is a sister species of *T. galzinii* according to the ITS-sequences. But the fruitbody of *T. viridula* has quite different, capitate cystidia (Fig. 20) while *T. galzinii* cystidia have sharp apices (Figs 17–19).

Tomentella pilosa fruitbodies have quite long, thin-walled, mostly colourless or rarely yellowish brown and capitate cystidia (Fig. 15). The ectomycorrhiza BP92148 has cystidia with nearly the same characteristics, they are only somewhat smaller and less distinctly capitate (Fig. 14). *Tomentella atroarenicolor*, probably closely related to *T. pilosa*, has non-capitate cystidia (Fig. 16) and therefore does not fit well in relation to the anatomy of the ectomycorrhiza BP92148.

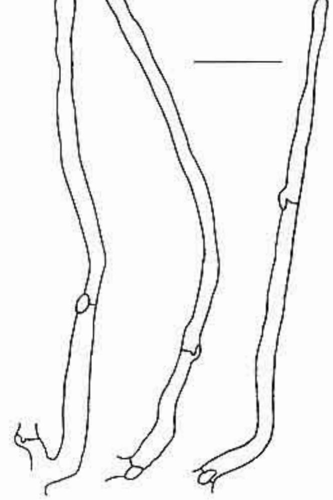


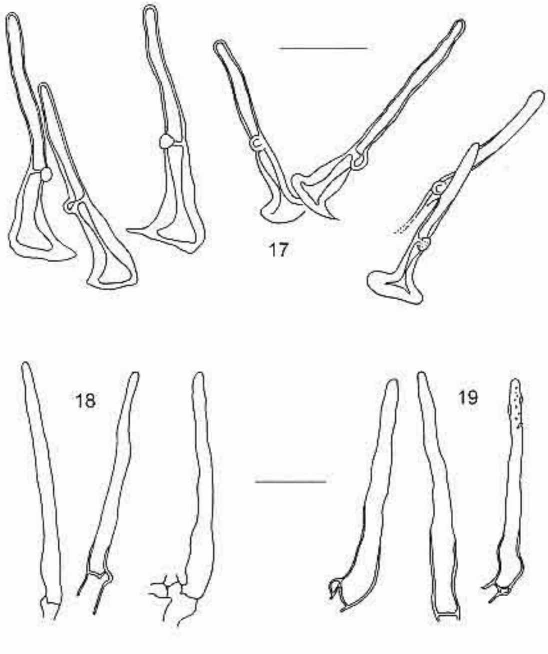
Fig. 16. Cystidia of *Tomentella atroarenicolor*. Bar = 20 µm.

Cystidia are used in many groups of Hymenomycetes for delimitation of species. There are eight species of *Tomentella* with cystidia and they are, in all cases, species-specific. Three species described here as ectomycorrhiza formers, viz. *T. galzinii, T. pilosa* and *T. subtestacea,* have also specific cystidia on the mantle of their ectomycorrhiza. Therefore this character can be used easily for routine identification of these three ectomycorrhiza types, particularly as identical cystidia on other ectomycorrhiza are as yet unknown (Agerer and Rambold, 1998).

All three species occur throughout the Northern Hemisphere (Larsen, 1974; Kõljalg, 1996) and *T. pilosa* is also found in New Zealand (Cunningham, 1963) and Australia (Dunstan & Kõljalg, unpubl.). There are a greater number of records on the distribution of *T. pilosa* than on *T. galzinii* and *T. subtestacea.* But this does not mean that *T. pilosa* is more frequent. The fruitbody of *T. pilosa* is more colourful and thicker than in the other two species and probably therefore more easily detected. According to fruitbody surveys, all three species are rarely identified. However, the fruitbodies of *Tomentella* species are not always easily detected because of their very thin morphology and developmental preference which is mainly restricted inside the litter layer, under dead wood, etc. Therefore these species are likely to be more common with a much wider distributed that presently appreciated.

According to the fruitbody survey in Norway (Stockland & Kõljalg, unpublished data) *T. pilosa* is only found in soils supporting deciduous tree species. *Tomentella galzinii* and *T. subtestacea* seem also to be mainly associated with deciduous trees (Larsen, 1974; Kõljalg, 1996). Even if fruitbodies are collected from the underside of decayed coniferous wood it is possible that they formed ectomycorrhiza with adjacent broad-leaved trees. The three ectomycorrhiza described here were all formed on deciduous trees.

A *Tometella galzinii* fruitbody was been collected in the Helsinki city park dominated by *Acer, Betula, Populus* and *Salix* tree species. The fruitbodies developed on different kinds of dead plant material. Danielson and Pruden (1989) reported on *Tomentella*-liked ectomycorrhiza on urban spruces. Many species of *Tomentella* appear in town parks, gardens, etc., but we do not know how important *Tomentella* species are as ectomycorrhiza formers in such habitats.



Figs 17–19. Cystidia of *Tomentella galzinii.* Fig. 17. Cystidia of the ectomycorrhizae (BP 92154). Fig. 18. Cystidia of the fruitbody (TAA 166821). Fig. 19. Cystidia from the fruitbody (TAA 149734). Bar = 20 µm (Fig. 17 taken from Jakucs et al. 1997; with permission).

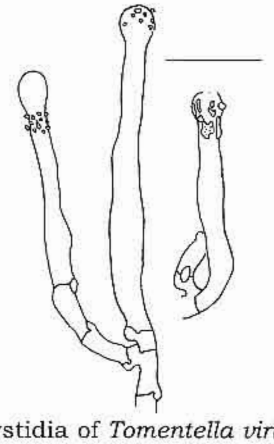
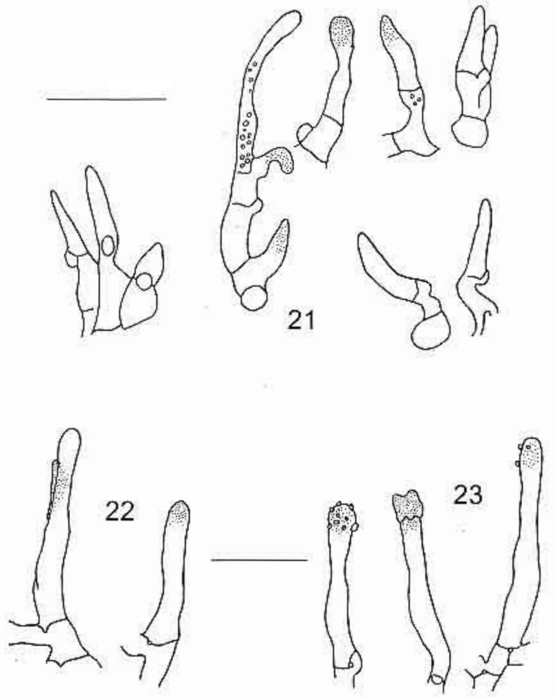


Fig. 20. Cystidia of *Tomentella viridula.* Bar = 20 µm.



Figs 21–23. Cystidia of *Tomentella subtestacea.* Fig. 21. Cystidia of the ectomycorrhizae (BP 92153). Fig. 22. Cystidia of the fruitbody (TAA 149885). Fig. 23. Cystidia of the fruitbody (RH 9567 in TAA). Bar = 20 μm (Fig. 21 taken from Jakucs and Agerer 2001; with permission).

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The ultrastructure of *Lachnellula willkommii* (Hyaloscyphaceae, Helotiales, Ascomycetes)

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Abstract: The ultrastructure of ascus apical apparatus and the hairs of *Lachnellula willkommii* (Hartig) Dennis is described and compared with ultrastructural characters of other genera of the Hyaloscyphaceae subfamily Lachnoideae.

Kokkuvõte: K. Leenurm ja A. Raitviir. Seene *Lachnellula willkommii* (Hyaloscyphaceae, Helotiales, Ascomycetes) ultrastruktuur

Kirjeldatakse tiksikulaadse seene *Lachnellula willkommii* (Hartig) Dennis eoskottide tipuaparaadi ja karvade ultrastruktuuri ning võrreldakse teiste perekondade ultrastruktuuri tunnustega harjastiksikuliste sugukonna (Hyaloscyphaceae) Lachnoidea alamsugukonnas.

INTRODUCTION

Lachnellula willkommii (Hartig) Dennis is a well-known parasitic ascomycete with orange yellow disc and white, hairy excipulum. It causes dieback of older branches in otherwise healthy naturally growing larch trees and stem cancer of young larches in forest plantation, and as such it is an important forest pathogen. Its taxonomic position has changed during its history. Nannfeldt (1932), who distinguished *Trichoscyphella* having ellipsoid ascospores from *Lachnellula* with rounded ascospores, placed it as *Trichoscyphella willkommii* (Hartig) Nannf. in the subfamily Trichoscyphelloideae of the Helotiaceae. Dennis (1962) rearranged its taxonomic position uniting *Trichoscyphella* Nannf. with an older genus *Lachnellula* P. Karst. According to Dennis the tribe Trichoscyphelloideae, including besides *Lachnellula* also the genus *Perrotia,* belongs to the Hyaloscyphaceae on the basis of excipular hairs. Additional characters are needed to confirm earlier taxonomic decisions and for this reason the apical apparatus ultrastructure of *L. willkommii* has been studied.

MATERIAL AND METHODS

Fresh material was collected in the forest and kept living in small plastic boxes until fixation. After identification and removal of several apothecia for fixation, the remaining material was dried and deposited in the herbarium of Institute of Zoology and Botany, Estonian Agricultural University (**TAA**).

The methods followed were those described by Curry & Kimbrough (1983) and Samuelson & Kimbrough (1978). In addition ruthenium red was used in the fixation (Wong, Hyde et. al., 1999). For transmission electron microscopy, the fruitbodies were fixed a) for 2 h using 2% paraformaldehyde, 2.5% glutaraldehyde and 2 mM calcium chloride in 0.1M sodium cacodylate buffer (pH=7.2). Material was rinsed in 0,1M cacodylate buffer (pH=7.2) and postfixed for 45 min in 1% osmium tetroxide in the same buffer (pH=7.2). b) as described in a), but ruthenium red was added to both aldehyde and osmium tetroxide fixative to a final concentration of 0.05 %. The material was buffer rinsed and dehydrated through a graded ethanol series from 10% to 90% (in 10% steps) and 3 x 96 % followed by acetone each 10 min. Fixation and dehydration was done at room temperature. The material was embedded in Spurr's resin (ERL 4206) using infiltration series resin and acetone in 1:3, 1:1 and 3:1 proportions for at least 3 hours each and polymerized. The material was thin-sectioned on a Reichert ultramicrotome Om2U using glass knives. The sections were stained with uranyl acetate and lead citrate. The material was examined using JEOL100S, TESLA BS-500 and HITACHI H-600 electron microscopes.

The hair wall structure and ascus apical apparatus of *Lachnellula willkommii* were studied using magnifications from 5000x to 20000x. Terms for hair wall stratification are according to Gooday (1995). 'Inner layer' is used for the stratum forming the septa, 'outer layer' for the stratum not taking part in septum formation (the boundary is the electron-transparent middle lamella) and 'fibrillar layer' for the outermost covering layer, which is often composed of more or less loose material, which may sometimes become disrupted or eroded. The terminology of Verkley (1995) is followed for the ascus apical apparatus.

Material studied:

Lachnellula willkommii (Hartig) Dennis – on a dead branch of *Larix* sp., coll. K. Leenurm, Võru Co., Vastseliina Comm., 31.V 1997 (TAA 165330); on a dead branch of *Larix* sp., Tartu Co., Kambja Comm., Vana-Kuuste, Röövlimägi, 12.X 1997 (TAA 165335) and 28.V 2000 (TAA 165725); on a dead branch of *Larix* sp., Tartu Co., Järvselja, Forestry block no. 286, 29.VIII 2000 (TAA 165696).

RESULTS

Ascus apical apparatus.

The ascus apex at an earlier developmental stage is slightly tapering and rounded (Fig. 1), with an early developing prominent pore. The apical apparatus is completed before formation of ascospores. The apical thickening is short and not well developed, the ascus wall thickens only gradually over a short extent of 0.1–1.3 µm in the subapical region (Fig. 1). The upward broadening annulus is composed of more electron-dense material than the ascus wall and has a striated structure of very fine, almost parallel, electron-transparent lines covering the whole annulus width (Figs 2–4). The material of central cylinder is more electron-transparent and sparsely granular, and the central cylinder itself is more narrow than the annulus.

During maturation the apex becomes more blunt, with wider and more compressed pore. The width of ascus apical apparatus increases under the pressure of the extensively widening central cylinder. The annulus is 1.6–2.6 µm and central cylinder 1.9–2.2 µm wide. The annular protrusions becomes incurved and rounded, and the material is more homogenous in its lower end (Figs 1–4).

The rounded annular protrusion and relatively short central cylinder in maturing and mature ascus form the specific "boletoid" shape of the apical chamber, measuring 0.5–1.1 x 0.3–0.7 µm (Figs 2–4).

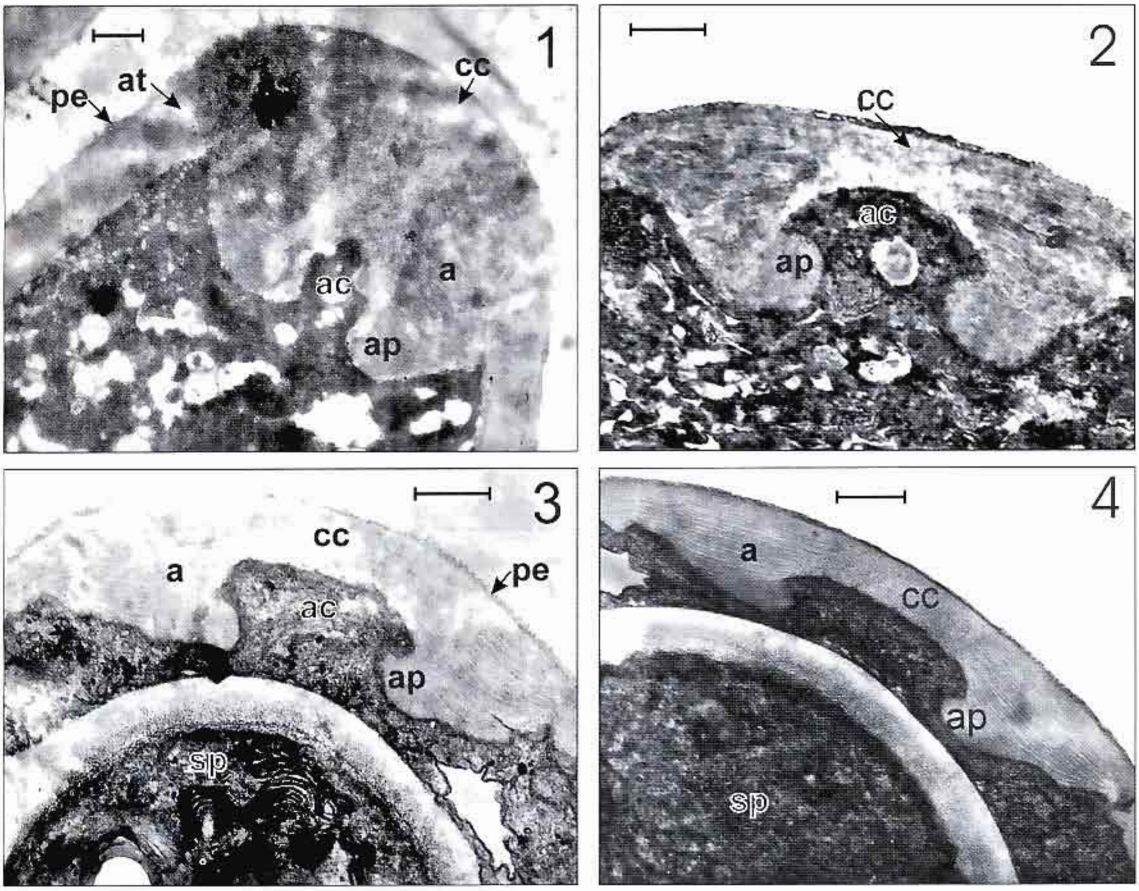
Ascus and ascospores.

The periascus, i. e., the fibrillar material covering the ascus wall, is relatively thin and electron-dense. The spore wall is two-layered. The spores contain several prominent vacuoles and their cytoplasm is rich in glycogen. Osmiophilic electron-dense bodies are present in the ascospore vacuoles (Fig. 5).

Hairs

The hairs have active living cytoplasm containing numerous mitochondria close to the hair wall. There are pulley-wheel shaped electron dense pore plugs in the septa of hairs and also spherical Woronin bodies (Fig. 7). The middle lamella is electron-transparent (Figs 6 & 7).

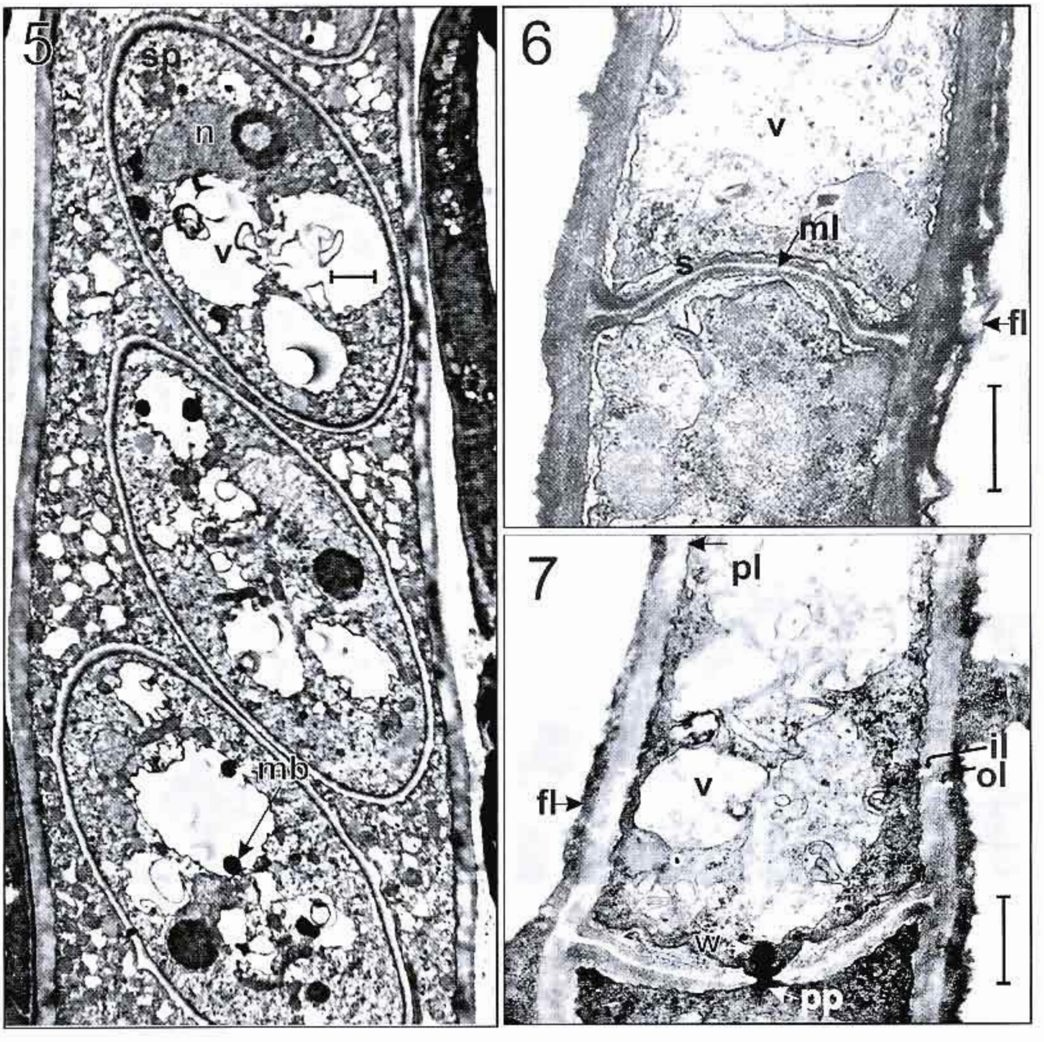
The hair wall is two-layered, bearing warts on its surface (Figs 5–12). These warts are abundant on the upper cells but almost absent on the two basal cells of hairs. They are variable in their shape and size (0.2–1 x 0.2–0.8 µm), mainly ellipsoid, sometimes basally more or less constricted. Their inner structure is composed of a rather loose reticulum of electron-dense fibrils and externally they are covered with an even more electron-dense fibrillar layer. The warts undergo significant changes in time. They seems to



Figs 1–4. Ascus apical apparatus of *Lachnellula willkommii*. 1. Young ascus. – 2–4. Mature asci. Abbreviations: a – annulus, ac – apical chamber, ap – annular protrusion, at – apical thickening, cc – central cylinder, pe – periascus.
Bar equals 1 µm.

develop as outgrowths from the outer layer and are at first covered with a sheath formed from the hair wall fibrillar layer (Fig. 9). The core material is rather compact in younger warts, then loosens (Figs 9–11) and at last the warts become eroded and disintegrated (Fig. 12).

The hair wall is 1–1.5 µm thick, and moderately electron-dense. The inner layer is of low electron-density, composed of fine-granular and homogenous material. The outer layer is differentiated into two strata that differ in electron-density and material arrangement. The inner stratum comprises of similar material as the inner layer, the boundary between them is hard to distinguish. The outer stratum comprises more electron-dense, irregular fibrillar material below the most electron-dense fibrillar layer. The fibrillar layer is well developed, comprising irregular material, which may sometimes become eroded or disrupted, often sheathing the warts on the surface (Figs 7 & 10).

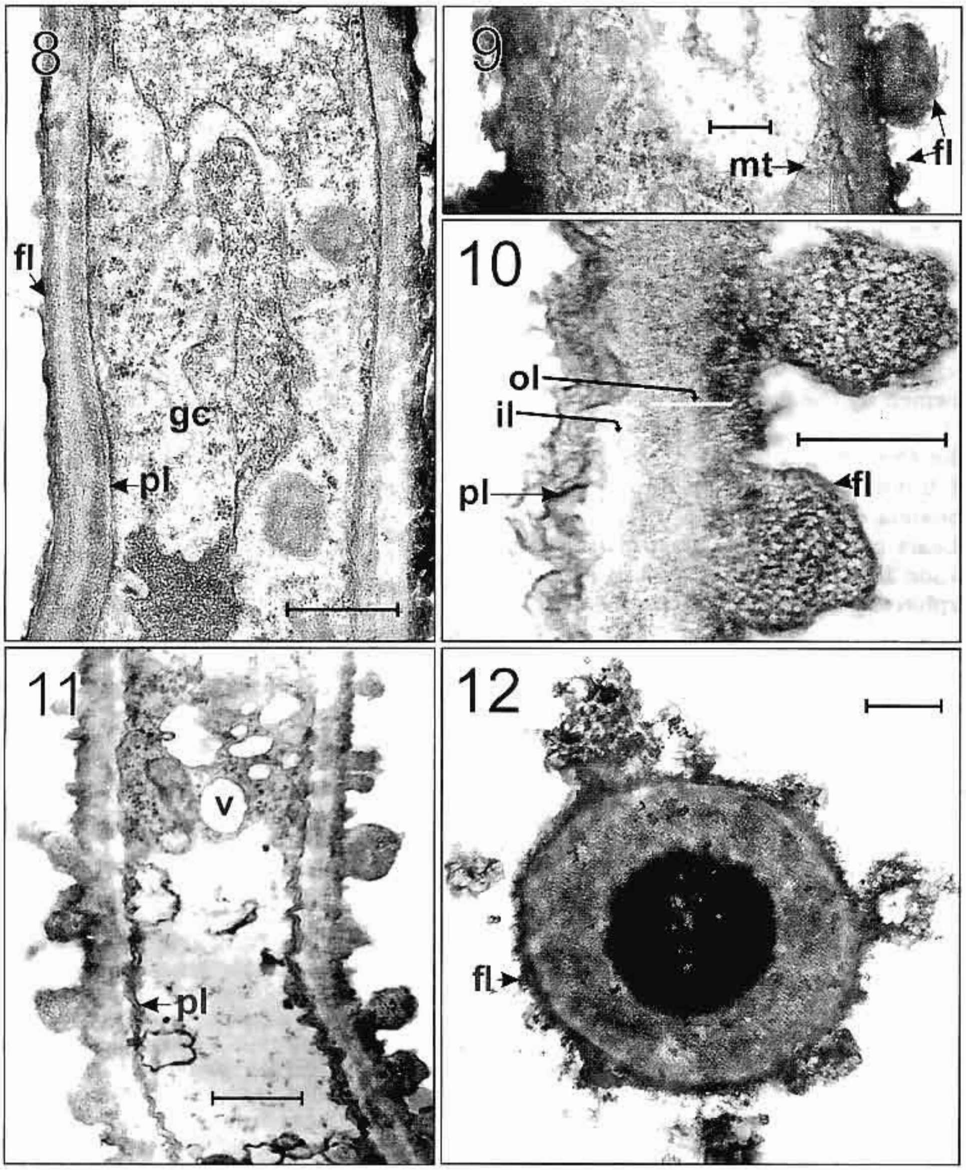


Figs 5–7. 5. Ascus with ascospores. – 6. Hair basal cells with septum. – 7. Hair basal cells with septal apparatus.
Abbreviations: fl – fibrillar layer of hair wall, il – inner layer of hair wall, mb – osmiophilic electron-dense bodies, ml – middle lamella of septum, n – nucleus, ol – outer layer of hair wall, pp – pore plug, s – septum, sp – ascospores, v – vacuole, w – Woronin body.
Bar equals 1 µm.

