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Lichenized, lichenicolous and other fungi from North and North-East Greenland

Vagn Alstrup[1], Eric Steen Hansen[1] & Fred J. A. Daniels[2]
[1]Botanical Museum, University of Copenhagen, 130 Gothersgade, DK-1123 Copenhagen K, Denmark
[2]Institute of Plant Ecology, Westfälische Wilhems-Universität, 55 Hindenburgplatz, D-48143 Münster, Germany

Abstract: A total of 410 taxa of lichens, lichenicolous fungi and other fungi are reported from fourteen localities in Kronprins Christian Land in North Greenland and Lambert Land in North East Greenland. Four new combinations are made, viz. *Aspicilia bennettii, A. expansa, Caloplaca elaeophora* and *Neuropogon sphacelatus*. 60 species of lichens and other fungi are reported as new to Greenland, viz. *Acarospora impressula*, *A. picea*, *Amphisphaerella erikssonii, Buellia elegans*, *Carbonea aggregantula*, *C. atronivea*, *Catillaria contristans*, *C. subnegans*, *Collema coccophorum*, *Dacampia engeliana*, *Dactylospora rimulicola*, *Dermatocarpon luridum*, *D. meiophyllizum*, *Didymella praestabilis, Gibbera uliginosa, Ionaspis ventosa*, *Lecanora cavicola*, *L. flotowiana*, *L. perpruinosa*, *L. umbrina*, *Lecidella carpathica*, *Leptogium corniculatum*, *Leptosphaeria hendersoniae, Leptosphaerulina peltigerae, Lichenostigma semiimmersa*, *Melanomma sanguinarium, Merismatium heterophractum*, *M. nigritellum*, *Peltigera britannica*, *Pertusaria chiodectonoides*, *Phomopsis salicina, Physarum oblatum*, *Placynthium subradiatum*, *Pleospora gramineárum, P. pyrenaica, Polyblastia fuscoargillacea*, *P. peminosa*, *P. schisticola*, *Polycoccum sporastatiae*, *Porpidia contraponenda*, *Pronectria robergei*, *Psora cerebriformis*, *Rinodina orcularis*, *Rutstroemia calopus, Sarcogyne privigna*, *Scleropleella hyperborea, Scutula krempelhuberi*, *Septoria caricis, Sporormiella intermedia, Stigmidium schaereri, Teichospora pruniformis*, *Thelidium umbrosum*, *Thelocarpon sphaerosporum*, *Verrucaria calciseda*, *V. floerkeana*, *V. latebrosa*, *V. muralis*, *V. nigrescens var. laeviuscula*, *V. tristis* and *V. umbrinula*. Geology, climate and vegetation of localities and areas, respectively, are briefly treated. A number of new species of lichens and lichenicolous fungi have been found. They will be published separately.

Kokkuvõte: V. Alstrup, E. S. Hansen ja F. J. A. Daniels. Põhja- ja Kirde-Gröönimaa lihheniseerunud, lihhenikoolsed ja teised seened.

Põhja- ja Kirde-Gröönimaa neljateistkümnes leiukohas on tuvastatud 410 sambliku-, lihhenikoolse seene ja seeneliigi esinemine. On tehtud neli uut kombinatsiooni: *Aspicilia bennettii, A. expansa, Caloplaca elaeophora* and *Neuropogon sphacelatus*. 60 sambliku ja muu seeneliigi leidmisest Gröönimaal teatatakse esmakordselt: *Acarospora impressula*, *A. picea*, *Amphisphaerella erikssonii, Buellia elegans*, *Carbonea aggregantula*, *C. atronivea*, *Catillaria contristans*, *C. subnegans*, *Collema coccophorum*, *Dacampia engeliana*, *Dactylospora rimulicola*, *Dermatocarpon luridum*, *D. meiophyllizum*, *Didymella praestabilis, Gibbera uliginosa, Ionaspis ventosa*, *Lecanora cavicola*, *L. flotowiana*, *L. perpruinosa*, *L. umbrina*, *Lecidella carpathica*, *Leptogium corniculatum*, *Leptosphaeria hendersoniae, Leptosphaerulina peltigerae, Lichenostigma semiimmersa*, *Melanomma sanguinarium, Merismatium heterophractum*, *M. nigritellum*, *Peltigera britannica*, *Pertusaria chiodectonoides*, *Phomopsis salicina, Physarum oblatum*, *Placynthium subradiatum*, *Pleospora gramineárum, P. pyrenaica, Polyblastia fuscoargillacea*, *P. peminosa*, *P. schisticola*, *Polycoccum sporastatiae*, *Porpidia contraponenda*, *Pronectria robergei*, *Psora cerebriformis*, *Rinodina orcularis*, *Rutstroemia calopus, Sarcogyne privigna*, *Scleropleella hyperborea, Scutula krempelhuberi*, *Septoria caricis, Sporormiella intermedia, Stigmidium schaereri, Teichospora pruniformis*, *Thelidium umbrosum*, *Thelocarpon sphaerosporum*, *Verrucaria calciseda*, *V. floerkeana*, *V. latebrosa*, *V. muralis*, *V. nigrescens var. laeviuscula*, *V. tristis* ja *V. umbrinula*. Lühidalt iseloomustatakse leiukohtade geoloogiat, kliimat ja taimestikku. On avastatud mitmed uued sambliku- ja lihhenikoolse seene liigid (avaldatakse iseseisvas publikatsioonis).