DISCUSSION

The ascus apical apparatus of *Lachnellula willkommii* represents clearly its own type (Fig. 13), differing from the types previously described in the studies on the ultrastructure of ascus apical apparatus of the Hyaloscyphaceae (Verkley, 1996; Leenurm, Raitviir & Raid, 2000; Leenurm & Raitviir, 2000). It bears some resemblance to the ascus apex of *Bulgaria inquinans* (Leotiaceae) – Verkley's type IV of ascus apical apparatus (Verkley, 1995).

Comparing the characters we can point out several differences:



Figs 8–12. Ultrastructure of *Lachnellula willkommii* excipular hairs. 8. Longitudinal section of hair basal cells. – 9. Hair cell with warts. – 10. Hair wall. – 11. Hair cell with warts. – 12. Cross section of hair.
Abbreviations: gc – glycogen granules, fl – fibrillar layer – and il – inner layer of hair wall, mt – mitochondrium, ol – outer layer of hair wall, pl – plasmalemma.
Bar equals 1 µm.

a) The ascus tip of *L. willkommii* is blunt, truncate-rounded (against conical-rounded, conical-truncate, umbonate or truncate of others) with a very small apical thickening. The annulus and central cylinder are comparatively wide.

b) The annular protrusion is notably incurved.
c) The apical chamber is large and has an unique shape, it is constricted from below by the annular protrusions; the others members of Helotiales studied by TEM have convex or

ovate apical chamber. A pyrenomycete *Hypoxylon fuscum* (Beckett, Heath & McLaughlin, 1974) has a similar apical chamber.

d) The pore is big and inward extending in the young ascus, but becomes very short and flat in the mature ascus.

The hair wall structure is similar to that observed in the hyaloscyphaceous genera *Capitotricha* and *Albotricha,* that also have non-persistent warts (Leenurm, Raitviir & Raid, 2000). There are, however, two differences, 1) in *Lachnellula* the warts develop under a sheath formed by the fibrillar layer of the hair wall; 2) the hair wall stratification is different. In the *Capitotricha* type the inner layer is stratified, but in *Lachnellula* it is the outer layer which consists of two strata.

On the basis of these ultrastructural results we conclude that Lachnellula belongs to the Hyaloscyphaceae subfamily Lachnoideae.

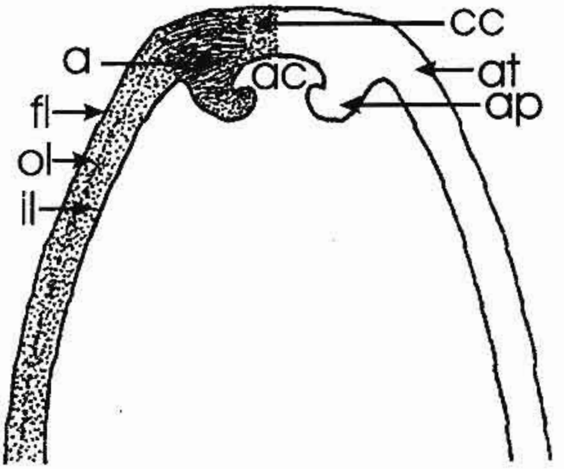


Fig. 13. Schematic structure of ascus apical apparatus of *Lachnellula willkommii.*

Abbreviations: a – annulus, ac – apical chamber, ap – annular protrusion, at – apical thickening, cc – central cylinder, il – inner layer of ascus wall, ol – outer layer of ascus wall, pe – periascus.

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Lichens of Harilaid Island (West-Estonian Archipelago)

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Abstract: The first published list of lichens of Harilaid Island consists of 98 species. Among them, *Amandinea coniops* and *Xylographa vitiligo* are ranged as quite rare, *Mycobilimbia lobulata* and *Thelomma ocellatum* as rare and *Xylographa parallela* as very rare in Estonia.

Kokkuvõte: E. Nilson ja I. Jüriado. Harilaiu (Lääne-Eesti saarestik) samblikud.

Esimeses trükisõnalises Harilaiu samblike nimestikus on esitatud 98 liiki. Neist *Amandinea coniops* ja *Xylographa vitiligo* on Eestis üsna haruldased, *Mycobilimbia lobulata* ja *Thelomma ocellatum* haruldased ning *Xylographa parallela* väga haruldane.

INTRODUCTION

Harilaid is one of the small islands in the West-Estonian Archipelago. It is situated in Hari Straight between larger islands Hiiumaa and Vormsi, ca 5 km east of Hiiumaa and 4 km west of Vormsi, with its approximate center at 58°58'N, 23°05'E (Fig. 1). It is a narrow, S-shaped and NW-SE oriented island with the area of 14.82 ha, length of 1.3 km and width of only 0.2 km. Its maximum height is 2.9 m a.s.l. (Loopmann, 1996). Higher northern part of the island has a moraine core, lower southern part consists of marine sediments. Northern part is covered with shrubbery, consisting mainly of *Juniperus communis*, *Ribes alpinum* and *Rosa* spp. Southern part is grassland with a few trees (*Betula pendula*, *Sorbus aucuparia*, *Pinus sylvestris*). The centre of the island is occupied by a lighthouse, and houses built in Soviet time for marine borderguard. Some trees of *Populus laurifolia* and *P. berolinensis* are planted around buildings. At the present time the island is not inhabited.

Field samples were collected during short stays at July 13, 1999 (E. Nilson) and June 5–6, 2001 (I. Jüriado). Nomenclature follows Randlane & Saag (1999). Herbarium samples are kept in the Institute of Ecology, Tallinn Pedagogical University (IE) and in the lichen herbarium of the University of Tartu (TU).

RESULTS

There is no earlier published records on the lichen flora of Harilaid Island. As a result of this study, altogether 98 lichen species and one variety were recorded. Supposedly, about 80% of lichen flora of the island may be represented.

Several species are growing on more than one substrate. Epiphytes are the most numerous (42 spp., among them 38 spp. on deciduous and 26 spp. on coniferous trees). Epilithes are represented by 36 species (22 spp. on siliceous boulders, 12 spp. on carbonaceous substrates). Remarkable number of species (23) is found on wood.

Besides natural substrates (ground, trees and shrubs, siliceous boulders and limestone pebble), various man-made constructions are also important substrata for lichens (the concrete stake, mortar, wooden fences and quai). The former military constructions has been noted to increase the diversity of suitable habitats for lichens also in other Estonian islands (Randlane et al., 1997; Randlane & Jüriado, 1999).

All species recorded are quite frequent to very frequent in Estonia, only *Amandinea coniops* and *Xylographa vitiligo* are ranged as quite rare, *Mycobilimbia lobulata* and *Thelomma ocellatum* as rare and *Xylographa parallela* as very rare (Randlane & Saag 1999).

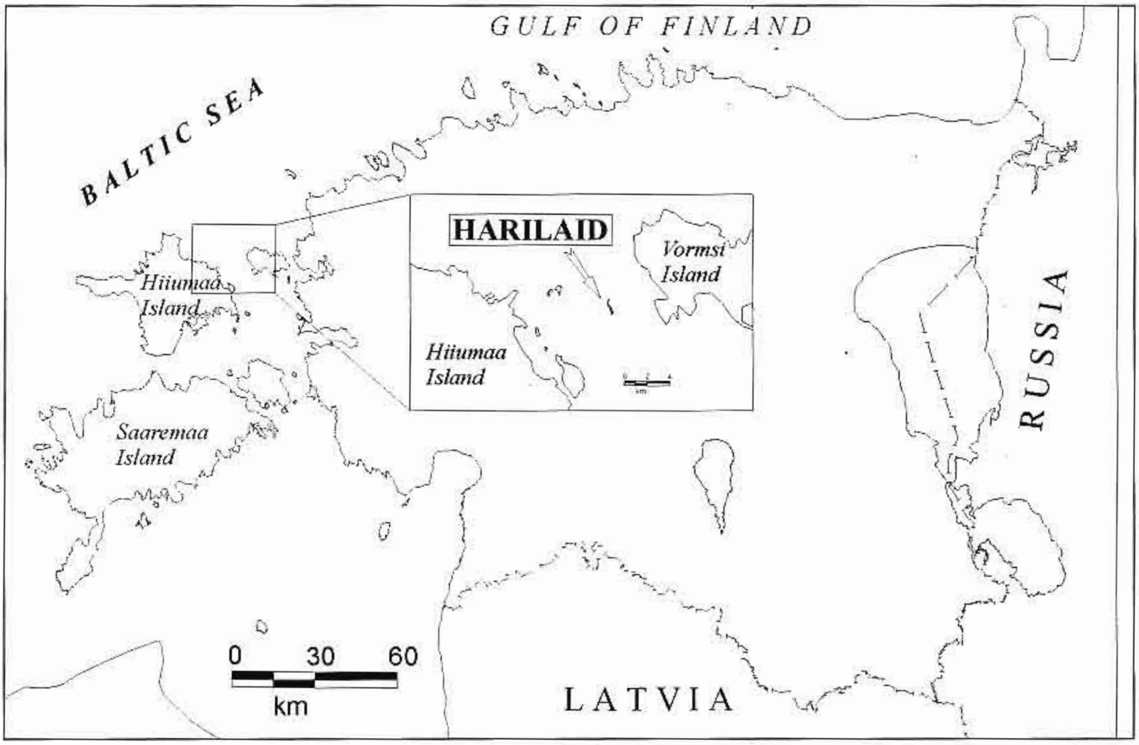

Fig. 1. Location of Harilaid Island in West-Estonian Archipelago.

LIST OF SPECIES

– lichenicolous fungus

Amandinea coniops (Wahlenb.) Scheid. & H. Mayrhofer – on siliceous boulder.

A. punctata (Hoffm.) Coppins & Scheid. – on bark of *Betula pendula*, *Rosa* sp., *Ribes alpinum*, *Juniperus communis* and *Pinus sylvestris*.

Aspicilia cinerea (L.) Körb. – on siliceous boulder.

'Bacidia' globulosa (Flörke) Hafellner & V. Wirth – on bark of *Populus* spp., on wood.

Buellia griseovirens (Turner & Borrer ex Sm.) Almb. – on bark of *Juniperus communis*.

Caloplaca cerina (Ehrh. ex Hedw.) Th. Fr. – on bark of *Populus* spp.

C. citrina (Hoffm.) Th. Fr. – on wooden quay.

C. decipiens (Arnold) Blomb. & Forsell – on mortar.

C. flavorubescens (Huds.) J. R. Laundon – on wooden quay.

C. holocarpa (Hoffm. ex Ach.) A. E. Wade – on bark of *Populus* spp., on tile.

C. lactea (A. Massal.) Zahlbr. – on limestone pebble.

C. saxicola (Hoffm.) Nordin – on limestone pebble and concrete stake.

C. scopularis (Nyl.) H. Magn. – on siliceous boulders.

Candelaria concolor (Dickson) Stein – on wooden quay.

Candelariella aurella (Hoffm.) Zahlbr. – on a concrete stake and tile.

C. coralliza (Nyl.) H. Magn. – on siliceous boulders.

C. vitellina (Hoffm.) Müll. Arg. – on siliceous boulders.

C. xanthostigma (Ach.) Lettau – on wooden quay.

Cetraria aculeata (Schreb.) Fr. – on ground.

C. ericetorum Opiz – on ground.

C. islandica (L.) Ach. – on ground.

C. muricata (Ach.) Eckfeldt – on ground.

'C.' sepincola (Ehrh.) Ach. – on bark of *Rosa* sp., *Juniperus communis*.

Cladina arbuscula (Wallr.) Hale & W. L. Culb. – on ground.

C. rangiferina (L.) Nyl. – on ground.

CLADONIA CONIOCRAEA (Flörke) Spreng. – on wooden quay.

C. DIGITATA (L.) Hoffm. – on lignum of *Betula pendula*.

C. FIMBRIATA (L.) Fr. – on bark of *Juniperus communis*, on wooden quay.

C. FURCATA (Huds.) Schrad. – on ground.

C. PYXIDATA (L.) Hoffm. – on ground.

C. SCABRIUSCULA (Delise) Nyl. – on ground.

C. SYMPHYCARPA (Flörke) Fr. – on ground.

CLIOSTOMUM GRIFFITHII (Sm.) Coppins – on bark of *Juniperus communis*.

EVERNIA PRUNASTRI (L.) Ach. – on bark of *Betula pendula*.

HYPOGYMNIA PHYSODES (L.) Nyl. – on bark of *Rosa* sp., *Populus* spp. and *Pinus sylvestris*, on wood, siliceous boulders and ground.

H. TUBULOSA (Schaer.) Hav. – on a siliceous boulder.

LECANIA CYRTELLA (Ach.) Th. Fr. – on bark of *Ribes alpinum*.

LECANORA ALBESCENS (Hoffm.) Branth & Rostr. – on mortar.

L. CARPINEA (L.) Vain. – on bark of *Rosa* sp., *Populus* spp. and *Sorbus aucuparia*.

L. CHLAROTERA Nyl. – on bark of *Betula pendula*, *Populus* spp. and *Juniperus communis*.

L. CRENULATA Hook. – on mortar (on a concrete stake).

L. DISPERSA (Pers.) Sommerf. – on tile.

L. EXPALLENS Ach. – on bark of *Betula pendula*.

L. HAGENII (Ach.) Ach. – on bark of *Populus* spp.

L. HELICOPIS (Wahlenb.) Ach. – on siliceous boulder.

L. LEPTYRODES (Nyl.) Degel. – on bark of *Populus* spp.

L. MURALIS (Schreb.) Rabenh. – on siliceous boulders.

L. POLYTROPA (Ehrh. ex Hoffm.) Rabenh. – on siliceous boulder.

L. POPULICOLA (DC.) Duby – on bark of *Populus* spp.

L. PULICARIS (Pers.) Ach. – on bark of *Betula pendula*, *Juniperus communis* and *Pinus sylvestris*.

L. RUPICOLA (L.) Zahlbr. – on siliceous boulders.

L. SALIGNA (Schrad.) Zahlbr. – on wooden quay.

L. SYMMICTA (Ach.) Ach. – on bark of *Betula pendula*, on wood.

L. VARIA (Hoffm.) Ach. – on wooden quay.

LECIDELLA ELAEOCHROMA (Ach.) M. Choisy – on bark of *Betula pendula*, *Populus* spp. and *Juniperus communis*.

MELANELIA EXASPERATA (De Not.) Essl. – on bark of *Populus* spp., *Rosa* sp.

M. OLIVACEA (L.) Essl. – on bark of *Betula pendula*.

M. SUBAURIFERA (Nyl.) Essl. – on bark of *Juniperus communis*.

MYCOBILIMBIA LOBULATA (Sommerf.) Hafellner – on mosses.

NEOFUSCELIA LOXODES (Nyl.) Essl. – on siliceous boulders.

N. PULLA (Ach.) Essl. – on siliceous boulders.

OCHROLECHIA ARBOREA (Kreyer) Almb. – on bark of *Juniperus communis*.

PARMELIA SAXATILIS (L.) Ach. – on siliceous boulders.

P. SULCATA Taylor – on bark of *Betula pendula*, *Rosa* sp., *Sorbus aucuparia*, *Juniperus communis*, *Pinus sylvestris*, on wood and siliceous boulders.

PARMELIOPSIS AMBIGUA (Wulfen) Nyl. – on bark of *Juniperus communis* and *Pinus sylvestris*.

PELTIGERA MEMBRANACEA (Ach.) Nyl. – on ground and wooden quay.

P. RUFESCENS (Weiss) Humb. – on ground.

PHAEOPHYSCIA ORBICULARIS (Neck.) Moberg – on bark of *Populus* spp., on wooden quay, concrete and tile.

PHLYCTIS ARGENA (Spreng.) Flot. – on bark of *Juniperus communis*.

PHYSCIA ADSCENDENS (Fr.) H. Olivier – on bark of *Populus* spp., on wooden quay.

P. AIPOLIA (Ehrh. ex Humb.) Fürnr. – on bark of *Sorbus aucuparia*.

P. CAESIA (Hoffm.) Fürnr. – on siliceous boulders.

P. DUBIA (Hoffm.) Lettau – on bark of *Betula pendula* and *Juniperus communis*, on siliceous boulders.

P. SEMIPINNATA (J. F. Gmelin) Moberg – on bark of *Ribes alpinum*.

P. STELLARIS (L.) Nyl. – on bark of *Populus* spp., on wooden quay.

P. TENELLA (Scop.) DC var. TENELLA – on bark of *Betula pendula*, *Rosa* sp., *Juniperus communis* and on wooden quay.

P. TENELLA var. MARINA (E. Nyl.) Lynge – on siliceous boulders.

PHYSCONIA DISTORTA (With.) J. R. Laundon – on bark of *Populus* spp.

PLACYNTHIELLA ICMALEA (Ach.) Coppins & P. James – on wooden quay.

PYRRHOSPORA QUERNEA (Dicks.) Körb. – on bark of *Juniperus communis*.

RAMALINA FARINACEA (L.) Ach. – on bark of *Betula pendula* and *Rosa* sp.

R. FASTIGIATA (Pers.) Ach. – on bark of dry *Juniperus communis*.

R. FRAXINEA (L.) Ach. – on bark of *Populus* spp.

R. POLYMORPHA (Lilj.) Ach. – on siliceous boulders.

RHIZOCARPON GEOGRAPHICUM (L.) DC. – on siliceous boulders.

#RIMULARIA INSULARIS (Nyl.) Hertel & Rambold – parasitic on *Lecanora rupicola*.

RINODINA BISCHOFFII (Hepp) A. Massal. – on limestone pebble and tile.

R. SOPHODES (Ach.) A. Massal. – on bark of *Betula pendula* and *Rosa* sp.

SCOLICIOSPORUM CHLOROCOCCUM (Stenh.) Vezda – on bark of *Betula pendula*, *Ribes alpinum*, *Rosa* sp. and *Pinus sylvestris*.

TEPHROMELA ATRA (Huds.) Hafellner ex Kalb – on siliceous boulders.

TRAPELIOPSIS FLEXUOSA (Fr.) Coppins & P. James – on wood.

VULPICIDA PINASTRI (Scop.) J.-E. Mattsson & M. J. Lai – on bark of *Juniperus communis* and *Pinus sylvestris*.

XANTHOPARMELIA CONSPERSA (Ach.) Hale – on siliceous boulders.

X. SOMLOËNSIS (Gyeln.) Hale – on siliceous boulders.

XANTHORIA CANDELARIA (L.) Th. Fr. – on siliceous boulders.

X. PARIETINA (L.) Th. Fr. – on bark of *Betula pendula*, *Rosa* sp., *Sorbus aucuparia*, *Juniperus communis* and *Pinus sylvestris*; on wooden quay, siliceous boulders and tile.

X. POLYCARPA (Hoffm.) Th. Fr. ex Rieber – on bark of *Betula pendula*, *Ribes alpinum*, *Rosa* sp., *Sorbus aucuparia* and *Pinus sylvestris*.

XYLOGRAPHA PARALLELA (Ach.: Fr.) Behlen & Desberg – on wooden quay.

X. VITILIGO (Ach.) J. R. Laundon – on bark of *Juniperus communis*.

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Stalpersia, gen. nova (Hericiales, Basidiomycota)

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Abstract: A new genus *Stalpersia* Parmasto (Hericiales, Basidiomycota) and a new species, *S. orientalis* collected in the Russian Far East are described.

Kokkuvõte: E. Parmasto. *Stalpersia*, uus perekond kandseente seltsist Hericiales.

Kirjeldatakse uus perekond *Stalpersia* ja uus liik *S. orientalis*, mis on kogutud Venemaa Kaug-Idas.

In the order Hericiales of the so-called aphyllophoroid fungi, very different types of basidiomata are represented: resupinate, pileate, ramarioid (i.e., negatively geotropic and branched). The hymenophore may be poroid, hydnoid, lamellate or smooth. Context may be homogeneous or composed of concrescent branched fibrils (hericioid). Hyphal system is monomitic or dimitic with skeletal hyphae. Dichohyphidia, asterohyphidia and cystidia may be present or absent. Generative hyphae are usually clamped, but some species have simple septa. Gloeoplerous hyphae are usually present, but sometimes lacking. Different combinations of these characteristics have been used to distinguish genera in this group of fungi (cf. Stalpers, 1996). A species with unique combination of characters was collected in the Russian Far East in 1987 and 1990; it does not fit in any described genus, hence a new monotypic genus *Stalpersia* is proposed.

STALPERSIA PARMASTO, GEN. NOVA (HERICIALES, HYMENOMYCETES, BASIDIOMYCOTA).

Pileus mollis vel subcartilagineus, albus, tenuis; superficies glabra vel subfloccosa, sine pileipelli; hymenium humile plicatum vel submerulioideum. Systema hypharum monomiticum; hyphae generatoriae tenuiter tunicatae, fibulatae; hyphae gloeopleroideae atque gloeocystidia adsunt, cystidia desunt; basidia subutriformia, cum 4 sterigmatis; sporae ellipsoideae, cum hilo magno et spinis valde amyloideis; pulvis sporarum albus.

Typus. *Stalpersia orientalis* Parmasto, sp. nova.

Basidiome irregularly pileate, semicircular or flabelliform, fleshy-membranaceous, thin, white, when dried almost horny; upper surface uneven, glabrous or slightly floccose; pileipellis absent; hymenophore radially low-folded or submerulioid.

Hyphal system monomitic; generative hyphae thin-walled, with clamps, not inflated; gloeoplerous hyphae and gloeocystidia present, with yellowish granulose content; cystidia absent; basidia subutriform, 4-spored; spores ellipsoid, with a large hilum, spinulose, strongly amyloid. Spore print white.

Etymology: *Joost A. Stalpers*, Dutch mycologist, author of a monograph of Hericiales. Gender: f.

Remarks. The unique combination of characters makes the genus different from other taxa of Hericiales. However, it has some characteristics in common with the genus *Lentinellus* P. Karst. of the family Auriscalpiaceae. The main differences are: the absence of brownish pigments in *Stalpersia*, the different structure of the hymenophore (lamellate or rarely with ridges in *Lentinellus*) and the absence of a distinct cuticle.

Stalpersia orientalis Parmasto, sp. nova Fig. 1

Pileus irregulariter semiorbicularis vel flabelliformis, albus vel cremeus, carnoso-membranaceus vel subcartilagineus, in statu sicco subcorneus. Basidia 35–40 x 6–8(–10) µm; sporae late ellipsoideae vel sublacrimiformes, 5.5–6.8 x 4.0–4.8(–5) µm.

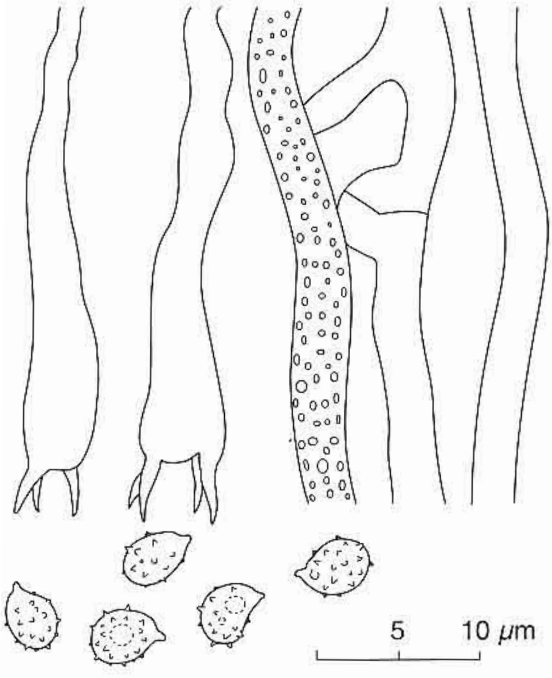

Fig. 1. Generative and gloeoplerous hyphae, basidia and basidiospores (TAA 151103, holotype).

Holotypus. Rossia Orientalis Extremis, montes Sichote-Alin (TAA 151103).

Basidiome irregularly pileate, semiorbicular, irregularly flabelliform or orbicular, shortly stipitate or dimidiate, 2–5 cm in diam, white or cream coloured, when dried slightly yellowish, watery soft, fleshy-membranaceous or subcartilagineous when fresh, light in weight, when dried almost horny. Stipe (when present) up to 2 cm long and 5–10 mm in diam, with 1–3 pilei. Pileal surface uneven, glabrous or slightly floccose, without pileipellis (cuticle); margin slightly dentate or lobed; hymenium radially low-folded or plicate, merulioid (sometimes like in *Plicaturopsis nivea)*, white or creamish (Munsell: 5 Y 9/3). With a light smell of flour or without odour.

Hyphal system monomitic; generative hyphae densely radially arranged, thin-walled, with clamps, sparsely branched, 3.5–6 μm diam; gloeoplerous hyphae present, slightly flexuose, thin-walled, with yellowish granulose content, 4–6 μm in diam, some forming tramal gloeocystidia 40–90 x 8–12 μm; subhymenial hyphae densely interwoven, with very thin walls. Gloeocystidia embedded, broadly clavate, obtuse, 30–50 x 8–12 μm; basidia subutriform, 35–40 x 6–8(–10) μm, soon collapsing, with 4 sterigmata 4–6 μm long; spores broadly ellipsoid or almost tear-shaped, 5.5–6.8 x 4.0–4.8(–5) μm, with a large hilum 1–1.5 μm long, sometimes with a big guttula, slightly thick walled, densely echinulate (spinulose), spines conical, 0.5–1 μm long, amyloid.

Holotype. Russia, Primorsk Terr., Distr. Ternei, Sikhote-Alin Nature Reserve, Maisa (45°15.5' N, 136°28' E), on forest litter in an *Abies* forest, 15 Sep 1990 E. Parmasto (TAA 151103). **Paratype**. Sikhote-Alin Nature Reserve, Ust-Serebryanka (45°07.5' N, 136°22.5' E), on rotten wood in a floodplain deciduous forest, 14 Sep 1987 I. Parmasto (TAA 126153).

Etymology: *orientalis*, eastern.

Remarks. The species is possibly a mycorrhiza fungus able to develop in forest litter.

Mean spore size (μm) and Q value in the type specimens:

6.29 x 4.49	1.40	(TAA 151103)
6.00 x 4.14	1.36	(TAA 126153, spore print)

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Phellinus baumii and related species of the *Ph. linteus* group (Hymenochaetaceae, Hymenomycetes)

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Abstract: Three sibling species of the *Phellinus linteus* group from Russian Far East and Middle Asia were distinguished using biometrical data: *Ph. baumii* s. str., *Ph. lonicericola* Parmasto sp. nova, and *Ph. lonicerinus*. Speciation of these taxa has obviously resulted from allopatric disjunction and sympatric specialization to different hosts.

Kokkuvõte: Erast Parmasto ja Ilmi Parmasto. Eoslavaseen *Phellinus baumii* ja selle *Ph. linteus*-rühma kuuluvad sugulasliigid.

Biomeetriliste andmete kasutamine võimaldab eristada kolme Venemaa Kaug-Idas ja Kesk-Aasias esinevat, *Phellinus linteus*-rühma kuuluvat torikseent. Neiks on *Ph. baumii* (mida käsitletakse senisest kitsamalt), teadusele uus liik *Ph. lonicericola* ja *Ph. lonicerinus*. Nende taksonite eristumine on ilmselt toimunud seoses allopatrilise liigitekkega ning sümpatrilise spetsialiseerumisega eri peremeestaimedele.

INTRODUCTION

Two externally very similar species of the genus *Phellinus* Quél. subgen. *Fulvifomes* (Murrill) Y.C. Dai have been found in the Russian Far East: *Ph. baumii* Pilát, growing mainly on *Syringa*, and a species called *Ph. lonicerinus* (Bondartsev) Bondartsev & Singer found on species of the genus *Lonicera*. M.A. Bondartseva (1986) synonymized the later species with the tropical *Ph. linteus* (Berk. & M.A. Curtis) Teng. Dai & Xu (1998), Dai (1999) and Núñez & Ryvarden (2000) asserted, however, that *Ph. lonicerinus* is a species different from *Ph. linteus*, and synonymized it with *Ph. baumii*.

Ph. lonicerinus was descibed as *Fomes lonicerinus* by Bondartsev with type locality in Uzbekistan (Middle Asia), i. e., very far from the Russian Far East. The type was restudied by Dai & Xu (1998) and Malysheva (2001); nevertheless, it remained to see whether there are two disjunctive conspecific populations (in Far East and Middle Asia), and whether the populations of the fungus growing in Far East on two different hosts (*Ph. baumii* and *Ph. lonicerinus*) really are identical. In the herbarium of the Institute of Zoology and Botany (TAA, Tartu) there are numerous collections of basidiomata of these taxa from both regions. These were used for a comparative study using statistical data on spore measurements, pore size and hyphal diameter.

MATERIALS AND METHODS

47 herbarium specimens and 20 spore prints taken in nature and maintained in the herbarium TAA were used for a statistical study. Spore size, form and size of setae were measured in 2% potassium hydroxide solution in a specimen (or spore print). 25 randomly taken spores were measured for a statistical study in each specimen with the aid of a Sony CCD Video Camera attached to a Nikon Labophot 2 microscope and analysed by Global Lab Image (Data Translation Inc.) software. Up to 25 randomly taken setae were measured using an eyepiece micrometer at 600 x. Diameter of 20 randomly taken skeletal hyphae of dissepiments was measured in Cotton Blue in lactic acid, and in 5% potassium hydroxide solution as used by Dai (1999). Pore size was measured as number of pores per 10 mm in five replications, and average number of pores per mm was calculated. Difference in pore size, spore size and form was compared using analysis of variance and Möls' test (Möls, 1985); phenetic analysis was carried on using A. Batko's program Tytan 87.

RESULTS

Results of measurements of specimens are given in Table 1 and on Fig. 1. Only four specimens of *Ph. linteus* and a few collections possibly closely related to this taxon have been

Table 1. Morphological data of specimens studied.

Herb., no.	Region	Substrate	Spore length x width (μm)	Q	Pores per mm	
Ph. lonicericola						
TAA 100080	FE	Lonicera	3.25 x 2.51	1.30	8.3	
TAA 13933	FE	Lonicera	3.31 x 2.56	1.29	9.1	Holotype
TAA 107585	FE	Lonicera	3.35 x 2.83	1.18	7.8	
TAA 110921	FE	Lonicera	3.37 x 2.69	1.25	8.5	
TAA 13845	FE	Lonicera	3.39 x 2.70	1.26	8.6	
TAA 110982	FE	Lonicera	3.42 x 2.63	1.30	8.5	
TAA 105739	FE	Lonicera	3.46 x 2.73	1.27	8.2	
TAA 13934	FE	Lonicera	3.46 x 2.78	1.24	8.0	
TAA 105314	FE	Lonicera	3.47 x 2.77	1.25	8.7	
TAA 107676	FE	Lonicera	3.48 x 2.73	1.27	8.3	
TAA 105691	FE	Lonicera	3.54 x 2.68	1.32	9.0	
TAA 105296	FE	Lonicera	3.55 x 2.71	1.31	8.1	
TAA 105738	FE	Lonicera	3.55 x 2.80	1.27	8.4	
TAA 105295	FE	Lonicera	3.57 x 2.74	1.30	8.9	
TAA 125081	FE	Lonicera	3.60 x 2.73	1.32	8.0	
TAA 100069	FE	Lonicera	3.63 x 2.71	1.34	8.5	
Ph. baumii						
TAA 108971	FE	Syringa	3.69 x 3.32	1.11	9.0	
TAA 104883	FE	Syringa	3.82 x 3.11	1.23	8.9	
TAA 107526	FE	Syringa	3.91 x 3.16	1.24	8.7	
TAA 125903	FE	Syringa	3.97 x 3.29	1.20	9.0	
TAA 105316	FE	Syringa	3.98 x 3.21	1.24	8.7	
PRM 189012	FE	Syringa	4.00 x 3.10	1.29	9.5	Holotype
TAA 107584	FE	Syringa	4.02 x 3.54	1.14	8.9	
TAA 100158	FE	Syringa	4.04 x 3.23	1.25	8.0	
TAA 118570	FE	Syringa	4.06 x 3.32	1.22	8.4	
TAA 125884	FE	Syringa	4.06 x 3.42	1.19	8.9	
TAA 104835	FE	Syringa	4.08 x 3.23	1.26	9.4	
TAA 105743	FE	Syringa	4.10 x 3.41	1.20	9.2	
TAA 13740	FE	Syringa	4.11 x 3.34	1.23	8.3	
TAA 112906	FE	Syringa	4.12 x 3.45	1.19	8.2	
TAA 104460	FE	Syringa	4.17 x 3.35	1.24	8.9	
TAA 59410	FE	Syringa	4.19 x 3.45	1.22	7.7	
Ph. lonicerinus						
TAA 55017	MA	Lonicera	4.34 x 3.28	1.32	4.6	
TAA 105677	MA	Lonicera	4.41 x 3.50	1.26	4.5	
TAA 55512	MA	Lonicera	4.42 x 3.32	1.33	4.0	
TAA 102824	MA	Lonicera	4.55 x 3.29	1.38	3.9	
TAA 104264	MA	Lonicera	4.56 x 3.51	1.30	4.0	
TAA 97301	MA	Lonicera	4.61 x 3.31	1.39	3.8	
TAA 127578	MA	Crataegus?	4.65 x 3.55	1.31	3.9	
TAA 44612	MA	Lonicera	4.67 x 3.44	1.36	3.9	
TAA 97218	MA	Lonicera	4.68 x 3.46	1.35	3.8	
TAA 127410	MA	Lonicera	4.74 x 3.54	1.34	4.0	
TAA 55407	MA	Lonicera	4.76 x 3.53	1.35	4.0	
LE 22512	MA	Lonicera	4.81 x 3.65	1.32	4.1	Lectotype
TAA 55395	MA	Lonicera	4.85 x 3.44	1.41	4.1	
TAA 55696	MA	Lonicera	4.87 x 3.71	1.31	3.6	
TAA 104407	MA	Lonicera	4.99 x 3.71	1.35	3.9	

Herb., no.	Region	Substrate	Spore length x width (µm)	Q	Pores per mm	
Ph. linteus						
O 118-79	Costa Rica		4.32 x 3.59	1.20	8.1	
O 11-880	Costa Rica		4.62 x 3.87	1.19	8.2	
K 50892	Nicaragua		4.79 x 4.06	1.18	7.4	Holotype
K 13326	Costa Rica		5.09 x 4.00	1.27	7.0	
? Ph. linteus (or related species)						
6168	India		3.34 x 2.75	1.22	8.0	
O Nunez 267	Ecuador		3.66 x 2.89	1.27	8.4	
O 540	Japan		3.72 x 3.07	1.21	7.7	*Ph baumii?*
274	India	Acer	4.10 x 3.28	1.25	8.0	
TAA 103309	India		4.94 x 4.06	1.22	?	
K Pegler 1018	E Africa		5.36 x 4.28	1.25	5.5	

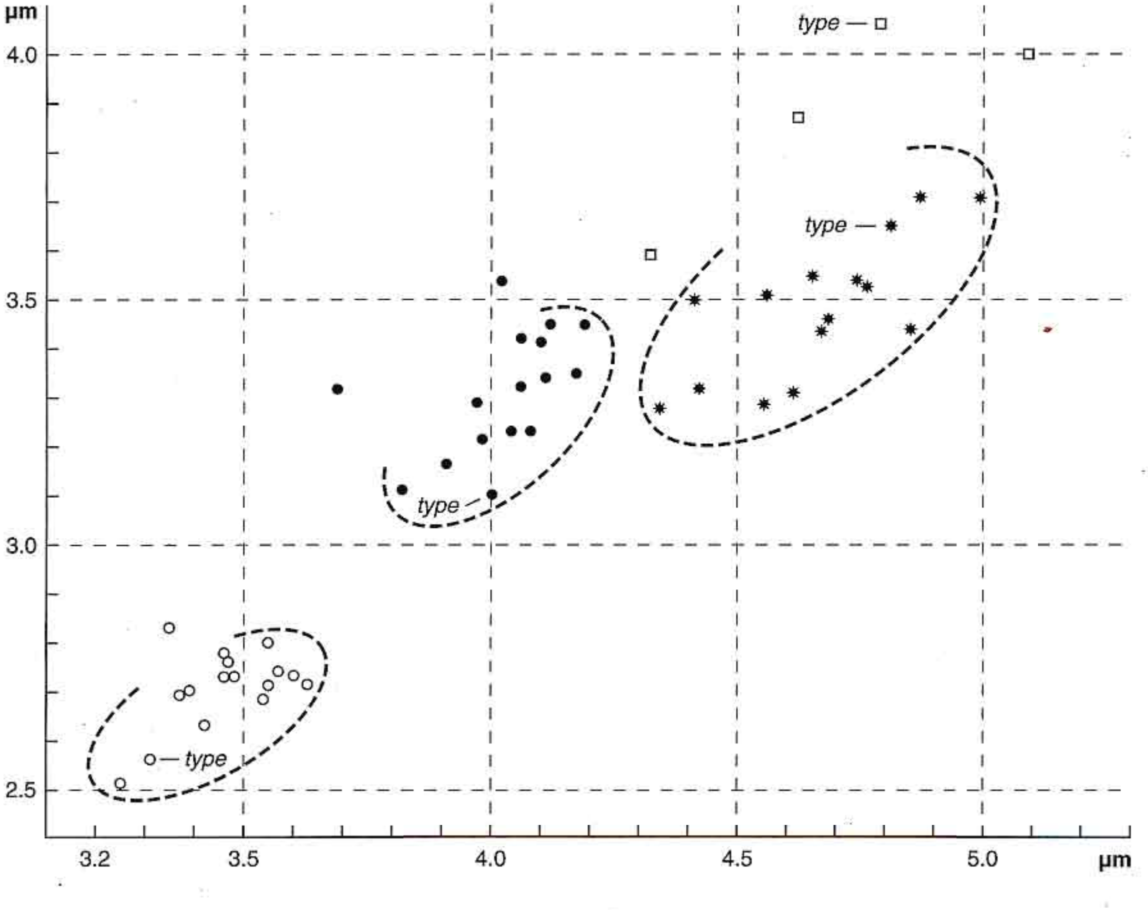

Fig. 1. Mean spore size of *Phellinus lonicericola* (**O**), *Ph. baumii* (●), *Ph. lonicerinus* (✱) and *Ph. linteus* (□).

studied by us. Data on these specimens are used in the *Taxonomy* part of this paper and in *Discussion* but not in the statistical comparison given below.

According to **spore length**, three different groups with non-overlapping specimen means may be distinguished (Far East *Ph. "lonicerinus"* = *Ph. lonicericola* sp. nova, *Ph. baumii* s. str. and Middle Asian *Ph. lonicerinus*). Length of spores in the three taxa may be characterized by the 90%-expected tolerance limits (Parmasto & Parmasto, 1987: 109–111). These discrete statistics are: 3.34–3.58 µm; 3.79–4.25 µm and 4.33–5.00 µm. The differences in mean spore length of the species are significant at $a = 0.001$ level when analysis of variance is used. However, Möls' homogeneity test (Möls, 1987) does not support heterogeneity of spore length data of *Ph. lonicericola* and *Ph. baumii* when analyzed together (the criterion $a = 5.05 > a_{crit} = 0.05$).

According to **spore width**, two different groups of specimen means may be distinguished (*Ph. lonicericola* in one group, *Ph. baumii* s. str. and *Ph. lonicerinus* in another). The 90%-expected tolerance limits in the three taxa are: 2.56–2.86 µm; 3.08–3.54 µm and 3.22–3.74 µm. Möls' homogeneity test demonstrates distinct heterogeneity of spore width data of *Ph. lonicericola* and *Ph. baumii* when analyzed together ($a < 0.05$). The differences in mean spore width between *Ph. lonicericola* and other species are significant at $a = 0.001$ level, between *Ph. baumii* and *Ph. lonicerinus* at $a = 0.01$ level when analysis of variance is used.

Spore length/width quotient **Q** is similar in all three taxa studied. The 90%-expected tolerance limits of *Q* values are: *Ph. lonicericola* – 1.21–1.35; *Ph. baumii* – 1.14–1.30; *Ph. lonicerinus* – 1.27–1.41. Möls' homogeneity test demonstrates, that *Q* data of all three taxa analyzed together may form a homogeneous sample. Nevertheless, when using analysis of variance, the differences of mean *Q* values between all species are significant at $a = 0.001$ level.

According to the mean **number of pores per mm** two very distinct groups may be distinguished *(Ph. lonicericola* and *Ph. baumii* in one, *Ph. lonicerinus* in another). The 90%-expected tolerance limits are 7.8–9.1, 7.8–9.6, and 3.5–4.5 pores per mm. Möls' homogeneity test demonstrates possible homogeneity of pore number data of *Ph. lonicericola* and *Ph. baumii* when analyzed together ($a = 1.87 > a_{crit} = 0.05$).

Mean **size of setae** and their length/width quotient are similar in all taxa studied; these uninformative data were not included into the Table 1.

Diameter of tramal skeletal hyphae is variable in all species; as a rule, mean diameter is less than 3 µm when measured in lactic acid and less than 3.8 µm when measured in KOH 5% solution. The three species differ in this character from *Ph. linteus* which has broader skeletal hyphae (more than 3 resp. 4 µm), as mentioned already by Dai & Xu (1998) and Dai (1999). However, in *all* four species the hyphae become swollen in KOH: their mean diameter will be 1.2–1.5 times larger than in lactic acid.

The Middle Asian specimens of *Ph. lonicerinus* were compared with the (lecto)type of *Fomes lonicerinus* Bondartsev (cf. Table 1); they are unquestionably conspecific. The studied specimens of *Ph. baumii* s. str. are conspecific with the holotype of this species. The holotype of *Polyporus linteus* Berk. & M.A. Curtis is similar to the Middle Asian *Ph. lonicerinus*, but differs in its pore size (as an average, 7.4 per mm) and broad almost subsphaerical spores with mean size 4.79 x 4.06 µm.

Based on the data in Table 1, their phenetic analysis (Fig. 2), and statistical analyzis given above, three sibling species closely related to *Ph. linteus* may be distinguished in North Asian Far East and Middle Asia (including the Far East *Ph. "lonicerinus"* described as a new species *Ph. lonicericola* below).

The differences between the four taxa are summarized in the table below.

	Ph. lonicericola	***Ph. baumii***	***Ph. lonicerinus***	***Ph. linteus***
Mean spore length	3.3–3.65	3.75–4.2	4.3–5.0	4–5.4
Mean spore width	2.6–2.95	3.05–3.5	3.2–3.8	3–4.3
Pores per mm	7.8–9.1	7.7–9.5	3.5–4.5	7–8.2
(Main) host	*Lonicera*	*Syringa*	*Lonicera*	Unknown angiosperms
Distribution	East Asia	East Asia	Middle Asia	(Sub)tropical America

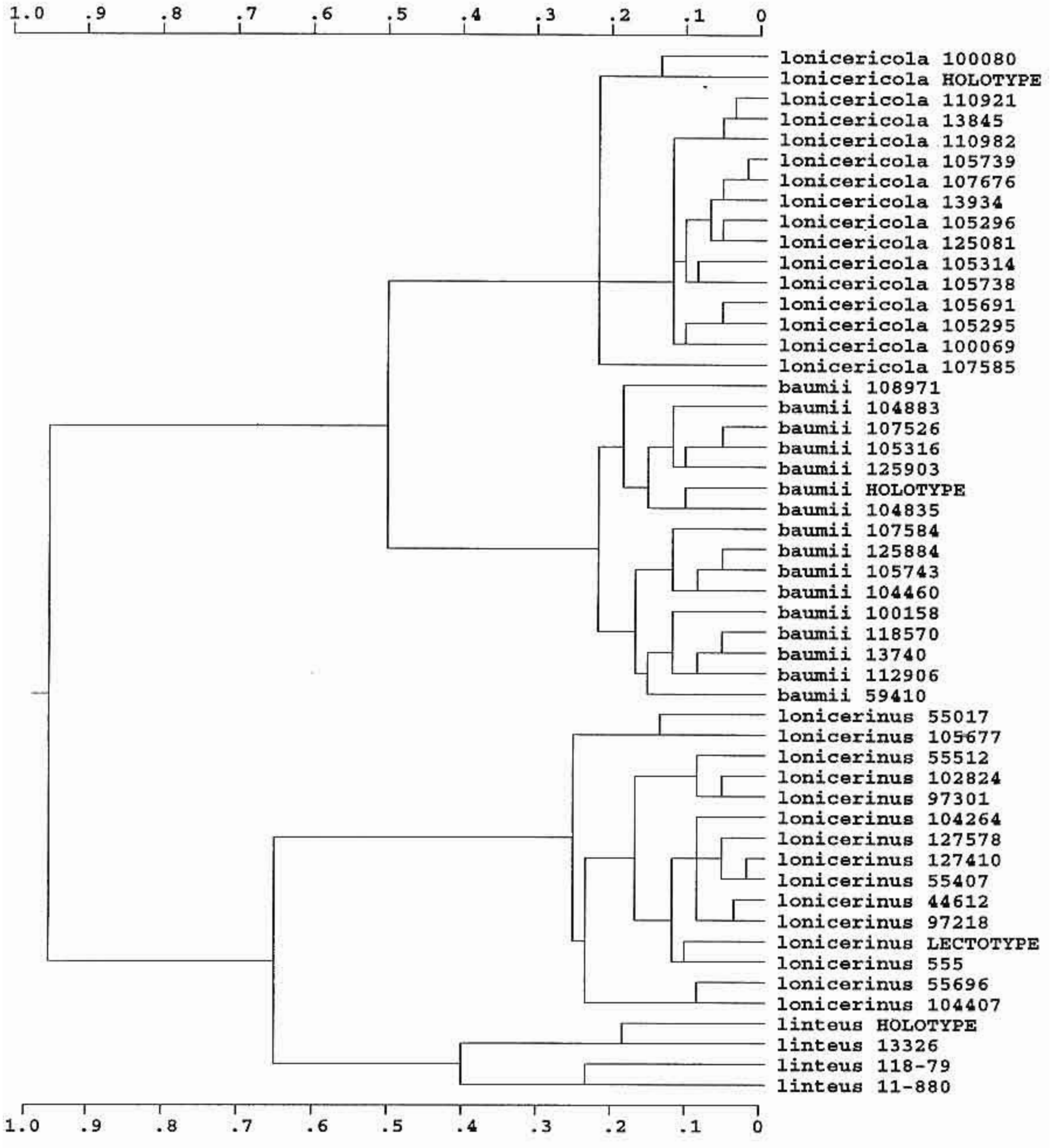

Fig. 2. Phenogram based on spore length, spore width and number of pores per mm data. Manhattan distance (data standardized), UPGMA clustering (scale relative, 0 = minimal distance between objects).