INTRODUCTION

Logistic and practical support provided by the Danish Polar Center (DPC) and the Geological Survey of Denmark and Greenland (GEUS) has recently made it possible to carry out lichenological and other botanical investigations in some areas in northern Greenland, which previously have been considered partly inaccessible. Kronprins Christian Land and Lambert Land are such areas. They are without a native population, but are more or less regularly inspected by the Sirius sledge patrol. Apart from Station Nord, which is a weather station with a landing strip big enough to receive C-130 (Hercules) flights, only a few huts occur in the two areas. They are both part of the National Park in North and North-East Greenland, the largest in the world.

Two of the authors, V. Alstrup and F. Daniels, investigated the flora of Kronprins Christian Land from late June to the end of July 1995. E. S. Hansen carried out lichenological studies in Kronprins Christian Land and Lambert Land a month later, from late July to late August the same year. He was

assisted by stud. scient. Lasse Vinner. More than 2000 specimens of lichens and lichenicolous fungi were collected by the two teams. The collected material is deposited at the Botanical Museum, University of Copenhagen (C). Hansen (1995) has outlined the previous lichenological investigations in northern Greenland.

Localities and geology

Totally 14 localities were investigated by Vagn Alstrup (VA), Fred Daniels (FD), Eric Steen Hansen (ESH) and Lasse Vinner (LV) in the summer of 1995 (Fig. 1). They are listed in the following. Locality 1 and 2 are situated in Lambert Land. The remaining localities are located in Kronprins Christian Land. The geology of each of the localities are briefly treated in accordance with information given by Peel & Sønderholm (1991), Escher & Jones (1994), Jepsen & Sønderholm (1994) and Higgins (1995).