TAXONOMY

Phellinus baumii Pilát, Bull. Soc. Mycol. France 48: 25 (1933); Pilát, Atlas Champ. Eur. Polyp. 524 (1942); Ito, Mycol. Fl. Japan 2 (4): 377 (1955); Lyubarski & Vasilyeva, Wood-destr. fungi 127 (1975); Bondartseva *in* Bondartseva & Parmasto, Clavis diagn. fung. URSS. Aphyll. 1: 85 (1986) *p. p.;* Larsen & Cobb-Poulle, Phellinus 41 (1990); Dai & Xu, Mycotaxon 67: 192 (1998) *p. p.*; Dai, Acta Bot. Fenn. 166: 55 (1999) *p. p.;* Núñez & Ryvarden, East Asian Polypores 101 (2000) *excl. syn.*

Hosts and distribution. Syringa amurensis, on living and dead trunks, mainly in floodplain forests; mentioned also on some other deciduous trees and bushes. Russian Far East: southern part of Khabarovsk Terr., Primorsk Terr.; Eastern Asia: China, Japan, ? Korea.

Specimens studied. **RUSSIA.** KHABAROVSK TERR. *Yevreiski Auton. Region, Distr. Obluchensk:* Yadrino, 11 Aug 1961 E. P. (TAA 13740, 13926, 13927, 13928). *Distr. Khabarovsk:* Korphovskaya, on a dead trunk, 8 Sep 1976 L. Järva (TAA 92262); Bolshekhekhchirsk Nature Reserve near Khabarovsk, at Rivulet Sosninski, 29 Jul 1982 E. P. (TAA 104460). *Distr. Lazo:* Mukhen, on a dead twig in a *Picea-Abies* forest, 29 Sep 1961 E. P. (TAA 14753); Bitshevaya SE of Khabarovsk, 15 and 16 Aug 1982 E. P. (TAA 104835, 104884, 104903). PRIMORSK TERR. *Distr. Chuguyevski:* Bulyga-Fadeyevo, on fallen trunks, 8 and 11 Sep 1975 E. P. (TAA 59410, 59688, 59758), at Rivulet Medvezhi, 7 Aug 1981 E. P. (TAA 103833), at Rivulet Beryozovyj, 8 Sep 1975 E. P. (TAA 59689). *Distr. Kavalerovo:* Kavalerovo, in a floodplain forest, 6 Oct 1977 E. P. (TAA 101164), Khrustalnyi, 3 Oct 1977 M. Murdvee-Saar (TAA 111405). *Distr. Khasansk:* Kedrovaya Pad' Nature Reserve, at Rivulet Olenij, on a living trunk in an *Abies holophylla* forest, 15 Sep 1961 E. P. (TAA 13937). *Distr. Lazo:* Lazo Nature Reserve, Sandagou, Aug 1961 E. P. (TAA 180483), same area, 9 Sep 1961 E. P. (TAA 14068), Lesosetshnyi, 8 Sep 1961 E. P. (TAA 14053), Amerika, 8 and 9 Aug 1986 E. P. (TAA 107526, 107584). *Distr. Partizansk:* Slinkino, on a dead trunk in a nemoral forest, 26 May 1983 E. P. (TAA 105306). *Distr. Ternei:* Sikhote Alin Nature Reserve, Khanov Klyuch, on a dead trunk in an *Alnus* forest, 17 and 19 Sep 1976 E. P. (TAA 52632, 100157, 100158), Kuruma, 21 Sep 1979 A. Kollom (TAA 112906), Ust'-Serebryanka, 11 Sep 1987 U. Kõljalg (TAA 149166); same area, 12 Sep 1987 E. P. (TAA 158971). *Distr. Ussurisk:* Ussuri Nature Reserve, 28 Oct 1973 H. Trass (TAA), Kaimanovka, 4 Aug 1979 M. Saar (TAA 118570); same area, 22 May 1983 E. P. (TAA 105316). *Distr. Vladivostok:* 5 Jun 1928 Ziling 267 (PRM 189012, **holotype**), Vladivostok, 16 Aug 1974 L. Järva (TAA 46953).

Phellinus linteus (Berk. & M.A. Curtis) Teng, Fungi China 762 (1963); Ryvarden & Johansen, Prelim. polypore fl. E. Africa 180 (1980); Gilbertson & Ryvarden, Amer. polypores 2: 582 (1987); Larsen & Cobb-Poulle, Phellinus 84 (1990); Dai & Xu, Mycotaxon 67: 195 (1998). – *Polyporus linteus* Berk. & M.A. Curtis, Proc. Amer. Acad. Boston 4: 122 (1860).

Hosts and distribution. On angiosperms. Found in tropical America; also indicated from Africa and India; one specimen collected from Australia (K).

The American specimens (including the holotype) are characterized by mean size of spores 4.3–5.1 x 3.6–4.1 µm, 7–8.3 pores per mm (specimen means), and tramal skeletal hyphae about 3.5–4.5 µm in diam in lactic acid, 4–6 µm in KOH 5% solution.

The specimens collected in Africa and Asia seen are few and their hosts are unknown. The specimens from Ecuador (Núñez 267, O) and India (Rattan 6168, O) have small spores and pores like those in *Ph. lonicericola;* another Indian specimen (Sharma 274, O) has spores smaller than in "typical" *Ph. linteus;* a specimen collected in East Africa (Pegler 1018, K) has very large spores and big pores (5.5 per mm).

Some 22 years ago, the senior author of this paper studied (without statistical measurement of spores) 16 specimens determined as *Ph. linteus* collected in India and maintained in the herbaria PAN and DD. Identification of these was confirmed by J.L. Lowe, in some cases by L. Ryvarden. They were collected in Maharashtra, Punjab, Tamil Nadu (Coimbatore Distr.) and Uttar Pradesh states; in 3 cases on *Lonicera* sp., but also on *Albizzia* sp. (Mimosaceae), *Anogeissus latifolia* (Combretaceae), *Corylus colurna* (Betulaceae), *Morus* sp. (Moraceae) and *Rhus punjabensis* (Anacardiaceae). Spores of these collections are about 4–5 mm long. In the book on Indian Hymenochaetaceae by Sharma (1995: 159), *Albizzia, Cassia, Corylus, Lonicera, Prunus, Pyrus* and *Rhus* have been mentioned as hosts of *Ph. linteus.*

Until more detailed studies, we avoid to comment the identifications of specimens collected as *Ph. linteus* in other countries than in America.

Specimens studied. COSTA RICA. Prov. San Jose, Villa Colón, 23 Jul 1963 J.L. Lowe 13326 (K); Palo Verde, Guanacaste, on hardwood, 24 Mar 1988 J. Carranza 11–88 (O); Alangares, Guanacaste, Carranza 125, 118–79 (O). EL SALVADOR. 1952 W. Löbischet (?) 818 (K). NICARAGUA. C. Wright 96 (K 50892, **holotype** of *Polyporus linteus.*)

Specimens identified as Ph. linteus but possibly different. ECUADOR. Sucumbios Prov., Reserva Natural de Cuyabeno, Jun-Jul 1993 M. Núñez 267 (O). TANZANIA. Rwanda Nat. Park, Mpululu Mts., 21 May 1968 D.N. Pegler 1018 (K). INDIA. Jammu & Kashmir, Batote, 25 Sep 1966 S.S. Rattan 6168 (PAN); Eastern Himalayas, Choupta, on a living tree trunk (*Acer*?), 12 Oct 1990 J.R. Sharma 274 (O).

Phellinus lonicericola Parmasto sp. nova. – *Phellini baumii* Pilát similis sed differt in sporis parvis (magnitudo media speciminum 3.3–3.65 x 2.6–2.95 μm) atque hospite (*Lonicera* spp.). Holotypus: Rossia, Regio Primorsk, Reservatum nomine Lazo, Insula Petrovii, ad caudicem vivum *Lonicerae ruprechtianae,* 2 IX 1961 E. Parmasto legit (TAA 13933); isotypi in herbaria BPI, H, K, LE, O.

Similar to *Ph. baumii;* differs with small spores (mean spore size of specimens: 3.3–3.65 x 2.6–2.95 μm) and with different hosts (*Lonicera* spp.). Etymology: *lonicericola,* growing on species of the genus *Lonicera.*

Hosts and distribution. On living and dead trunks and branches of *Lonicera maackii, L. maximowiczii, L. ruprechtiana* and other species of *Lonicera,* mainly in nemoral forests and riverside bushlands. Russian Far East: southern part of the Primorski Territory.

The taxon has been identified as *Ph. lonicerinus* by Bondartsev (1953), as *Ph. linteus* by Bondartseva (1986), and as *Ph. baumii* by Lyubarski & Vasilyeva (1975), Dai & Xu (1998) and Dai (1999).

Ph. lonicericola differs from *Ph. lonicerinus* by its much smaller spores and pores; it is closely related to *Ph. baumii* but differs in distinctly smaller spores and its substrate (Caprifoliaceae: *Lonicera* L. versus Oleaceae: *Syringa* L. in *Ph. baumii).*

Specimens studied. RUSSIA, PRIMORSK TERR. *Distr. Anisimovka: Lonicera maximowiczii,* on dead branches, 16 Oct 1977 M. Murdvee (TAA 110921, 110982). *Distr. Khasansk:* Kedrovaya Pad' Nature Reserve, on *Lonicera* sp., 7 Aug 1979 I. Parmasto (TAA 125081), at Rivulet Kabanij, on a dead trunk of L. *maackii* in a nemoral forest, 21 Jun 1984 E. P. (TAA 105691), at Rivulet 1 Zolotoi, on living trunks of *L. maackii* in a nemoral forest, 22 Jun 1984 E. P. (TAA 105738, 105739); at Rivulet 2 Zolotoi, on a dead trunk of *L. maackii* in a nemoral forest, 15 Sep 1961 E. P. (TAA 15084); same area, on a fallen trunk, 16 Sep 1961 E. P. (TAA 13845). *Distr. Lazovsk:* Lazo Nature Reserve, Sandagou, on a dead trunk of *L. maackii,* 9 Sep 1961 E. P. (TAA 15993), Petrov Is., *L. ruprechtiana,* on living trunks in a *Taxus* forest, 2 Sep 1961 E. P. (TAA 13933, **holotype**; 13934), Amerika, *L. maackii,* on a living trunk, 9 Aug 1986 E. P. (TAA 107585). *Distr. Ussurisk:* Kamenushka, on living trunks of *L. ruprechtiana* in a nemoral forest, 22 May 1983 E. P. (TAA 105295, 105296, 105314); same area, on dead trunks of *L. maackii,* 1–2 Jun 1976 E. P. (TAA 100069, 100080). *Distr. Partisansk:* Mountain Pass, on a dead branch of *Lonicera* sp. in an *Abies* forest, 16 Aug 1986 E. P. (TAA 107676).

Phellinus lonicerinus (Bondartsev) Bondartsev & Singer, Ann. Mycol. 39: 56 (1941); Pilát, Atl. Champ. Eur. Polyporaceae 535 (1942); Bondartsev, Trutovye griby 372 (1953); Larsen & Cobb-Poulle, Phellinus 87 (1990). – *Fomes lonicerinus* Bondartsev, Sporovye Rastenia 2: 500 (1934). – ? *Ph. everhartii* (Ellis & Galloway) A. Ames sensu Dai, Acta Bot. Fennica 166: 60 (1999).

The taxon has been synonymized with *Ph. linteus* by Bondartseva (1986), with *Ph. baumii* by Lyubarski & Vasilyeva (1975), Dai & Xu (1998), Dai (1999) and Núñez & Ryvarden (2000).

The "holotype" of *F. lonicerinus* studied by Dai (1999), Malysheva (2001) and by us is actually the lectotype. Bondartsev (1934: 500 and 502) cited as the type a specimen collected in Uzbekistan in the text written in Russian, but another specimen collected in Samara Prov. (in East European Russia) in the text written in Latin. Later he cited the Uzbek specimen as the type (Bondartsev, 1953: 372). However, according to the spore measurements given by Malysheva (2001: 63), both specimens are conspecific.

Ph. lonicerinus is closely related to *Ph. linteus* but differs by its wider pores (specimen means: 3.6–4.6 vers. 7–8.2 per mm), and more ellipsoid spores. According to the analysis of variance, mean spore width and *Q* value differences are significant at a = 0.001 level; difference in spore length is insignificant (a > 0.1).

Hosts and distribution. On living and dead trunks and branches of *Lonicera altmannii, L. korolkovii, L. nummulariifolia* and other species of *Lonicera*, mainly in dry bushlands and mountain semideserts on elevation of up to 2,500 m. Widely spread in Middle Asia.

Specimens studied. KAZAKHSTAN. Turgen Valley near Alma-Ata, on a living trunk of *Lonicera* sp., 2 May 1984 I. & E. P. & S. Abiev (TAA 105677). KIRGHIZIA. Chatkal Mts., Sary-Tshelek Nature Reserve, on *Lonicera* sp., 5 Aug 1967 A. & T. Raitviir (TAA 44612). TADZHIKISTAN. Khissar Mts., Kondara Valley, on *Lonicera* sp., 5, 6 and 7 Apr 1977 I. Parmasto (TAA 96732, 96750, 96751, 96769, 96789); same area, on *L. nummulariifolia,* 6 Apr 1977 I. Parmasto (TAA 96762); same area, on dead and living trunks of *Lonicera* sp., 24, 27 and 28 May 1978 I. Parmasto (TAA 97218, 97282, 97301); same area, on living *L. nummulariifolia,* 26 Apr 1980 M. Bondartseva (TAA 102824); Kondara, Kvak, on *Lonicera* sp., 26 and 27 May 1978 I. Parmasto (TAA 97260, 97284, 97290, 97291); Nurek, on a living trunk of *L. korolkovii,* 25 Apr 1980 E. P. (TAA 102814); Darvag Mts., Tavildara-Sagisdashto, on *Lonicera* sp., 22 Jun 1982 A. Raitviir (TAA 64949); Ramit Nature Reserve, on *Lonicera* sp., 11 and 12 Apr 1977 I. Parmasto (TAA 96829, 96830, 96853); Pamir, Vautsh Valley, Gudshevash, on *Lonicera* sp., 8 Jun 1978 I. Parmasto (TAA 97352). TURKMENIA. *Distr. Bakharden:* Arvaz, on *L. nummulariifolia,* 18 Oct 1971 I. Frolov (TAA 55490); same area, on *Lonicera* sp., 17 Oct 1971 E. P. (TAA 55395, 55407, 55428, 55696); Nukhur, Kara-Suv, on trunks of *L. nummulariifolia,* 20–22 Oct 1971 E. P. (TAA 55469, 55512, 55523). *Distr. Geok-Tepe:* Dushak Mt., on a trunk of *Lonicera* sp., 29 Oct 1971 E. P. (TAA 55696). *Distr. Kara-Kala:* Aiu-Dere, on *Lonicera* sp., 16 Apr 1969 P. Põldmaa (TAA 33119), Khozly-Dere, on *L. nummulariifolia,* 22 Apr 1971 E. P. (TAA 54985, 55017, 55022, 55023); Tazae-Taplan and Chozly-Dere, on dead branches of *L. nummulariifolia,* 22 Apr 1971 E. P. (TAA 55002, 55017). UZBEKISTAN. *Distr. Bostanlyksk:* Yubileinyi, on living trunks of *L. altmannii,* 22 Apr 1982 E. P. (TAA 104277) and a living trunk of *Lonicera* sp., 22 Apr 1982 E. P. (TAA 104281). *Distr. Parkent:* Chatkal Nature Reserve, on *Crataegus* sp. (?) 29 Apr 1988 A. Kollom (TAA 127578); nearby, on a dead trunk, 29 Apr 1988 I. Parmasto (TAA 126250). *Prov. Samarkand, Distr. Sarymat:* on *Lonicera* sp., 1926 E. Czerniakowski (LE 22512, **lectotype** of *Fomes lonicerinus*). *Distr. Tashkent:* Yangi-Kurgan, at the River Kurgan-Soh, on dead trunks of *Lonicera* sp., 24 Apr 1982 A. Kollom (TAA 127410, 127412); same area, Kovluk-Sai, on base of a *Lonicerus* sp., 24 Apr 1982 E. P. (TAA 104264); same area, Chimgan, Bolshoi Kok-Sai, 25 Apr 1982 E. P. (TAA 104407, 104439); Chimgan, on base of a living *Lonicera* sp., 27 Apr 1982 E. P. (TAA 104396).

DISCUSSION

Ecology of most species of *Phellinus* Quél. *s. l.* is not well known, but in species growing on living trees, specialization on certain host genera (or related genera) is a rule. There are only a few species with a broad spectrum of hosts, e. g., *Ph. torulosus* (Pers.) Bourdot & Galzin is able to infect numerous tree species including both angiospermic and gymnospermic genera; *Phylloporia (Phellinus) ephedrae* (Woron.) Parmasto is growing on two very different hosts, *Ephedra* (Gnetopsida, Gymnospermae) and *Jasminum* (Magnoliopsida, Angiospermae).

Phellinus igniarius (L.: Fr.) Quél., a species thought to be common on several tree genera earlier, is a complex of not less than eight specialized sibling species: *Ph. alni* (Bondartsev) Parmasto, *Ph. cinereus* (Niemelä) Fischer, *Ph. igniarius* s. str., *Ph. laevigatus* (Fr. ex P. Karst.) Bourdot & Galzin, *Ph. lundellii* Niemelä, *Ph. nigricans* (Fr.: Fr.) P. Karst., *Ph. populicola* Niemelä, *Ph. tremulae* (Bondartsev) Bondartsev & Borisov. *Ph. pini* (Brot.: Fr.) A. Ames has been divided into not less than seven specialized species. *Ph. robustus* (P. Karst.) Bourdot & Galzin *s. l.* has been found to be a complex of three species. *Ph. weirii* (Murrill) Gilb. *s. l.* has been found to be a complex of two species, *Ph. sulphurascens* Pilát and *Ph. weirii* s. str.

The macromorphological differences between the specialized sibling species are not always striking but usually remarkable for experienced eyes. Moreover, micromorphological differences may be found, but in many species of *Phellinus,* the spores are of small size and their differences between species may only be correctly observed when modern methods of measurement under high magnification and statistical study of variability of specimen means will be used.

In this study, small, but constant distinctions have been found between three sibling species of the *Phellinus linteus* group present in Middle and East Asia. Both allopatric and sympatric speciation have caused the origin of these taxa.

Ph. linteus has been described from Mesoamerica and South America on unidentified hosts. It is possible but not proved, that the same species is widely distributed and occurs also in Africa, South Asia and Australia. Too various hosts mentioned in literature or on herbarium labels, and suspiciously great variability of spores and pores (cf. Table 1) of the specimens collected in these regions, points to the need of further studies. Our predictions are, that several additional sibling species related to *Ph. linteus* specialized to different angiospermic genera will be found in future in Africa, South Asia and Australia. The use of molecular characters may shed light on this complex. On the other side, when collecting in (sub)tropical areas, greater efforts must be made to identify the host of any *Phellinus* species growing on living trees or bushes.

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Rare and interesting species of the Dermateaceae from Estonia

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Abstract: Fifteen species of the Dermateaceae are reported for the first time from Estonia. Some species of *Belonopsis, Coronellaria* and *Pirottaea* are discussed in detail.

Kokkuvõte: A. Raitviir ja K. Leenurm. Nahktiksikuliste haruldased ja huvitavad liigid Eestist.

Artiklis esitatakse andmed viieteist Eestile uue nahktiksikulise liigi kohta.

INTRODUCTION

Several rare or interesting species of the Dermateaceae have been collected in Estonia in recent years and also found in old unnamed collections of TAA. The authors have collected or identified from collections by other mycologists fifteen first records of the Dermateaceae for Estonia.

MATERIALS AND METHODS

Freshly collected living material was mounted in tap water, and dry herbarium material was resoaked in 3% aqueous solution of KOH. Meltzer's reagent (MLZ), Congo Red (CR) and Cotton Blue (CB) were used for histochemical reactions. The mounts were examined in a Nikon Labophot-2 microscope equipped with a drawing tube. The size of microscopical structures was measured and drawings made from mounts in 3% KOH if not stated otherwise. All specimens are deposited in the Mycological Herbarium of the Institute of Zoology and Botany (TAA)

LIST OF SPECIES

Belonopsis obscura (Rehm) Aebi

Figs 1-3

Apothecia appearing in a thick, dark brown to blackish subiculum, with a short stipe remaining hidden in subiculum, shallow-cupulate to saucer-shaped, 1–2 mm diam., externally dark brown and hairy, hymenium pale yellowish-gray. Ectal excipulum of textura globulosa, cells 5–11 µm diam., with dark brown walls, the external layer covered with clavate dark brown 1–2-celled outgrowths giving it a hairy appearance. Margin covered with cylindrical, subhyaline, hair-like hyphae up to 100 µm long and 4 µm wide forming a rather thick fringe. Asci arising from simple septa, cylindrical-clavate, 8-spored, 50–80 x 8–11 µm, apical pore MLZ+. Spores in two fascicles, rarely in a single fascicle, cylindrical-clavate, 0–7-septate, 30–50 x 2.5–3.2 µm, spore wall slightly thickening and becoming pale brownish at maturity. Paraphyses cylindrical, apically slightly swollen, slightly exceeding the asci.

Hiiumaa, Kõrgessaare county, Kaibaldi Heath, 58° 58.5' N 22° 40' E on a dead stem of *Calluna vulgaris* L., Sep 16 2001, coll. K. Leenurm, det. A. Raitviir (TAA 165827).

B. obscura is a species of unclear taxonomic position. Nauta & Spooner (2000) have excluded it from *Belonopsis* suggesting that it belongs to *Mollisia*. The authors agree, that it is not a good *Belonopsis* as it lacks the characteristic crystals of calcium oxalate in the medulla, but its ascus and spore characters are very different from those of typical species of *Mollisia*. For this reason we prefer to retain the valid current name for this species until the generic limits in mollisioid fungi will be clearer than at the present moment.

B. obscura is a rare species, known until now only from a few localities in Austria, Germany and Sweden (Eriksson, 1970; Remler 1979).

BELONOPSIS RETINCOLA (Rabenh.) LeGal & F. Mangenot

Apothecia appearing in a thick, dark brown to blackish subiculum, with a short stipe remaining hidden in subiculum, at first deeply cupulate, then shallow-cupulate to saucer-shaped, 1–3 mm diam., externally dark brown and hairy, hymenium pale yellowish or greyish-white. Ectal excipulum of textura globulosa, cells 5–11 µm diam., with dark brown walls, the external layer covered with clavate dark brown 1–2-celled outgrowths giving it hairy appearance. Medulla of textura intricata, containing numerous crystals of calcium oxalate. Asci arising from croziers, narrowly clavate, 8-spored, 100–110 x 5–6 µm, apical pore MLZ+. Spores in two fascicles, cylindrical-fusoid, hyaline, 0–3-septate, 15–20 x 2–2.5 µm. Paraphyses cylindrical, apically slightly swollen, slightly exceeding the asci.

Läänemaa, Puise 58° 46.5' N 23° 27.5' E, on a dead culm of *Phragmites communis* Trin., June 2 1972, coll. B. Kullman, det. A. Raitviir (TAA 65534).

This species is rather widely distributed in Europe but evidently rare everywhere (Nannfeldt, 1985a).

CORONELLARIA PULICARIS (P. Karst.) Sacc.

Figs 4–6

Apothecia of subcuticular origin, erumpent and at maturity almost fully protruding and seemingly superficial, shallow cupulate to saucer-shaped, 0.2–0.5 mm diam., pale yellowish to pale yellowish brown when fresh and dry. Ectal excipulum basally of textura globulosa-angularis, cells hyaline to pale yellowish, 5–10 µm diam., turning into a zone of textura prismatica at the flanks toward to the margin. Margin covered with a fringe of cylindrical-clavate hyaline cells, 30–50 x 3–5 µm, apically encrusted with colourless granules. Asci arising from simple septa, broadly cylindrical-clavate with a short narrow stalk, 8-spored, 50–60(–70) x 8–10 µm, wide apical pore MLZ+. Spores irregularly biseriate, rarely obliquely uniseriate, ellipsoid, straight, sometimes slightly inequilateral, aseptate, containing two big or numerous minute lipid droplets, 12–15 x 4–5 µm. Paraphyses cylindrical, apically lanceolate and encrusted by numerous colourless granules, up to 5 µm wide, exceeding the asci by 10–15 µm.

Lääne-Virumaa, Võsu 59° 35' N 25° 58.5' E, on dead stems of *Scirpus tabernaemontani* K. Gmel. on a wet coastal meadow, July 28 1959, coll. P. Põldmaa, det. A. Raitviir (TAA 30230).

MOLLISIA AMENTICOLA (Sacc.) Rehm

Pärnumaa, Varbla, 58° 25' N 23° 43' E, on fallen fruits of *Alnus incana*, Sep 13 1980, A. Raitviir (TAA 64798); Jõgevamaa, Alam-Pedja Nature Reserve, Puurmani, Kirna Nature Trail, 58° 32.5' N 26 12.5' E, on fallen fruits of *Alnus incana* (L.) Moench, Nov 3 2000, K. Leenurm (TAA 165742).

MOLLISIA BENESUADA (Tul.) W. Phillips

West-Estonian Biosphere Reserve, Osmussaar, 59° 17' N 23° 24' E, on a dead branch of *Salix* sp.

Aug. 19 2000, coll. K. Leenurm, det. A.Raitviir (TAA 165668).

MOLLISIA CARICINA Fautr.

Tartumaa, Ropka, 58° 19' N 26° 38' E, on dead leaves of *Carex* sp., Oct 10 1984, coll. B. Kullman, det. A. Raitviir (TAA 115779). West-Estonian Biosphere Reserve, Osmussaar, 59° 17' N 23° 24' E, on dead leaves of *Carex* sp., Aug 19 2000, coll. K. Leenurm, det. A.Raitviir (TAA 165667).

MOLLISIA REVINCTA (P. Karst.) Rehm

Hiiumaa, Hanikatsi, islet 58° 46.5' N 23° 03' E , on dead stems of *Filipendula ulmaria* (L.) Max., June 10-15 1972, coll. B. Kullman, det. A. Raitviir (TAA 65581, 65582, 65603). Jõgevamaa, Tõivere, 58° 48.5' N 26° 05' E, on dead stems of *Filipendula ulmaria* (L.) Max., July 25 1966, coll. T. Heinrichson-Normet, det. A. Raitviir (TAA 31196).

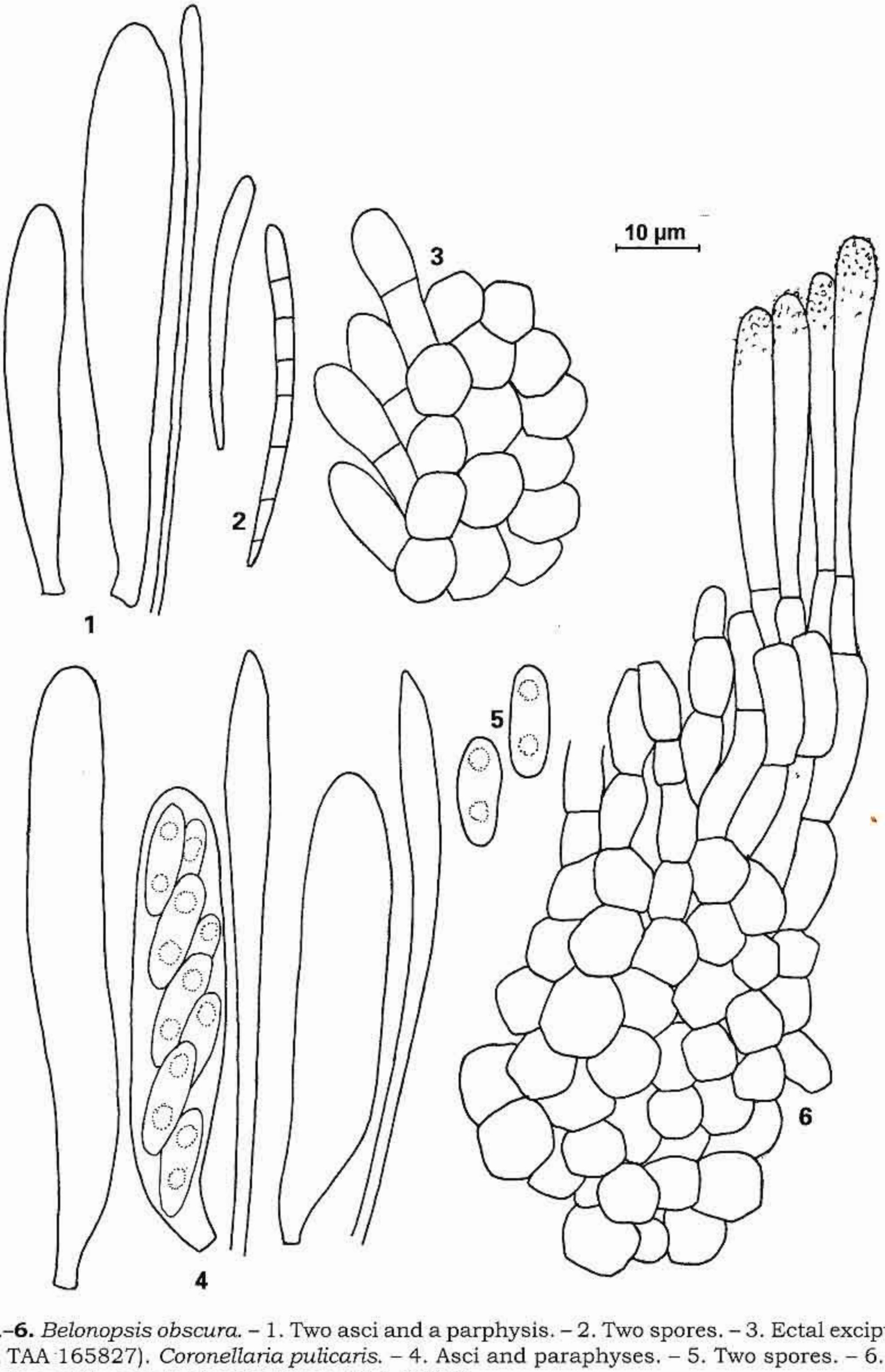
PEZICULA AESCULEA Kirscht.

Saaremaa, Viidu, 58° 17' N 22° 07.5' E, on dead branches of *Corylus avellana* L. in Picea-Pinus mixed forest, Aug 25 1960, A. Raitviir (TAA 41047).

PIROTTAEA ASTRAGALI Nannf.

Figs 7–10

Apothecia of subcuticular origin, erumpent and at maturity almost fully protruding and seemingly superficial, shallow cupulate, 0.15–0.3 mm diam., dark gray when fresh, totally blackish with a narrow greyish-white margin



Figs 1–6. *Belonopsis obscura.* – 1. Two asci and a parphysis. – 2. Two spores. – 3. Ectal excipulum. (From TAA 165827). *Coronellaria pulicaris.* – 4. Asci and paraphyses. – 5. Two spores. – 6. Ectal excipulum with marginal hairs (From TAA 30230).

when dry. Ectal excipulum of textura globulosa, cells dark-walled, 5–10 µm diam., sometimes turning into a narrow zone of textura prismatica close to the margin. Grana abundant, single celled or composed of 2–4 cells with thick, dark-brown walls, 5–7 µm diam. Setae numerous, often arranged into fascicles at the margin, cylindrical or slightly tapering, dark brown, thick-walled, apically subconical, 1–3-septate, 40–50 x 3–5 µm. Asci arising from croziers, cylindrical-clavate, 8-spored, 25–40 x 4–6 µm, apical pore MLZ+. Spores irregularly biseriate or obliquely uniseriate, fusoid to clavate fusoid, straight to curved, aseptate, without distinct inclusions or containing several minute lipid droplets, 6–9 x 1–1.5 µm. Paraphyses cylindrical, apically clavate, up to 2.5 µm wide.

Tartumaa, Konguta, Erumäe hill-fort, 59° 19' N 25° 34' E, on dead stems of *Filipendula ulmaria* (L.) Max., May 26 2001, coll. K. Leenurm, det. A. Raitviir & K. Leenurm (TAA 165796).

This species, until now known only from the type locality in Switzerland, is easily recognizable by its small-celled excipulum lacking a wide, distinct zone of textura prismatica close to the margin and short spores. It is evidently a polyphagous species, not specific to *Astragalus*. Although several species of *Pirottaea* have a rather narrow substrate range not all of them are so strictly host-specific as emphasized by Nannfeldt (1985).

PIROTTAEA NIGROSTRIATA Graddon

Figs 11–14.

Apothecia of subcuticular origin, erumpent and at maturity almost fully protruding and seemingly superficial, deeply cupulate, 0.2–0.5 mm diam., dark gray with the blackish stripes on the flanks and with pale greyish hymenium when fresh, totally blackish with a whitish margin when dry. Ectal excipulum basally of textura globulosa, cells dark-walled, 8–15 µm diam., laterally toward the margin of textura prismatica, passing at the margin into subhyaline protruding hyphae. Grana very numerous, very dark and opaque, mostly single celled, 6–8 µm diam. Setae arranged into longitudinal streaks, cylindrical, with thick dark-brown walls, 0–2-septate, 5–50 x 3.5–5 µm. Asci arising from simple septa, cylindrical-clavate, 8-spored, 40–50 x 4–6 µm, apical pore MLZ+. Spores irregularly biseriate, clavate fusoid, straight to curved, aseptate, with two small polar lipid globules, 8–11 x 1.8–2.5 µm. Paraphyses cylindrical, up to 2.5 µm wide.

Tartumaa, Kavilda, 58° 20.5' N 26° 22' E on a dead stem of *Heracleum* sp., June 17 1987, A. Raitviir (TAA 136054).

This species seems to be confined to the big Apiaceae, *Anthriscus, Angelica* and *Heracleum*.

PIROTTAEA PILOSISSIMA NANNF.

Figs 15–18.

Apothecia of subcuticular origin, erumpent and at maturity almost fully protruding and seemingly superficial, deeply cupulate, 0.2–0.3 mm diam., dark gray with pale greyish hymenium when fresh, totally blackish when dry. Ectal excipulum basally of textura globulosa, cells dark-walled, (6–)8–14 µm diam., laterally of textura prismatica, cells dark-walled, 8–12 x 6–8 µm, passing at the margin into hyaline long-celled protruding hyphae. Grana scarce, very dark and opaque, single celled or composed of two or three cells. Setae very numerous, forming a many-layered fringe hiding the margin, which is broken up into triangular teeth, cylindrical, thin-walled, apically rounded, with 5–6 thick, dark brown septa, 50–100 x 3.5–5 µm. Asci arising from croziers, cylindrical-clavate, 8-spored, (45–)50–65(–70) x 5–7 µm, apical pore MLZ+. Spores irregularly biseriate, fusoid to clavate fusoid, straight to curved, aseptate, containing 2 big lipid globules, 12–16 x 2.5–3.2 µm. Paraphyses cylindrical, apically clavate to slightly monilioid, up to 3 µm wide.

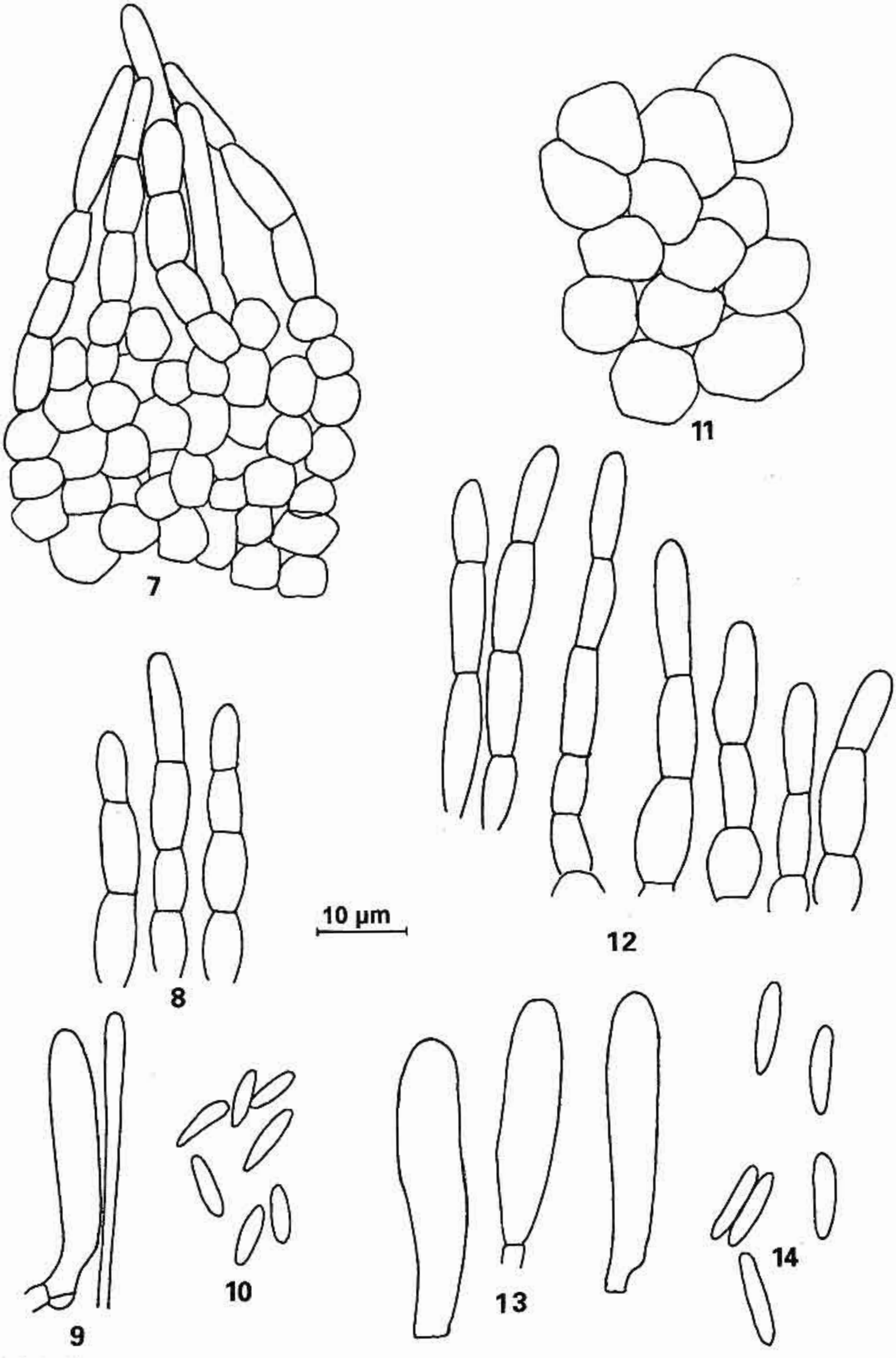
Järvamaa, Anija, by Mustjõgi River, 59° 19' N 25° 34' E, on dead stems of *Veronica longifolia* L., May 20 2001, coll. K. Leenurm, det. A. Raitviir & K. Leenurm (TAA 165784).

Nannfeldt (1985) reports the species France, Switzerland and Italy, always growing on *Geranium silvaticum*. The present collection is the first one outside of the Alps and from a different substrate.

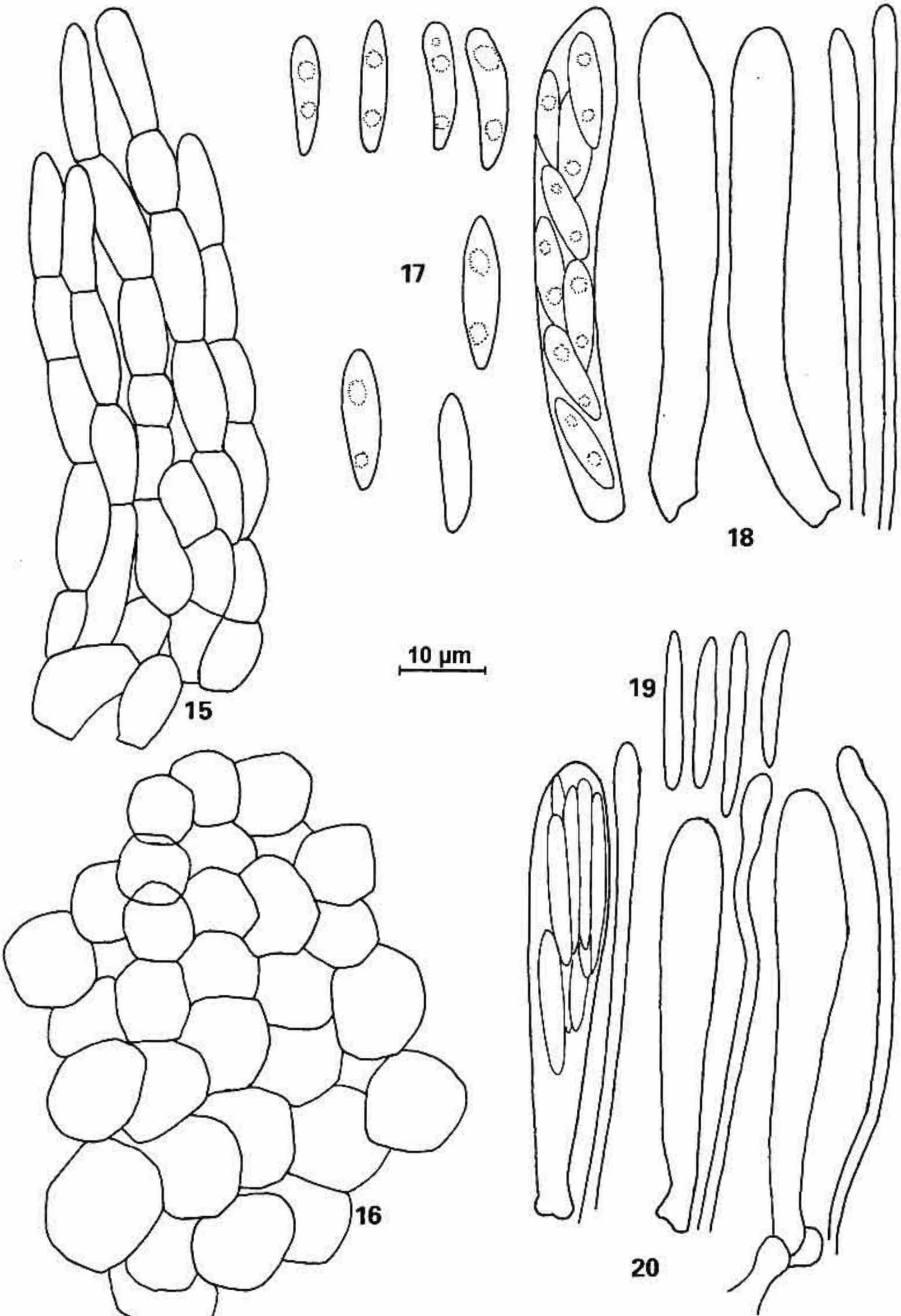
PYRENOPEZIZA GALII-VERI (P. Karst.) Sacc.

Figs 19–20.

Harjumaa, Vasalemma, 59° 15' N 24° 18' E, on dead stems of *Galium boreale* L., May 30 1959, coll. P. Põldmaa, det. A. Raitviir (TAA 26593); Ida-Virumaa, in vincinity of Jõhvi rail-



Figs 7–14. *Pirottaea astragali.* – 7. Ectal excipulum with marginal setae. – 8. Three setae. – 9. An ascus and a paraphysis. – 10. Spores (From TAA 165796). *P. nigrostriata.* – 11. Excipular cells. – 12. Setae. – 13. Asci. – 14. Spores (From TAA 136054).



Figs 15–20. *Pirottaea pilosissima.* – 15. Setae. – 16. Excipular cells. – 17. Spores. – 18. Asci and paraphyses (From TAA 165784). *Pyrenopeziza galii-veri.* – 19. Spores. – 20. Asci and paraphyses (From TAA 26593).

way station, 59° 21' N 27° 24' E on dead stems of *Galium mollugo* L., June 14 1959, coll. P. Põldmaa, det. A. Raitviir (TAA 30304).

This species is difficult to notice in the field because of its minute immersed apothecia. It is easily recognizable by the fasciculate arrangement of long spores in the ascus. Hütter (1958) describes the spores as 3-septate at maturity, but in both examined collections they were non-septate, and probably not fully mature as only a few free spores were seen.

PYRENOPEZIZA MILLEGRANA Boud.
Tartumaa, Nõo Community, Mosina, by River Elva, 58° 16' N 26° 26' E, on dead stems of *Filipendula ulmaria* (L.) Max., Nov 12 1998, coll. K. Leenurm (TAA 165467), det. H.-O. Baral.

PYRENOPEZIZA PASTINACAE (Nannf.) Gremmen
Lääne-Virumaa, Väike-Maarja 59° 07.5' N 26° 15' E, on dead stems of *Angelica sylvestris* L., July 30 1964, A. Raitviir (TAA 43313); Tartumaa, Konguta, Erumäe hill-fort, 59° 19' N 25° 34' E, on dead stems of *Angelica sylvestris*, May 26 2001, K. Leenurm (TAA 165793).

PYRENOPEZIZA PULVERACEA (Fuckel) Gremmen
Järvamaa, Anija, by Mustjõgi River, 59° 19' N 25° 34' E, on dead stems of *Filipendula ulmaria* (L.) Max., May 20 2001, coll. K. Leenurm, det. K. Leenurm (TAA 165787). Tartumaa, Nõo, Vapramäe, 58° 15' N 26° 26' E, on dead stems of *Filipendula ulmariae* (L.) Max., Jan 14 2001, coll. K. Leenurm, det. A. Raitviir & K. Leenurm (TAA 165769).