1. Jørgen Brønlunds Grav. 79°09'N, 19°03'W. Alt. 0–10 m. ESH & LV 10 Aug 1995. Migmatitic gneisses of Caledonian age with basic inclusions.
2. Kap Lagervallen. 79°14'N, 19°00'W. Alt. 0–100 m. ESH & LV 6–9 Aug 1995. Migmatitic gneisses of Caledonian age with basic inclusions.
3. Station Nord. a. Weather Station. 81°36'N, 16°40'W. VA & FD 26–27 June 1995. b. Knuth Fjeld. 81°34'N, 16°24'W. Alt. 0–150 m. ESH 24 Aug 1995. Permian calcareous rocks.
4. Romer Sø. 80°59'N, 19°29'W. Alt. 0–100 m. ESH & LV 21–29 July 1995. Late Proterozoic sandstones and other types of sedimentary rocks more or less rich in carbonate. Gneissic erratics occur commonly.
5. Gletscher Sø. 79°57'N, 21°59'W. a. Surroundings of camp W of lake. Alt. 548–550 m. VA & FD 18–21 July 1995. b. Mountain N of Gletscher Sø. Alt. 860–900 m. VA 20 July 1995. c. Glacier SW of lake. VA 19 July 1995. Late Proterozoic calcareous rocks without or with a low content of Ca.
6. Centrum Sø. 80°10'N, 22°30'W. a. Flat area of river deposits W of Centrum Sø. Alt. 10–20 m. VA & FD 27 June–2 July, 7–8 July and 22 July 1995. b. Fossilfjeld. Limestone mountain. Alt. 20–450 m. VA & FD 27–28 June, 30 June and 22 July 1995. c. Mountain N of Centrum Sø, S-slope with limestone and erratic boulders. Alt. 10–300 m. VA & FD 29 June 1995. d. Mountain SW of Centrum Sø, N and NW-slope. Alt. 40–350 m. VA & FD 1 July 1995. Early Cambrian – Middle Silurian carbonates and sandstones with a low content of Ca.
7. Græselvdal. 80°03'N, 23°11'W. Alt. 0–300 m. ESH & LV 11–15 Aug 1995. Early Cambrian – Middle Silurian carbonates (dolomite), quartzites and sandstones.
8. Valley W of Centrum Sø. 80°11'N, 22°49'W. Alt. 0–300 m. ESH & LV 16–19 Aug 1995. Early Cambrian – Middle Silurian carbonates (dolomite), quarzites and sandstones. Siliceous and basaltic erratics occur commonly.
9. Musk Ox Valley. 80°13'N, 24°10'W. a. Surroundings of camp on S-slope in limestone area. Alt. 40–350 m. VA & FD 2–6 July 1995. b. River valley and surroundings of Geese Lake. Alt. 25–30 m. Loess deposits, stoneridge and turf hummocks. VA & FD 4 July 1995. Early Cambrian – Middle Silurian carbonates and sandstones.
10. Head of Danmark Fjord. 80°34'N, 23°57'W. Alt. 0–100 m. ESH & LV 1–3 Aug 1995. Late Proterozoic carbonates, quarzites and sandstones.
11. Campanuladal. 80°40'N, 24°20'W. a. Around northern part of Campanulasø and camp. Alt. 105–150 m. VA & FD 9 July–13 July 1995. b. Mountain NW of Campanulasø, Campanula Sidedal. Alt. 200–620 m. VA & FD 10 July 1995. Alt. 300 m. VA 13 July 1995. Late Proterozoic sandstones overlayed by basalt. Basaltic rocks also occur locally in the lowland. Carbonates are rare.
12. Bristol Plateau. a. 80°45'N, 24°36'W. Alt. 920 m. VA & FD 14 July 1995. b. Alt. 1000 m. VA & FD 14 July 1995. c. Alt. 960 m. VA & FD 14 July 1995. Middle Proterozoic basalts.
13. Amdrup Højland. 80°24'N, 25°30'W. a. Mosquito Camp and surroundings. Alt. 200–320 m. VA & FD 14–17 July 1995. b. Lowland SE Mosquito Camp. Alt. 90–200 m. VA & FD 15 July 1995. c. Kap Georg Cohn. At inland ice. Alt. 1320 ft. VA & FD 18 July 1995. d. At inland ice. 80°16'N,

25°57'W, alt. 1060 ft. VA & FD 18 July 1995. Middle Proterozoic sandstones and basalts.