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Additions to the list of the Estonian bryophytes, 1997-2001

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Abstract: Ten new species and one subspecies have been added to the list of Estonian bryophytes: *Athalamia hyalina, Mannia pilosa, Bryum rubens, B. turbinatum, Orthotrichum lyelli, Rhizomnium magnifolium, Schistidium crassipilum, S. elegantulum, Trichostomum brachydontium, Ulota hutchinsiae, S. maritimum* spp. *piliferum*. Also three varieties new for Estonia was determined. At present the number of bryophytes recorded from Estonia is 537. New localities of very rare (1-3 localities) and rare species (4-7 localities) for 49 bryophytes are presented. 33 species should be eliminated from the list of rare species due to number of findings. Reasons for rarity in Estonia are discussed.

Kokkuvõte: K. Vellak, L. Kannukene, N. Ingerpuu ja M. Leis. Täiendusi Eesti sammalde nimestikule, 1997-2001.

Viimaste aastate uurimistööde tulemusel on Eesti samblafloora täienenud 10 liigi ja ühe alamliigiga: *Athalamia hyalina, Mannia pilosa, Bryum rubens, B. turbinatum, Orthotrichum lyelli, Rhizomnium magnifolium, Schistidium crassipilum, S. elegantulum, Trichostomum brachydontium, Ulota hutchinsiae, S. maritimum* spp. *piliferum*. Leiti ka kolm Eestile uut varieteeti. Praeguseks on Eestist teada 537 liiki sammaltaimi. Käesolevas töös on esitatud uued leiukohad 49 väga haruldase (1-3 leiukohta) ja haruldase (4-7 leiukohta) liigi kohta. Leidude rohkuse tõttu võib 33 samblaliiki haruldaste hulgast välja arvata. Analüüsitakse ka samblaliikide harulduse põhjuseid.

INTRODUCTION

Protection of the biological diversity is based on the knowledge of the distribution of all plant groups. Several recent nature investigation projects on the distribution and diversity of plant communities include also data about bryophytes. The databases of the Estonian Wetland Inventory (Paal et al., 1998), an inventory of seminatural landscapes, as well as investigations conducted in Estonian klint forests, on Vormsi Island (Leis & Kannukene, 2001) and in several nature protection areas (Soomaa National Park, Viidumäe Nature Reserve, Sarve Landscape Reserve, etc.) provided excellent information about the new localities of several bryophytes. Also, the revision of some old herbaria yielded additional information about the distribution of several species.

The aim of our study was to present information about the species and localities of bryophytes, new or rare for Estonia, that have been discovered after the publishing of the key-book of the Estonian bryophytes (Ingerpuu et al., 1998), and to examine the relationships between rarity and the level of investigation. The key-book of the Estonian bryophytes refers to six species and two varieties new for Estonia: *Mannia sibirica, Scapania gymnostomophila, Sphagnum molle, Seligeria patula, Schistidium confusum, Racomitrium aciculare, Atrichum undulatum* var. *gracilisetum* and *Schistidium apocarpum* var. *robustum*. Here we report their precise localities. Estonian names for new species, genera, families and divisions are presented. Based on recent studies (Mischler & Churchill, 1984; Garbary & Renzaglia, 1998; Hedderson et al., 1998 etc.), the class *Bryopsida* is divided into separate divisions.

RESULTS

Herbarium abbreviations: TAA – Herbarium of the Institute of Zoology and Botany, Estonian Agricultural University; TAM – Herbarium of the Estonian Museum of Natural History; TU – Herbarium of the Institute of Botany and

Ecolgy, University of Tartu, TALL – Herbarium of the Tallinn Botanical Garden.
Other abbreviations: Co – County; comm. – community; Is. – island.
Species new for Estonia are presented in bold and for them also Estonian names are given.

Phylum: MARCHANTIOPHYTA – Hõimkond: HELVIKSAMMALTAIMED
Class: MARCHANTIOPSIDA – Klass: HELVIKSAMBLAD

ATHALAMIA HYALINA (Sommerf.) S. Hatt. – kahkjas atalaamia – Represents a new for Estonia fam. *Cleveaceae* Cavers (in Estonian – sugukond kleevealised) – 1st loc.: Harjumaa Co., Tallinn, Harku, on soil, 10 May 1927. Ex Herbario Alberti Ueksipi no 248, A. Üksip (sub nom. *Clevea suecica* Lindb.), ver. N. Ingerpuu (2001) (TU).

MANNIA PILOSA (Hornem.) Frye & L. Clark – karvane mannia – 1st loc.: Harjumaa Co., Väike-Pakri Is., *Sesleria* alvar meadow in the central part of the island, on soil, 9 June 1999 N. Ingerpuu (TAA).

M. SIBIRICA (Müll.Frib.) Frye & L. Clark – 1st loc.: Harjumaa Co., Suur-Pakri Is., moist alvar meadow in the northern part of the island (former military area), on the slope of a bomb crater, 12 June 1996 L. Kannukene, det. K. Damshold (1997) (TAA).

Class: JUNGERMANNIOPSIDA – Klass: LEHTHELVIKSAMBLAD

BARBILOPHOZIA KUNZEANA (Huebener) Müll.Frib. – 6th loc.: Saaremaa Co., Saaremaa Is., quagmire between Viki and Taavi villages, among *Polytrichum strictum*, 21 June 1997 N. Ingerpuu (TAA); 7th loc.: Viljandimaa Co., Soomaa Nature Park, Vastemõisa forestry, transitional mire pine forest near Ördi bog, on a decaying stump, Aug 1998 K. Vellak, det. N. Ingerpuu (TAA).

BAZZANIA TRILOBATA (L.) Gray – 4th loc.: Viljandimaa Co., Soomaa Nature Park, Põlendmaa forestry (forest square 196), drained swamp spruce forest, on a hummock, 29 Aug 1998 M. Leis (TU, TAA); 5th loc.: Pärnumaa Co., Tõstamaa comm., drained spruce forest north of Lindi bog, 19 Sept 2001 N. Ingerpuu (TAA).

CEPHALOZIA LOITLESBERGERI Schiffn. – 4th loc.: Võrumaa Co., Pikasilla (Koemetsa) bog, 6 Sept 1997 E. Leibak, det. N. Ingerpuu (TAA); 5th loc.: Viljandimaa Co., Soomaa Nature Park, on the shore of Lake Ördi among *Sphagnum* spp. 19 July 1998 K. Vellak (TAA).

CEPHALOZIELLA DIVARICATA (Sm.) Schiffn. – 7th loc.: Pärnumaa Co., Kanaküla primeval forest (forest square 100), on a log, 27 May 2000 N. Ingerpuu (TAA).

JUNGERMANNIA CONFERTISSIMA Nees – 2nd loc.: Ida-Virumaa Co., the North-Estonian Klint near Saka, at the upper edge of the escarpment, Aug 1999 N. Ingerpuu (TAA).

J. HYALINA Lyell – 4th loc.: Ida-Virumaa Co., the North-Estonian Klint near Toila, the upper edge of the escarpment, on Cambrian sandstone, Aug 1999 K. Vellak, det. N. Ingerpuu (TAA); 5th loc.: Lääne-Virumaa Co., the North-Estonian Klint near Purtse, on Cambrian blue clay in upper part of the escarpment, Aug 1999 K. Vellak, det. N. Ingerpuu (TAA).

J. SPHAEROCARPA Hook. – 5th loc.: Harjumaa Co., the North-Estonian Klint near Ülgase, the upper part of escarpment, on sandstone, Aug 1999 K. Vellak, det. N. Ingerpuu (TAA).

PORELLA PLATYPHYLLA (L.) Pfeiff. – 7th loc.: Pärnumaa Co., nemoral forest on the base of the Salevere klint, on an erratic boulder, 18 June 2000 K. Vellak (TAA).

RICCIOCARPOS NATANS (L.) Corda – 3rd loc.: Tartumaa Co., Rannu, in a pond near the Limnological station, July 1999 leg. H. Mäemets, det. N. Ingerpuu (TAA); 4th loc.: Tartumaa Co., Tammispää, near the Kõrgemäe shop, in a canal in shallow water, 5 Aug 1999 H. Mäemets (pers. comments); 5th loc.: Tartumaa Co., southern part of Lake Peipsi, Saksa bay, on mud among reeds, 30 Aug 2001 H. Mäemets, det. N. Ingerpuu (TAA).

SCAPANIA CALCIOLA (Arnell & J. Perss.) Ingham – 4th loc.: Harjumaa Co., Väike-Pakri Is., the central part of the island, on a *Sesleria* alvar meadow, 9 June 1999 N. Ingerpuu (TAA); 5th loc.: Saaremaa Co., Saaremaa Is., alvar meadow near Oriküla, on soil, 21 July 1999 N. Ingerpuu (TAA).

S. GYMNOSTOMOPHILA Kaal. – 1st loc.: Harjumaa Co., Väike-Pakri Is., limestone quarry in the north-eastern part of the island, on a moist limestone outcrop, 29 May 1997 N. Ingerpuu (TAA); 2nd loc.: Raplamaa Co., N of Kuusiku, Tõrma escarpment, in a karst area, 30 June 1998 T. Ploompuu, det. N. Ingerpuu (TAA).

S. LINGULATA H. Buch – 6th loc.: Lääne-Virumaa Co., the North-Estonian Klint W of Kunda, in the upper part of the escarpment, Aug 1999 N. Ingerpuu (TAA).

S. UMBROSA (Schrad.) Dumort. – 4th loc.: Lääne-Virumaa Co., Lahemaa Nature Park, Oandu hiking path, on a log in a stream, 11 June 1999 N. Ingerpuu (TAA).

Phylum: BRYOPHYTA – Hõimkond: LEHTSAMMALTAIMED

Class: SPHAGNOPSIDA – Klass: TURBASAMBLAD

SPHAGNUM AURICULATUM Schimp. – 2nd loc.: Ida-Virumaa Co., Lake Valgejärv near Kurtna, in water, 23 July 1954 H. Tuvikene (sub nom. *S. gravetii* Russow), ver. K.Vellak (2001) (TAA).

S. MOLLE Sull. – 1st loc.: Hiiumaa Co., Hiiumaa Is., in a bog N of Tubala, 22 June 1997 A. Møen & E. Fremstad (TAA).

Class: BRYOPSIDA – Klass: LEHTSAMBLAD

ALOINA RIGIDA (Hedw.) Limpr. – 2nd loc.: Läänemaa Co., Vormsi Is., 0.8 km SSW of Hosby–Sviby crossroad, suprasaline meadow, on a sandy ditch bank, 19 Sept 1998 M. Leis (TU).

AMBLYODON DEALBATUS (Hedw.) Bruch & Schimp. – 5th loc.: Järvamaa Co., Kõrvemaa Landscape Reserve, Lõhmu mire, 20 Oct 2001 T. Pesur, det. N. Ingerpuu (TAA).

AMBLYSTEGIUM SAXATILE Schimp. – 2nd loc.: Läänemaa Co., Vormsi Is., 0.8 km SSW of Hosby–Sviby crossroad, in a suprasaline meadow, 19 Sept 1998 M. Leis (TU).

APLODON WORMSKIOLDII (Hornem.) Kindb. – 4th loc.: Pärnumaa Co., northern edge of Rääma bog, on peat of a ditch bank, 18 June 2000 T. Ploompuu (TAM).

ATRICHUM UNDULATUM (Hedw.) P. Beauv. var. GRACILISETUM Besch. – 1st loc.: Tartumaa Co., near Tartu, 19th century G. K. Girgensohn (det. as *A. angustatum* (Brid.) Bruch & Schimp.), det. L. Kannukene (2001) (TAM); 2nd loc.: Lääne-Virumaa Co., Venevere nemoral forest, on roots of a wind-thrown spruce, 28 Oct 1970 L. Kannukene (sub nom. *A. hausknechtii* Jur. & Milde) (TAA); 3rd loc.: Jõgevamaa Co., Vooremaa nemoral forest, on roots of a stump, 28 Apr 1970 L. Kannukene, (1991, sub nom. *A. hausknechtii* Jur. & Milde) (TAA); 4th loc.: Tartumaa Co., Järvselja Primeval Forest, on the roots of a wind-thrown spruce, 23 Nov 1985 K. Tõnnson, det. M. Leis (1992, sub nom. *A. hausknechtii* Jur. & Milde) (TU); 5th loc.: Põlvamaa Co., Taevaskoja Emaläte, spruce forest, on soil 6 Sept 1992 J. Liira, det. M. Leis (sub nom. *A. hausknechtii* Jur. & Milde) (TU).

BARTRAMIA POMIFORMIS Hedw. – 5th loc.: Valgamaa Co., SW of Krabi up to Külmlätte, on a sandy path side, 21 June 2000 M. Leis (TU).

BRYUM FUNCKII Schwägr. – 4th loc.: Läänemaa Co., Vormsi Is., 0.4 km S of the Saxby lighthouse, alvar spruce forest, on an erratic boulder, 8 June 1998 L. Kannukene (TAM).

B. KNOWLTONII Barnes – 2nd loc.: Hiiumaa Co., Hanikatsi islet, Võrgu Peninsula, on coastal shingle, 9 May 2001 L. Kannukene (TAM).

B. MAMILLATUM Lindb. – 3th loc.: Hiiumaa Co., Hiiumaa Is., Sarve Landscape Reserve, on a coastal limestone shingle ridge, in the northern coast of the Sarve Peninsula, 27 July 1998 L. Kannukene (TAM).

B. RUBENS Mitt. – puna-pungsammal – 1st loc.: Saaremaa Co., Nootamaa Islet, on a moist coastal limestone shingle ridge on the western coast of the islet, 14 July 1998 T. Ploompuu, det. L. Kannukene (TAM).

B. SALINUM Limpr. – 2nd loc.: Saaremaa Co., Saaremaa Is., Vilsandi Nature Park, southern coast of the Harilaid Peninsula, on a moist coastal limestone shingle ridge, 25 Sept 1996 L. Kannukene (TAM).

B. TURBINATUM (Hedw.) Turner – liiv-pungsammal – 1st loc.: Ida-Virumaa Co., Narva-Jõesuu, on dune, 18 June 2001 L. Kannukene (TAM).

B. VIRIDIS (DC.) Moug. & Nestl. – 3rd loc.: Hiiumaa Co., Hiiumaa Is., near Kaibaldi village, forest square 187/16, on a log with *Riccardia palmata*, 26 Apr 1999 N. Ingerpuu (TAA); 4th loc.: Hiiumaa Co., Hiiumaa Is., near Mõirasoo bog (58°56'N 22°11'E), 24 June 1999 N. Ingerpuu (pers. comments).

B. WARNEUM Blandow – 6th loc.: Harjumaa Co., Suur-Pakri Is., on a limestone outcrop of the klint with *Myurella julacea*, 12 Aug 1998 L. Kannukene (TAM).

DIDYMODON TOPHACEUS (Brid.) Lisa – 5th loc.: Läänemaa Co., Vormsi Is., NO of Borby village, on a dry meadow, 3 Sept 1952 H. Karu, det. M. Leis (TU); 6th loc.: Harjumaa Co., Väike-Pakri Is., on a moist limestone outcrop of the North-Estonian Klint, 30 May 1995 L. Kannukene (TAM); 7th loc.: Hiiumaa Co., Hiiumaa Is., Sarve Landscape Reserve, 2 km S of the Heltermaa small harbour, on a moist coastal limestone shingle ridge, 10 June 1998 L. Kannukene (TAM).

ENCALYPTA MUTICA I. Hagen – 2nd loc.: Läänemaa Co., Vormsi Is., Huitberg, on a limestone outcrop, 20 Sept 1998 M. Leis (TU); 3rd loc.: Saaremaa Co., Muhu Is., on an alvar meadow near Nõmmküla village, 1 June 1999 N. Ingerpuu (TAA); 4th loc.: Hiiumaa Co., Kadakalaid Islet, on a moist coastal limestone shingle ridge, 5 June 2000 L. Kannukene (TAM).

GYMNOSTOMUM AERUGINOSUM Sm. – 5th loc.: Hiiumaa Co., Hiiumaa Is., Sarve Landscape Reserve, in the western part of the Sarve Peninsula, on an alvar meadow, 28 July 1998 L. Kannukene (TAM); 6th loc.: Harjumaa Co., Türisalu cliff, on wet limestone in the upper part of the cliff, Aug 1999 K. Vellak (TAA).

HYPNUM CUPRESSIFORME var. JULACEUM Brid. – lst loc.: Hiiumaa Co., Hiiumaa Is., Sarve Landscape Reserve, Aruküla alvar, on a decaying tussock of *Sesleria caerulea*, 12 June 1998 L. Kannukene, ver. O. M. Afonina (1999) (TAM).

ISOTHECIUM MYOSUROIDES Brid. – 4th loc.: Pärnumaa Co., Rangu forest, 20 Aug 1936 L. Reinomägi, det. K. Vellak & N. Ingerpuu (1995) (TAA); 5th loc.: Põlvamaa Co., Ahja forestry, Arniku, on lower part of a granite stone, N. Ingerpuu (TAA); 6th loc.: Saaremaa Co., Saaremaa Is., Viidumäe Nature Reserve, Laasmaa wooded meadow, on a stone fence, 16 June 1999 L. Kannukene (TAM).

ORTHOTRICHUM DIAPHANUM Brid. – 4th loc.: Saaremaa Co., Vilsandi National Park, Mustapanga Cliff, 5 Aug 1998 T. Ploompuu, det. L. Kannukene (TAM); 5th loc.: Tartumaa Co., Tartu, Narvamäe, in front of "Economicum", on a birch trunk, 8 Dec 1999 M.Leis (TU); 6th loc.: Hiiumaa Co., Harilaid Islet, on concrete, 6 June 2000 L. Kannukene (TAM).

O. LYELLII Hook. & Taylor – Lyelli tutik – 1st loc.: Saaremaa Co., Saaremaa Is., Viidumäe Nature Reserve, deciduous forest near Pätsuma mire, on a trunk of *Sorbus aucuparia*, 25 Aug 1999 L. Kannukene (TAM).

PLAGIOTHECIUM UNDULATUM (Hedw.) Bruch, Schimp. & W. Gümbel – 5th loc.: Saaremaa Co., Kessulaid Islet, spruce forest, on soil, 26 June 1998 M. Reitalu, det. L. Kannukene (TAM).

POGONATUM NANUM (Hedw.) P. Beauv. – 2nd loc.: Saaremaa Co., Saaremaa Is., on an alvar meadow near Oriküla village, July 2000 N. Ingerpuu, det. K. Vellak (TAA).

POHLIA BULBIFERA (Warnst.) Warnst. – 4th loc.: Raplamaa Co., Jalase Village Reserve, alvar forest (forest square 41), on soil, 5 May 1995 M. Leis (TU); 5th loc.: Võrumaa Co., Urvaste comm., W of Keema, on roadside ditch bank, 11 Sept 2001 K.Vellak (TAA).

POLYTRICHUM PALLIDISETUM Funck – 2nd loc.: Hiiumaa Co., Hanikatsi Islet, in a broadleaved forest, on a log, 19 July 1993 L. Kannukene (TALL, TAM).

POTTIA BRYOIDES (Dicks.) Mitt. – 3rd loc.: Hiiumaa Co., Kadakalaid Islet, on a coastal terrace, 6 June 2000 N. Ingerpuu (TAA).

P. DAVALLIANA (Sm.) C.E.O. Jensen – 5th loc.: Hiiumaa Co., Hiiumaa Is., Sarve Landscape Reserve, in the eastern part of the Sarve Peninsula, moist alvar meadow, on soil, 27 Aug 1998 L. Kannukene (TAM); 6th loc.: Hiiumaa Co., Hiiumaa Is., Sarve Landscape Reserve, on a moist *Sesleria* alvar meadow N of Viita farm, 28 Aug 1998 L. Kannukene (TAM); 7th loc.: Harjumaa Co., 0.5 km WSW of Rahula village, on an alvar meadow, July 2000 T. Ploompuu & E. Leibak, det. M. Leis (TU).

PSEUDOCROSSIDIUM HORNSCHUCHIANUM (Schultz) R.H. Zander – 5th loc.: Saaremaa Co., Muhu Is., on an alvar meadow near Nõmmküla village, 1 June 1999 N. Ingerpuu (TAA).

PSEUDOLESKEELLA CATENULATA (Brid.) Kindb. – 6th loc.: Raplamaa Co., Jalase Village Reserve, alvar forest near the Tiidu-Tõnikse karst area, on limestone, 22 July 1999 L. Kannukene (TAM).

RACOMITRIUM ACICULARE (Hedw.) Brid. – 1st loc.: Viljandimaa Co., Soomaa National Park, Tipu forestry, swampy nemoral forest with reed, on a periodically submerged stone, July 1999 K. Vellak, det. M. Leis (TAA).

R. ELONGATUM Frisvoll – 2nd loc.: Saaremaa Co., Saaremaa Is., Odalätsi dunes, on sand, 12 Sept 1969 L. Kannukene (TAA); 3rd loc.: Saaremaa Co., Saaremaa Is., Viidumäe Nature Reserve, on a small stone at the edge of a field near Mäepea farm, 18 June 1999 L. Kannukene (TAM).

R. FASCICULARE (Hedw.) Brid. – 2nd loc.: Raplamaa Co., Jalase Village Reserve, alvar forest near Tiidu-Tõnikse, on a small erratic boulder, 22 July 1999 H. Haab, det. J. Koopmann (TAM).

RHIZOMNIUM MAGNIFOLIUM (Horik.) T.J. Kop. – suurelehine viltvars – 1st loc.: Lääne-Virumaa Co., the North-Estonian Klint W of Kunda, on soil at the upper edge of the escarpment, Aug 1999 N. Ingerpuu (TAA).

SCHISTIDIUM APOCARPUM var. ROBUSTA Nees & Hornsch. – 1st loc.: Hiiumaa Co., Hiiumaa Is., Sarve Landscape Reserve, alvar birch forest in the weastern part of the Sarve Peninsula, on limestone, 29 July 1998 L. Kannukene, ver. O. M. Afonina (1999) (TAM).

SCH. ELEGANTULUM H.H. Blom – lubilõhistanukas – 1st loc.: Hiiumaa Co., Hiiumaa Is., Sarve Landscape Reserve, moist alvar meadow in the eastern part of the Sarve Peninsula, on limestone, 27 July 1998 L. Kannukene, det. O. M. Afonina (1999) (TAM).

SCH. MARITIMUM (Turner) Bruch & Schimp. ssp. MARITIMUM – 2nd loc.: Harjumaa Co., Juminda Peninsula, N from Tapurla, on coast of Naskal bay, on a granite stone, 19 June 2001 U. Ratas, det. L. Kannukene (TAM).

SCH. MARITIMUM ssp. PILIFERUM (I. Hagen) B. Bremer – 1st loc.: Lääne-Virumaa Co., Mohni Is., NNO coast, on an erratic boulder, 12 July 1999 L. Kannukene, det. O. M. Afonina (1999) (TAM).

SCH. RIVULARE (Brid.) Podp. – 4th loc.: Jõgevamaa Co., Muta River, on stones on the riverbank, 20 May 1975 L. Kannukene (TAA); 5th loc.: Läänemaa Co., Matsalu Nature Reserve, Kumari Islet, on a moist coastal limestone shingle ridge, 29 July 1999 L. Kannukene (TAM).

SCH. RIVULARE var. LATIFOLIUM (J. E. Zetterst.) H.A. Crum & L.E. Anderson – 5th loc.: Pärnumaa Co., spruce forest at Mihkli, on a stone at the roadside, 5 July 1970, L. Kannukene (TAA); 6th loc.: Hiiumaa Co., Hiiumaa Islets Landscape Reserve, Saarnaki Islets, on a stone fence under *Juniperus* shrubbery, 23 June 1991 L. Kannukene (TAM); 7th loc.: Läänemaa Co., Vormsi Is., ca 0.5 km S of the Saxby lighthouse, alvar spruce forest, on an erratic boulder, 8 June 1998 L. Kannukene (TAM).

SELIGERIA CAMPYLOPODA Kindb. – 2nd loc.: Saaremaa Co., Saaremaa Is., Kuusnõmme Peninsula, alvar pine forest, on limestone, 27 July 1979 L. Kannukene (det. as *S. recurvata* (Hedw.) Bruch, Schimp. & W. Gümbel), det. R. Ochyra (1997) (TAM); 3rd loc.: Saaremaa Co., Saaremaa Is., Viidumäe Nature Reserve, stone fence "Tümina", on limestone, 15 Sept 1999 L. Kannukene (TAM); 4th loc.: Hiiumaa Co., Hanikatsi islet, deciduous forest, on a limestone fence, 10 June 2001 L. Kannukene (TAM).

S. DONNIANA (Sm.) C. Müll. – 2nd loc.: Harjumaa Co., Valkla Cliff, on limestone, 24 Aug 1999 N. Ingerpuu (TAA).

S. PATULA (Lindb.) Broth. – 1st loc.: Harjumaa Co., Väike-Pakri Is., limestone quarry in the north-eastern part of the island, on moist outcrops, 18 May 1994 L. Kannukene (det. as *S. calcarea* (Hedw.) Bruch, Schimp. & W. Gümbel), det. R. Ochyra (1997) (TAM).

TAYLORIA TENUIS (Dicks.) Schimp. – 2nd loc.: Harjumaa Co., ca 1 km S of Joaveski, on a pasture, 19 May 1949 E. Peikel, det. L. Kannukene (TAM).

TORTELLA RIGENS Alb. – 5th loc.: Hiiumaa Co., Hiiumaa Is., Sarve Landscape Reserve, on a moist *Sesleria* alvar meadow, N of the Viita farm, 26 Aug. 1998 L. Kannukene (TAM); 6th loc.: Saaremaa Co., Saaremaa Is., Ilpla alvar meadow, on soil, 22 July 1999 N. Ingerpuu (TAA).

TORTULA NORVEGICA (F. Weber) Lindb. – 2nd loc.: Läänemaa Co., 0.5 km NW of Kirbla village, on a grassland, 31 Aug 1999 M. Leis (TU).

TRICHOSTOMUM BRACHYDONTIUM Bruch – suur juussammal – 1st loc.: Saaremaa Co., Saaremaa Is., Oriküla alvar, on soil, 10 May 1999 N. Ingerpuu, det. L. Hedenäs (2001) (TAA).

ULOTA CURVIFOLIA (Wahlenb.) Lilj. – 3rd loc.: Lääne-Virumaa Co., Mohni Is., on an erratic boulder on NO coast of the island, 12 Sept 1997 L. Kannukene, det. M. Leis (TAL, TAA); 4th loc.: Saaremaa Co., Saaremaa Is., Viidumäe Nature Reserve, on a small stone at the edge of a field of Mäepea farm, 18 June 1999 L. Kannukene (TAM).

U. DRUMMONDII (Hook. & Grev.) Brid. – 2nd loc.: Saaremaa Co., Saaremaa Is., Viidumäe Nature Reserve, Kivesselja forest, in an oak forest E of Pätsuma mire, on a trunk of *Quercus robur* L., 16 June 1999 L. Kannukene (TAM).

U. HUTCHINSIAE (Sm.) Hammar – Hutchinsi säbrik – 1st loc.: Läänemaa Co., Vormsi Is., pine forest between Suuremõisa and Fällerna villages, on an erratic boulder near the Huitberg limestone outcrop, 9 June 1998 L. Kannukene, det. M. Leis (TAM); 2nd loc.: Läänemaa Co., Vormsi Is., deciduous forest between Borby and Rälby villages, on an erratic boulder "Smeni", 21 Sept 1998 M. Leis (TU).

WARNSTORFIA TUNDRAE (H.J. Arn.) Loeske – 7th loc.: Harjumaa Co., in the quagmire of Lake Suur-Kalajärv NW of Kakerdaja bog, 19 May 2001 T. Pesur, det. N. Ingerpuu (TAA).

WEISSIA SQUARROSA (Nees & Hornsch.) C. Müll. – 4th loc.: Läänemaa Co., pasture between Järise and Vagivere villages, 1.5 km O of Järise, on a molehill, 5 Aug 1999 M. Leis (TU).

DISCUSSION

Ten bryophyte species and one subspecies, new for Estonia, have been found recently. Two of them, *Mannia pilosa* and *Athalamia hyalina*, belong to hepatics. The latter was identified from the old herbarium of Albert Üksip, collected already in 1927. *M. pilosa* was found in 1999 while another species of the same genus, *M. sibirica*, was collected in 1996 and included in the key-book of the Estonian bryophytes (Ingerpuu et al. 1998). The *Mannia* species occur on small North-Estonian islands. Both of them are characterized by northern distribution and could have been introduced by the Soviet army as they were found in former military areas.

The following taxa are new to the Estonian mossflora: *Trichostomum brachydontium, Orthotrichum lyelli, Rhizomnium magnifolium, Bryum rubens, Bryum turbinatum, Ulota hutchinsiae, Schistidium crassipilum, S. elegantulum* and *S. maritimum* spp. *piliferum*.

New localities were found for 49 very rare or rare species and 33 species can not be considered not rare in Estonia any longer (Table 1).

Thorough investigations often change the knowledge of the rarity of various species. The diversity of the Estonian broad-leaved klint forest was studied in 1998–1999 and new localities were found for 20 rare bryophytes (Paal et al., 2001). Since the area had been used for military purposes and was closed for investigations until 1989, the collections from this area had been occasional or old. *Fissidens gracilifolius* with the single locality in the list of the Estonian bryophytes (Ingerpuu et al., 1994) appeared to be one of the indicator species on the klint forest floor. A recent study showed that also *Gyroweisia tenuis, Campylium calcareum, Rhynchostegium murale, Seligeria* spp. and some other species were quite common in the klint forest and on outcrops. Furthermore, one species new for the Estonian bryophyte flora, *Rhizomnium magnifolium*, was found on a wet escarpment in klint forest.

In 1997 inventory of the Estonian wetlands was started. In the course of this several species, e.g. *Calliregon trifarium, Calypogeia sphagnicola, Sphagnum lindbergii, S. platyphyllum, Pohlia sphagnicola* (first record from Estonia in 1996!) were found not to be rare in Estonia. The inventory added one more new species for Estonia, *Sphagnum molle*, collected from Hiiumaa Island by Norwegian bryologists. Although the occurrence of this species was predicted already in 1954 (Laasimer et al., 1954), there was no exact evidence of it until now.

The islands of Estonia, which were not available for studies during many years, have a rich bryoflora and many new species have been found during recent studies. H. H. Blom has identified *Schistidium crassipilum* and *S. confusum* from the herbarium of J. Micutowicz, who had collected them from Saaremaa Island in 1907 (Blom 1995). Blom mentioned also the possible occurrence of *S. apocarpum* var. *robusta* (sub nom. *S. robustum* (Nees & Hornsch.) H.H. Blom) in Estonia, whose first

Table 1. List of species that are not rare for Estonia any more. The number of known localities is given in brackets. Abbreviations: st r – rather rare (8–12 localities); p – sporadically (13–20 localities).

Species	No. of localities	Species	No. of localities
Amblystegium tenax (Hedw.) C.E.O. Jens.	st r (9)	Plagiothecium latebricola Bruch, Schimp. & W. Gümbel	st r (12)
Anastrophyllum hellerianum (Lindenb.) R.M. Schust.	st r (12)	P. ruthei Limpr.	st r (8)
Brachythecium campestre (C. Müll.) Bruch, Schimp. & W. Gümbel	st r (9)	Platydictya jungermannioides (Brid.) H.A. Crum	st r (9)
B. starkei (Brid.) Bruch, Schimp. & W. Gümbel	st r (9)	Pogonatum dentatum (Brid.) Brid.	st r (10)
B. turgidum (Hartm.) Kindb.	st r (9)	Pohlia sphagnicola (Bruch, Schimp. & W. Gümbel) Broth.	st r (8)
Calliergon trifarium (F. Weber & D. Mohr.) Kindb.	st r (8)	Porella cordaeana (Huebener) Moore	st r (8)
Calypogeia sphagnicola (H.J. Arn. & J. Perss.) Warnst.	st r (8)	Rhodobryum ontariense (Kindb.) Kindb.	st r (8)
Campylium calcareum Crundw. & Nyholm	st r (10)	Rhynchostegium murale (Hedw.) Bruch, Schimp. & W. Gümbel	st r (8)
Cephaloziella hampeana (Nees) Schiffn.	st r (9)	Scapania mucronata H. Buch	st r (9)
Fissidens gracilifolius Brugg.-Nann. & Nyholm	p (20)	Seligeria calcarea (Hedw.) Bruch, Schimp. & W. Gümbel	st r (8)
F. pusillus (Wilson) Milde	st r (10)	S. pusilla (Hedw.) Bruch, Schimp. & W. Gümbel	st r (11)
Geocalyx graveolens (Schrad.) Nees	st r (8)	Sphagnum lindbergii Lindb.	st r (9)
Gyroweisia tenuis (Hedw.) Schimp.	st r (9)	S. platyphyllum (Braithw.) Warnst.	p (15)
Lophozia bantriensis (Hook.) Steph.	st r (8)	Thamnobryum alopecurum (Hedw.) Gang.	st r (10)
L. rutheana (Limpr.) M. Howe	st r (8)	Timmia bavarica Hessl.	st r (9)
Plagiopus oederi (Sw.) H.A. Crum & L.E. Anderson	st r (8)	Tortula lingulata Lindb.	st r (10)
		Trematodon ambiguus (Hedw.) Hornsch.	st r (8)

locality was registered by L. Kannukene in 1998 from Hiiumaa Island.

We have studied the reasons for rarity in Estonia and have identified them for about 60% of the rare species. For the rest of the species the reasons are still unknown. The main known reasons for rarity are the following. 1. Occurrence in the border region of the distribution area. There are about 20% of such species among rare bryophytes in Estonia. Almost half of them grow on the northern or north-eastern border region, one-fourth in the eastern and one-fourth in the southern border region of their distribution area; 2. Differences in some ecological requirements. A large proportion of rare species is characterized by the demand for high humidity or they are substrate specific (Ingerpuu & Vellak, 1995). Suitable for them localities are rare. 3. Human activity which affects about half of the rare species. The main threatening activities are forest management, drainage of mires and drainage and pollution of waterbodies (Lilleleht, 1998).

The number of bryophyte species, new for Estonia, which have been discovered in the seven years since the publication of the list of the Estonian bryophytes in 1994, amounts to 27. Of these species seven have been found on the Pakri Islands (Kannukene, 1998) and nine species on other islands (Kannukene, 1997a, 1997b; Ingerpuu & Leis, 1999;

Ploompuu et al., 1999 etc.). This indicates once again that the bryoflora of the Estonian islands is extremely diverse. At the same time, 37 species are considered not to be rare any more due to the existence of new localities. Thus there are less rare species in Estonia today than in 1994.

Although many new localities have been found recently, earlier investigations showed that human impact has been drastically increasing during the last decades, and several localities of different species have been damaged or destroyed. This concerns mainly species inhabiting fens or virgin forests. For many species, altogether for about one-fifth of all rare species (e.g. *Meesia longiseta, Sphagnum auriculatum, S. aongstroemii, Tayloria tenuis, Splachnum sphaericum, Oncophorus wahlenbergii* etc.), only old data are available (from before 1970). To obtain information about the state of the bryological diversity in Estonia data not only for rare species but also about the distribution of all bryophyte species is needed.

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Lichenicolous fungi from the Sayan-Tuva Mountains, Southern Siberia, Russia

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Abstract: 20 species of lichenicolous fungi are reported from Southern Siberia. *Abrothallus caerulescens, Endococcus alpestris, Monodictys fuliginosa, Paranectria oropensis, Phacopsis cephalodioides, Refractohilum peltigerae*, and *Sphaerellothecium parmeliae* are new to Russia. The other fungi are new to the Sayan-Tuva Mountains.

Kokkuvõte: M. P. Zhurbenko ja T. N. Otnyukova. Sajaani-Tuva mägede (Lõuna-Siber, Venemaa) lihhenikoolsed seened.

Teatatakse 20 lihhenikoolse seeneliigi leiust Lõuna-Siberis. Neist 7 – *Abrothallus caerulescens, Endococcus alpestris, Monodictys fuliginosa, Paranectria oropensis, Phacopsis cephalodioides, Refractohilum peltigerae* ja *Sphaerellothecium parmeliae* – on esmasleiud Venemaal. Ülejäänud on leitud Sajaani-Tuva mägedest esmakordselt.

INTRODUCTION

This paper continues the series dealing with lichenicolous fungi of Siberia (Zhurbenko & Davydov, 2000; Zhurbenko & Hafellner, 1999; Zhurbenko & Santesson, 1996). The study is mainly based on the material collected by T. N. Otnyukova during her studies of the lichen flora of State Reserves Stolby ("Pillars") and Azas located in the Sayan-Tuva mountain country, Southern Siberia, Russia (Fig. 1). As lichenicolous fungi were not a primary focus of the field research at that time, the resulting list is doubtless incomplete. Some additional specimens from the neighbouring areas are also included.

Reserve Stolby (50°30'–55°50'N, 90°40'–92°55'E) is located 15 km S of Krasnoyarsk by the right bank of the Enisey River, on the northwestern spurs of the Eastern Sayan Mountains (Berezovskii District of the Krasnoyarsk Region, Krasnoyarsk Territory, Russia). Weathered outcrops of Devonian syenite intrusive rocks, exhibiting fanciful pillars, are responsible for the characteristic topography of the area. Most of the pillars have its own names, e.g., Heart, Mittens. The region has relatively low mountainous relief, with elevations gently increasing southwards and varying from 200 to 800 m a. s. l. The area is influenced by a continental climate. The average annual extremes range from -20 °C in January to +15.7 °C in July (Belyak & Serikov, 2000). Mean annual temperature is -0.6 °C. Mean annual precipitation is 437 mm. The active vegetation growing period lasts 138 days. The vegetation of the area is boreal and reflects a vertical zonation caused by the mountainous terrain. The principal vegetation types are mountain taiga dominated by *Abies sibirica* Ledeb., occurring from 500 to 700 m, and forests with *Pinus sylvestris* L., associated with the syenite outcrops. *Betula pendula* Roth and *Picea obovata* Ledeb. may co-dominate in forest communities.

The second study area was located in the inter-montane Todzhinskaya Depression (Todzhinskii District of Tuva Republic, Russia), surrounded by mountain systems of the Akademika Obrucheva Range to the south, Western Sayan to the west and north-west, and Eastern Sayan to the north and north-east. Collections have been made within the Reserve Azas (52°19'–42'N, 96°32'–98°48'E) and from 30 km to the west, near the settlement of Toora-Khem by the Big Yenisey (Biy-Khem) River, which is the main river of Todzhinskaya Depression. The floor of the depression is gently inclined from west to east from elevations of 850 to 2000 m a. s. l., surrounding mountain ranges reach elevations of 2300–2900 m

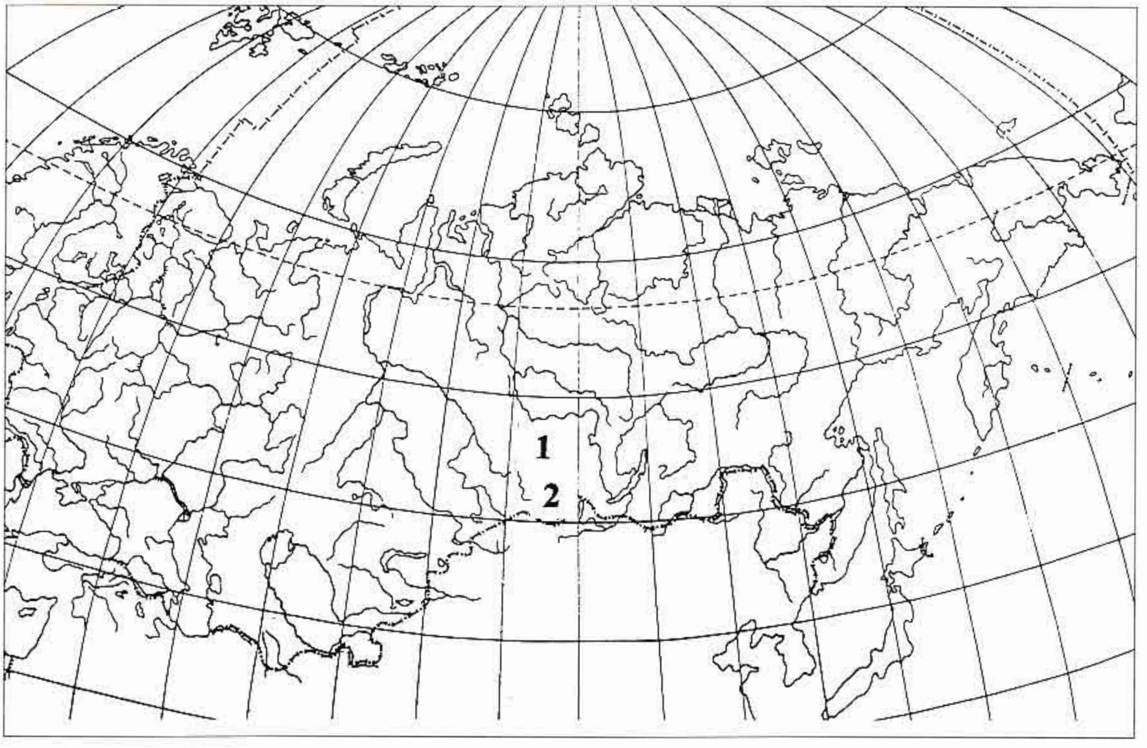

Fig. 1. Location of the main study areas: 1 – Reserve Stolby, Eastern Sayan; 2 – State Reserve Azas, Tuva.

(Molokova & Kartashov, 1999). The area was extensively glaciated during the late Pleistocene and thus is mainly covered by overlying fluvioglacial sand, pebble, and boulder deposits. The climate is markedly continental. The temperature ranges from a mean minimum of -28.7 °C in January to +14.6 °C in July. The mean annual temperature is -5.5 °C. The mean annual precipitation is 343 mm, most falling in summer (60%). Winter is very cold, with minimal temperatures as low as -54 °C. Summer is short and cool, with occasional night frosts. The frost-free period is 52 days. The vegetation growing period lasts 123 days. The study area supports different types of vegetation: steppes, meadows, bogs, shrubs, forests (dominated e. g. by *Betula pendula* Roth, *Pinus sibirica* Du Tour, *Larix sibirica* Ledeb.) and mountain tundras. Mountain belts are represented by steppe and forest-steppe from 850–900 m; herb, *Larix* and *Betula* forests from 900–1100 m; lichen-moss, *Larix, Pinus sibirica* forests from 1000–1700 m; subalpine meadows, shrubs and sparse forests from1700–1900 m; alpine meadows and tundras from 1900–2600 m.

MATERIAL AND METHODS

Most collections were made by the second author during 1995–1999. All determinations are by the first author. Macroscopic features were examined with a LOMO dissecting microscope MBS-1. Microscopic characters were studied in squash preparations or hand sections in water, 10% KOH (K), or Lugol's iodine solution (I) by use of a LOMO light microscope MBR-3 (to x 900). Unless otherwise indicated, microscopic measurements are based on water mounts. The cited specimens are deposited in the mycological herbarium of the Komarov Botanical Institute in St. Petersburg (LE).

RESULTS AND DISCUSSION

Annotated list of species

The annotations include information on collecting sites, host lichens, collector's numbers, known distribution in Russia, and some incidental notes. Species denoted by an asterisk (*) are new to Russia.

Abbreviations: LE – Komarov Botanical Institute, St. Petersburg; M. Z. – M. Zhurbenko; T. O. – leg. T. N. Otnyukova; th. – thallus.

*ABROTHALLUS CAERULESCENS Kotte (syn. *A. tulasnei* M. S. Cole & D. Hawksw.) – Tuva. Todzhinskaya Depression, Big Yenisey River valley, Arbyk Creek mouth opposite the settlement of Toora-Khem, 52°26'N, 96°05'E, alt. 850 m, on rocks at the steppe slope on the left bank of the creek, on *Xanthoparmelia conspersa* (th.), 11 Aug 1996, T. O., LE 207749.

New to Russia.

ABROTHALLUS PARMELIARUM (Sommerf.) Arnold – Eastern Sayan. State Reserve Stolby, 55°50'N, 92°45'E, alt. 600 m, pillar Mittens, on *Parmelia omphalodes* (th.), 26 May 1996, T. O.; ibid., alt. 550 m, pillar Heart, on *Parmelia omphalodes.* (th.), 26 May 1996, T. O., LE 207751. – Tuva. Todzhinskaya Depression: Big Yenisey River valley, near the settlement of Toora-Khem, 52°26'N, 96°05'E, alt. 850 m, in birch and larch forest on the river terrace, on *Parmelia sulcata* (th.), 14 Aug 1996, T. O. 922, LE 207756; State Reserve Azas, Lake Azas, 52°24'N, 96°27'E, alt. 850 m, near the fishermen's cabin, on epiphytic *Parmelia sulcata* (th.), 2 Aug 1995, T. O. 1115; ibid., 52°24'N, 96°35'E, alt. 850 m, near the Red Stone cabin, in larch forest, on *Parmelia sulcata* (th.), associated with *Phacopsis oxyspora* and *Echinothecium reticulatum*, 19 Aug 1996, T. O. 1172, LE 207753; 8 Aug 1999, T. O.; ibid., lower portions of the Azas River at its junction with the Kara-Tesh Creek, 52°26'N, 96°50'E, alt. 1000 m, on *Parmelia sulcata* (th.), 18 Aug 1999, T. O., LE 207755.

Known distribution in Russia: Karelia (Fadeeva et al., 1997; Norrlin, 1876), Leningrad Region (Brenner, 1886; Wainio, 1878), Putorana Plateau (Zhurbenko & Hafellner, 1999), Eastern Sayan, Tuva, Altai (Zhurbenko & Davydov, 2000).

BACHMANNIOMYCES UNCIALICOLA (Zopf) D. Hawksw. – Tuva. Todzhinskaya Depression, State Reserve Azas, Ulug-Arga Mts., upper stream of Arkhaige-Khem River, 52°35'N, 97°39'E, alt. 2080 m, mountain *Betula* shrub tundra, 17 Jul 1995, N. I. Molokova, on *Cladina arbuscula* (th.: all through podetia), LE 210256; on *Cladina stellaris* (th.: all through podetia), LE 210255. Pycnidia 0.1–0.13 mm diam., immersed in verrucae of the host thallus, which are in turn aggregated into convex botryose galls 0.5–3 mm diam., concolorous with the host thallus. Conidia simple, ellipsoidal to oval, 7–8 x 3–4 µm (n=10, specimen on *C. arbuscula*) or ellipsoidal to lemon-shaped, 6.5–10 x 5–6 µm (n=20, specimen on *C. stellaris*), truncated at the basal apex, with rather thick wall, hyaline. Though *B. uncialicola* has been reported on *Cladina* (*C. stellaris*, Vouaux, 1914), later verified records were restricted to *Cladonia* spp., viz. *C. amaurocraea, C. terrae-novae, C. turgida.* and *C. uncilais* (Hawksworth, 1981; Santesson, 1993). When growing on *Cladonia* spp. the fungus was reported to make the branches on which it occurs geniculate, and have somewhat wider conidia (7–)8–10(10.5) x 4–5.5(–6) µm (Hawksworth, op. cit.).

Known distribution in Russia: Taimyr Peninsula (Zhurbenko, 1998; Zhurbenko & Pospelova, 2001), Tuva.

CORTICIFRAGA FUCKELII (Rehm) D. Hawksw. & R. Sant. – Tuva. Todzhinskaya Depression, Big Yenisey River valley, near the settlement of Toora-Khem, 52°26'N, 96°05'E, alt. 850 m, in larch forest, on *Peltigera praetextata* (th.), 17 Jul 1995, T. O., LE 207757; on *Peltigera* spp. (th.), 23 Jul 1995, T. O., LE 207713; 2 Jul 1999, T. O., LE 207758.

Known distribution in Russia: Kola Peninsula (Zhurbenko, 2001), Karelia (Hawksworth & Santesson, 1990), Tuva.

ECHINOTHECIUM RETICULATUM Zopf – Tuva. Todzhinskaya Depression, State Reserve Azas, Lake Azas, 52°24'N, 96°35'E, alt. 850 m, near the Red Stone cabin, in larch forest, on *Parmelia sulcata* (th.), associated with *Abrothallus parmeliarum*, 8 Aug 1999, T. O., LE 207761.

Known distribution in Russia: Taimyr Peninsula (Zhurbenko & Santesson, 1996), Tuva, Altai (Zhurbenko & Davydov, 2000).

*Endococcus alpestris D. Hawksw. – Western Sayan. 125 km SE of Abakan, valley of Malyi Kebezh River in the vicinities of Tanzybei, 53°10'N, 92°55'E, alt. 350 m, N.V. Stepanov: 9 Nov 1997, on *Usnea subfloridana* (th.), LE 210253; on *Usnea substerilis* (th.), LE 210254; 5 Nov 1997, on *Usnea* sp. (th.), LE 210252.

Ascomata perithecioid, globose, 0.05–0.07 mm diam., black, glossy, superficial, crowded on globose, dark brown to black, 0.2–0.8 mm diam. galls at the apices of host branches. Interascal filaments absent. Asci subcylindrical to obclavate, 37–50 x 8–13 µm (n=10), 8-spored, apex 2–5 µm thick, I-, K/I-; protoplast I+, K/I+ red-orange. Ascospores soleiform, lower cell narrower than the upper and slightly attenuated, 8–12 x 3.5–4.5 µm (n=20), 1-septate, constricted at the septum, with smooth and thick wall 0.5–1 µm, at first colourless, then pale to medium olive-brown, overlapping biseriate.

New to Russia.

Endococcus nanellus Ohlert – Tuva. Todzhinskaya hollow, Big Enisey Plateau, at conjunction of Khoral and Big Enisey Rivers, 52°10'N, 96°37'E, alt. 1000 m, in *Pinus sylvestris* forest, on *Stereocaulon tomentosum* (healthy and bleached phyllocladia), 6 Jul 1999, N. I. Molokova, LE 210262.

Known distribution in Russia (mainly based on unpublished materials of M. Z.): Baikal Lake Region, Karelia, Malyi Yamal Peninsula, Murmansk Region (Zhurbenko, 2001), Central and Northen Ural, Putorana Plateau (Zhurbenko & Hafellner, 1999), Tuva, Central Yakutiya.

Lichenostigma maureri Hafellner – Tuva. Todzhinskaya Depression, State Reserve Azas, near eastern extremity of Lake Azas, left bank of the Azas River, 52°23'N, 96°35'E, alt. 950 m, in larch forest, on *Evernia mesomorpha* and *Usnea* sp.(thalli), 12 Aug 1997, T. O., LE 207762; ibid., 52°25'N, 96°38'E, alt. 950 m, in forested *Sphagnum* bog, on *Usnea* sp.(th.), 18 Aug 1997, T. O., LE 207763.

Known distribution in Russia: Tuva, Altai (Zhurbenko & Davydov, 2000).

*Monodictys fuliginosa Etayo – Tuva. Todzhinskaya Depression, Serlig-Khem River at 3 km upstreams from its mouth, 52°08'N, 96°54'E, alt. 1000 m, on *Lobaria pulmonaria* (th.: upper surface), 8 Jul 1999, N. I. Molokova, LE 210251.

New to Russia.

Nectriopsis lecanodes (Ces.) Diederich & Schroers – Tuva. Todzhinskaya Depression: Big Yenisey River valley, near the settlement of Toora-Khem, 52°26'N, 96°05'E, alt. 850 m, in birch-larch forest, on *Peltigera* sp. (th.: upper surface), associated with *Corticifraga fuckelii* and *Scutula* sp., 2 Jul 1999, T. O., LE 207765; State Reserve Azas, Lake Azas, 52°26'N, 96°37'E, alt. 850 m, near Ylgi-Chul cabin, on *Peltigera canina* (th.), 1 Aug 1995, T. O., LE 207764; ibid., 52°24'N, 96°35'E, alt. 850 m, near the Red Stone cabin, in larch forest, on *Peltigera collina* (Ach.) Schrad. (th.: mostly on its upper surface, occasionally on the lower one), 19 Aug 1996, T. O. 1153, LE 207766.

Ascospores narrowly ellipsoid, 1-septate, constricted at the septum, colourless, 9.5–11.5 – 3–5 µm (n = 26).

Known distribution in Russia: Tuva, Altai (Zhurbenko & Davydov, 2000).

Neolamya peltigerae (Mont.) Theiss. & Syd. – Tuva. Todzhinskaya Depression, Big Yenisey River valley, near the settlement of Toora-Khem, 52°26'N, 96°05'E, alt. 850 m, in birch-larch forest, on *Peltigera* sp. (th.), 22 Jul 1996, T. O., LE 207718; on *Peltigera* cfr. *horizontalis* (th.), 22 Jul 1996, T. O.; on *Peltigera* cfr. *polydactylon* (th.), 11 Aug 1996, T. O., LE 207754.

Known distribution in Russia: Putorana Plateau (Zhurbenko & Hafellner, 1999), Tuva, Altai (Zhurbenko & Davydov, 2000).

*Paranectria oropensis (Cesati) D. Hawksw. & Piroz. – Eastern Sayan. State Reserve Stolby, 55°50'N, 92°45'E, alt. 600 m, pillar The First Pillar, on *Physconia detersa* (th.), 10 Sept 1995, T. O., LE 207768.

Apothecia globose, sessile, pink, 0.2 mm diam. Ascospores muriform, 4–7-transseptate and 1-longiseptate, colourless, 27–37 x 8.5–12 µm (n = 10, in KOH).

New to Russia.

*Phacopsis cephalodioides (Nyl.) Triebel & Rambold – Tuva. Todzhinskaya Depression, Big Yenisey River valley, near the settlement of Toora-Khem, 52°26'N, 96°05'E, alt. 850 m, in birch-larch forest, on *Hypogymnia physodes* (th.), 13 Jul 1996, T. O., LE 207759; 14 Aug 1996, T. O., LE 207760.

New to Russia.

PHACOPSIS OXYSPORA (Tul.) Triebel & Rambold – Eastern Sayan. State Reserve Stolby, 55°50'N, 92°45'E, alt. 600 m, pillar Mittens, on *Parmelia omphalodes* (th.), 26 V 1996, T. O. – Tuva. Todzhinskaya Depression: State Reserve Azas, Lake Azas, 52°24'N, 96°27'E, alt. 850 m, near the fishermen's cabin, on *Parmelia sulcata* (th.), 2 Aug 1995, T. O.; ibid., 52°24'N, 96°35'E, alt. 850 m, near the Red Stone cabin, in larch forest, on *Melanelia olivacea* (th.), 19 Aug 1996, T. O.; on *Parmelia sulcata* (th.), associated with *Abrothallus parmeliarum*, 8 Aug 1999, T. O.; on epilithic *Xanthoparmelia conspersa* (th.), 19 Jul 1996, T. O.; Big Yenisey River valley, near the settlement of Toora-Khem, 52°26'N, 96°05'E, alt. 850 m, in birch-larch forest, on *Melanelia olivacea* (th.), 22 Jul 1996, T. O.; 11 Aug 1996, T. O., LE 207750; on *Parmelia sulcata* (th.), associated with *Abrothallus parmeliarum*, 5 Aug 1996, T. O. 931; 14 Aug 1996, T. O. 1020, LE 207767; ibid., in rocks on steppe slope, on *Xanthoparmelia conspersa*, 11 Aug 1996, T. O. 981, LE 207752.

Known distribution in Russia: Karelia (Räsänen, 1939), Leningrad Region (Brenner, 1886), Putorana Plateau (Zhurbenko & Hafellner, 1999), Eastern Sayan, Tuva, Altai (Zhurbenko & Davydov, 2000).

PHAEOSPOROBOLUS USNEAE D. Hawksw. & Hafellner – Eastern Sayan. State Reserve Stolby, 55°50'N, 92°45'E, alt. 600 m, near Laletino cabin, on *Usnea substerilis* (th.), 4 Nov 2000, T. O., LE 210257; on *Usnea glabrescens* (th.), 4 Nov 2000, T. O., LE 210258. – Tuva. Todzhinskaya Depression, State Reserve Azas, left bank of the Azas River at the eastern extremity of Lake Azas, 52°23'N, 96°35'E, alt. 950 m, in larch forest, on *Usnea* sp. (th.), 12 Aug 1997, T. O., LE 207769.

Known distribution in Russia: Northern Ural (unpublished materials of M. Z.), Taimyr Peninsula (Zhurbenko & Santesson, 1996), Eastern Syan, Tuva, Altai (Zhurbenko & Davydov, 2000).

PRONECTRIA ROBERGEI (Mont. & Desm.) Lowen – Eastern Syan. 40 km N of Krasnoyarsk, near the settlement of Pogorelka, 56°25'N, 93°00'E, in larch forest, on *Peltigera canina* (th.: bleached spots on the upper surface), 20 Jul 2000, T. O., LE 210259.

Perithecia markedly obpyriform. Ascospores 12–16 x 3–4 µm.

Known distribution in Russia: Northern Ural (unpublished materials of M. Z.), Eastern Syan, Altai (Zhurbenko & Davydov, 2000), Baikal Lake Region.

*REFRACTOHILUM PELTIGERAE (Keissl.) D. Hawksw. – Tuva. Todzhinskaya Depression, State Reserve Azas, Lake Azas, 52°24'N, 96°35'E, alt. 950 m, near the Red Stone cabin, in larch forest, on *Peltigera canina* (th.), 16 Aug 1997, T. O., LE 207770.

New to Russia.

"SCUTULA MILIARIS (Wallr.) Trevis." – Tuva. Todzhinskaya Depression, State Reserve Azas, lower portions of the Azas River at the junction with the Kara-Tesh Creek, 52°26'N, 96°50'E, alt. 1000 m, in *Sphagnum* bog, on *Peltigera malacea* (th.), 15 Aug 1999, T. O., LE 207771.

Apothecia rounded, sessile, light yellow to dark brown, glossy, 0.1–0.3 mm diam. Ascospores 1-septate, colourless, 8–12 x 3.5–5.5 µm (n = 15). According to Triebel et al. (1997: 333) *Scutula miliaris* should have larger (10–15 x 4–7 µm) ascospores.

Known distribution of *Scutula miliaris* in Russia: Kola Peninsula (Vainio, 1934; Zhurbenko, 2001), Karelia (Fadeeva et al., 1997; Räsänen, 1939; Vainio, 1934, 1940), Chukchi Peninsula (Karatygin et al., 1999).

*SPHAERELLOTHECIUM PARMELIAE Diederich & Etayo – Eastern Sayan. State Reserve Stolby, 55°50'N, 92°45'E, alt. 600 m, pillar Mitra, on saxicolous *Rimelia reticulata* (th.: associated with necrotic patches), 13 Sept 1995, T. O., LE 210214.

New to Russia.

TAENIOLELLA BESCHIANA Diederich – Tuva. Todzhinskaya Depression, Akademika Obrucheva Range, Big Yenisey River basin, upper stream of Dugdu River, 52°07'N, 98°02'E, alt. 1880 m, mountain tundra, on *Cladonia pleurota* (th.: mainly basal squamules, also podetia), 23 Jul 1999, N. I. Molokova, LE 210260.

Known distribution in Russia: Franz Josef Land (Zhurbenko & Santesson, 1996), Murmansk region (Zhurbenko, 2001), Taimyr Peninsula (Zhurbenko, 1998), Tuva.

In this work we report 17 genera with 20 species of lichenicolous fungi. *Abrothallus caerulescens, Endococcus alpestris, Monodictys fuliginosa, Paranectria oropensis, Phacopsis cephalodioides, Refractohilum peltigerae*, and *Sphaerellothecium parmeliae* are new to Russia. *Abrothallus parmeliarum, Phacopsis oxyspora, Phaeosporobolus usneae*, and *Pronectria robergei* are new to the Eastern Sayan. *Abrothallus parmeliarum, Bachmanniomyces uncialicola, Corticifraga fuckelii, Echinothecium reticulatum, Endococcus nanellus, Lichenostigma maureri, Nectria lecanodes, Neolamya peltigerae, Phacopsis oxyspora, Phaeosporobolus usneae*, "*Scutula miliaris*", and *Taeniolella beschiana* are new to Tuva.

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Folia Cryptog. Estonica, Fasc. 38: 85–86 (2001)

NEW ESTONIAN RECORDS

Helotiales and Pezizales

Bellis Kullman
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Helotiales

PEZOLOMA MARCHANTIAE (Sommerf.) Benkert – Järvamaa Co., Albu Comm., Järva-Madise, Kodru smash (59°06.7'N, 25°36.3'E), on moss, 3 July 1999 B. Kullman, det. B. Kullman & A. Raitviir (TAA 179075).

Apothecia cup-shaped, watery-white throughout, disc up 2-4 mm in diam., surrounded by narrow erect rim with narrow pointed teeth, 250 µm long, formed of ca 20 hypha- like hairs of 246–300 x 2.1–3.8 µm. Asci slightly pointed towards apex, 76.3–84.8 x 7.4–9.5 µm, pores blued by iodine. Spores cylindrical, hyaline, smooth, (6.9)7.4(8.5) x (3.2)3.4(4.2.) µm. Paraphyses cylindrical, up to 1–1.6 µm thick, septate, colorless.

Very rare. The sixth finding in the world.

Pezizales

PSEUDOMBROPHILA CERVARIA (W. Phillips in Stev.) Brumm. – Harjumaa Co., Harku Comm., Harku smash. (59°22.5'N, 24°35.5'E), on dung, 15 May 2001 B. Kullman (TAA 179609).

Asci cylindrical, 150–155 x 15–16.5 µm, ascospores oblong-ellipsoid (length/width ratio 1.9–2), 16.4–17.2 x 8.2–9.0 µm, smooth.

Known from Northern and Central Europe, and Southern Argentina.

PYRONEMA DOMESTICUM (Sowerby: Fr.) Sacc. – Harjumaa Co., Harku Comm., Harku park (59°23'N, 24°35'E), on burned soil, 15 May 2001 B. Kullman (TAA 179609).

Ascospores 15.6–19 x 10.7–12.3 µm.

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Lichens and lichenicolous fungi

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Abbreviations of distribution regions and frequency classes in Estonia and names of herbaria follow Randlane & Saag (1999). Lichenicolous fungi are pointed out by the symbol #.

ABROTHALLUS PEYRITSCHII (Stein) Kotte – NW: Harjumaa, near Jägala factory (59°25'N, 25°14'E), on thallus of *Vulpicida pinastri* (Scop.) J.-E. Mattson & M. J. Lai growing on *Juniperus communis*, 22 Oct 1937 H. Aasamaa, det. A. Suija (TU 3928); SE: Võrumaa, Kasaritsa, pine-wood near Võru-Kubja (57°49'N, 27°00'E), on thallus of *Vulpicida pinastri* growing on *Pinus sylvestris*, 7 Dec 1948 H. Trass, det. A. Suija (TU 3929); WIs: Saaremaa, Sõrve peninsula, Lõo alvar (58°06'N, 22°11'E) on thallus of *Vulpicida juniperina* (L.) J.-E.

Mattson & M. J. Lai growing on ground, 20 June 1983 T. Randlane, det. A. Suija (TU 3927). Freq.: r.

The species is widespread; restricted to the lichen genus *Vulpicida*.

ARTHONIA GLAUCOMARIA Nyl. – WIs: Pärnumaa, Ruhnu Island, western coast (57°48'N, 23°15'E), in hymenium of *Lecanora rupicola* (L.) Zahlbr. growing on granite, 18 July 1988 H. Trass, det. A. Suija (TU 3930). Freq.: rr.

The fungus is easily noticed as apothecia of *Lecanora rupicola* turn black by the infection. This species is widely distributed.

BAEOMYCES PLACOPHYLLUS Ach. – NW: Harjumaa, Viimsi Comm., Naissaar Island, (59°35'N, 24°31'E), on sand, 4 Aug 2000 E. Nilson (IE). Freq.: rr.

LECIDELLA SUBVIRIDIS Tønsberg – SE: Valgamaa, Karula forestry, forest square 64 (57°41'N, 26°21' E), on *Alnus glutinosa*, 14 July 1998 I. Jüriado, det. L. Saag (TU). Freq.: rr.

The specimen contains atranorin, thiophanic acid, arthothelin, fatty acid (Rf=3) and unidentified xanthone (Rf=4) (TLC 38-5).

PHAEOSPOROBOLUS USNEAE D. Hawksw. & Hafellner – SE: Põlvamaa, Himmaste (58°07'N, 27°05'E), fir-wood, on thallus of *Usnea* sp. growing on *Picea abies*; 3 Sept 1995 H. Trass, det. A. Suija (TU 3943); Himmaste, *Alnus glutinosa* growing near the road, on thallus of *Evernia prunastri* (L.) Ach., 28 Aug 1987 H. Trass, det. A. Suija (TU 3945). Freq.: rr.

This fungus grows on different pendulous lichens and is widely distributed all over the world.

ROSELLINIELLA CLADONIAE (Anzi) Matzer & Hafellner – NW: Raplamaa, Mailokse village near Järvakandi (58°47'N, 24°47'E), birch wood, on podetia and squamules of *Cladonia* sp. growing on the base of *Betula*, 24 Aug 1995 H. Trass, det. A. Suija (TU 3946). Freq.: rr.

The fungus grows on different species of *Cladonia* and *Cladina*. It is a widespread taxon.

SPHINCTRINA TURBINATA (Pers.) De Not. – WIs: Pärnumaa, Ruhnu Island, eastern coast (57°48'N, 23°16'E), *Alnus glutinosa* trunk 10 m from the sea-shore, on thallus of *Pertusaria pertusa* (Weigel) Tuck., 21 July 1988 H. Trass, det. P. Lõhmus (TU). Freq.: rr.

A rather rare and vanishing species in Northern countries (Tibell, 1999). In Denmark this species is included in the Red Data Book as an endangered species while in Sweden it is in the category of care demanding taxa (Miljøministeriet ..., 1991; Thor & Arvidsson 1999).

STIGMIDIUM LECIDELLAE Triebel, Roux & Le Coeur – SW: Pärnumaa, Nigula Nature Reserve, forest square 77 (58°00'N, 24°40'E), in apothecia of *Lecidella cf. elaeochroma* growing on *Fraxinus excelsior*, 15 Aug 1996 H. Trass, det. A. Suija (TU 3939). Freq.: rr.

This recently described species (Roux et al., 1995) was found for the first time in the Mediterranean region. Later it has been recorded in the Russian Arctic (Karatygin et al., 1999). The occurrence of this fungus also in Estonia is not unexpected as the host lichen, *Lecidella elaeochroma s. lat.*, is widely distributed.

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OBITUARY – VALE HEINAR STREIMANN, 1938-2001

Heinar Streimann was born on December 19, 1938 in Tartu, Estonia and his early life was shaped by the events of World War II. His father, serving in the air force, was killed in the fighting and his family including his mother, grandmother and brother were forced to flee their native Estonia towards the end of the war. They made their way to Oldenburg in Germany to begin a new life and it was in Olderburg that Heinar began his schooling, before emigrating to Australia with his family in the winter of 1950. There he settled in Seymour, Victoria where he completed his matriculation at Seymour High School before moving to Melbourne to take a job with the Bureau of Meteorology. In 1961 he moved again, this time venturing to Papua New Guinea where he worked in the forestry industry. His particular job involved surveying, planning and building roads for the expanding industry. It was in Papua New Guinea that Heinar's love for botany came to the fore. He pursued his new interest with a passion and eventually began teaching botany at the Forestry College in Bulolo. At the same time he took every opportunity to expand his knowledge of the tropical plants that he saw around him every day.

During this period Heinar began to correspond intermittently with a pen pal also interested in collecting postage stamps – her name was Angelina (Lina) from the Philippines. Lina remembers that the letters were long, hard to read because of the hand writing and sometimes perhaps "a little boring", but he was persistent and their correspondence continued. It wasn't until he visited the Philippines in 1965 that their relationship blossomed, and they were married in Manila on July 12, 1965. Theirs was a lifelong friendship that stood the test of time.

Fig. – Heinar Streimann working in one of his favourite places – in the cryptogamic herbarium of CANB.

Together, Heinar and Lina had three children, Arlene (born in 1968 in Seymour, Victoria), Mirja (born in Lae, PNG in 1972) and Arvid (born in Manila in 1977). As the different birthplaces of the children attest, Heinar and Lina travelled widely, working in various parts of the world as well as discovering the different things that each place had to offer. Only last year (2000) they spent six months travelling visiting Egypt, Greece, the US, Finland and Estonia where Heinar was interested to rediscover his family roots. This desire to travel and explore remained a passion of Heinar's throughout his life.

Apart from his wife and family, Heinar's greatest passion was botany, more particularly cryptogamic botany. In 1973 Heinar departed from Papua New Guinea to take up a position at the Australian National Botanic Gardens in Canberra where his employment continued (apart for a second stint at the PNG Forestry College in Bulolo in 1981-83) until his retirement in April, 2000. It was here that Heinar really established himself as an expert bryologist and collector of mosses, lichens and liverworts. He also completed his tertiary qualifications the hard way – that is, by part-time study as a mature age student while working full time and supporting his young family. By so doing he successfully completed his Bachelors Degree (University of Canberra) and Masters Degree (University of New South Wales). During this time Heinar was primarily responsible for building up the CANB cryptogamic herharium (formerly CBG) from 14 packets to be the largest and best curated collection of cryptogams in the Southern Hemisphere. He achieved this through individual dedication, perseverance, tenacity, and long hours of work. Heinar was never happier than when he was in the 'bush', going to new places in search of new or rare mosses, lichens or liverworts. He made many significant scientific contributions in his own published papers and even more from his meticulous collections. His *Catalogue of mosses of Australia and its external territories* [Austr. Flora & Fauna series no. 10, AGPS Canberra, 1989] co-authored with Judith Curnow is particularly noteworthy. In the field he had an excellent eye for the unusual and the numerous new species of lichens, mosses and liverworts described over the last 20 years bearing the epithet '*streimannii*' bear witness to this. Despite his many achievements Heinar was a man of great humility.

Quiet and private by nature, Heinar was a very obliging and hospitable person, and an excellent host to our many visiting botanists from around the world. He particularly enjoyed taking visitors in the field – the further and more remote the locality the better. I remember one particular evening when after a very convivial dinner in a local restaurant at ca. 10 p.m. our guest Professor requested "Heinar, now we shall go to the Herbarium .....". Heinar, being the gentleman that he was, not only accompanied her but was happy to do so! He was also more than willing to assist fellow botanists who were in a less privileged position that he – irrespective of whether they were from Estonia, the United States, Papua New Guinea or Vanuatu.

Heinar died on August 29, 2001 after a tough struggle with prostate cancer. I will miss my old friend – and going into the bush without him will not be quite the same – but then again, I expect that he will be waiting there!

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