14. Norsemanndal. Short stop. Alt. < 100 m. VA & FD 8 July 1995.

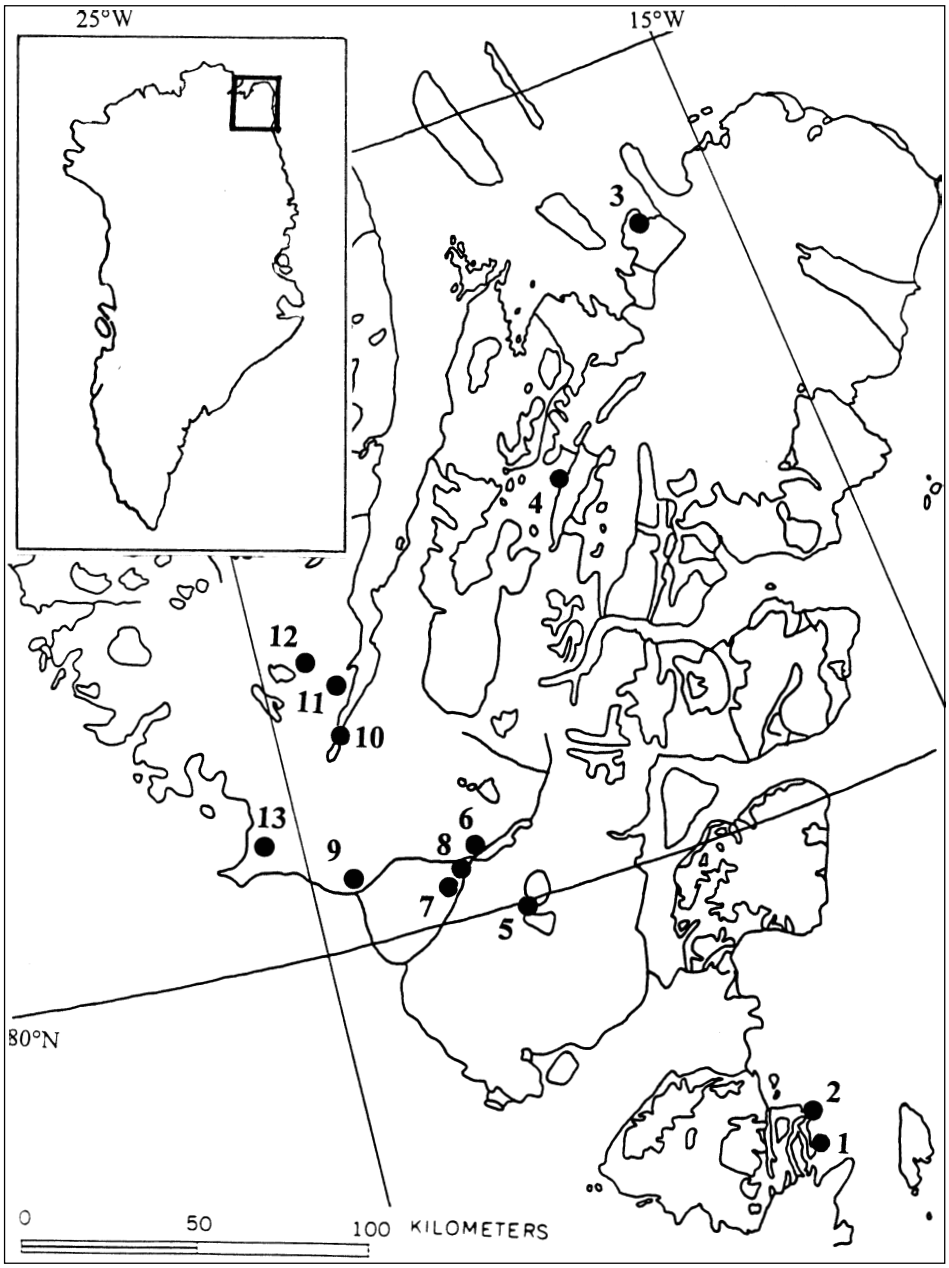

Fig.1. The investigation area showing the thirteen collection localities. 1. Jørgen Brønlunds Grav. 2. Kap Lagervallen. 3. Station Nord (including Knuth Fjeld). 4. Romer Sø. 5. Gletscher Sø. 6. Centrum Sø. 7. Græselvdal. 8. Valley W of Centrum Sø. 9. Musk Ox Valley. 10. Head of Danmark Fjord. 11. Campanuladal. 12. Bristol Plateau. 13. Amdrup Højland. The map has been compiled by F. Daniels. The small Greenland map shows the location of the investigation area.

Climate

Kronprins Christian Land and Lambert Land have a high arctic climate with a long, cold winter and a short, cold summer. The precipation is higher in the coastal than in the inland areas. Climatic data from Station Nord show that the annual precipation is c. 230 mm (Bay 1992). The mean annual temperature is –17 °C. The mean annual precipitation in the inland is estimated to be less than 50 mm. Most of it falls as snow, which accumulates in certain sheltered patches because of the wind. Large areas are free of snow during winter. The vegetation of these areas is usually extremely open due to a water deficit during summer. Only areas below snowbeds or along rivers and lakes have sufficient water supply during the growing season.

Snow and storm made some trouble during the whole investigation period in 1995. Thus a snowstorm hampered the botanical work at Romer Sø in the beginning.

General remarks on the vegetation

The terricolous vegetation at the investigated localities in Lambert Land consists of open heaths dominated by *Saxifraga oppositifolia* and *Dryas integrifolia* and mossy marshes. Lichens associated with siliceous rocks occur abundantly.

The vegetation of the inland parts of Kronprins Christian Land and Mylius Erichsen Land around Danmark Fjord is rather diverse and uniform (Daniels & Alstrup 1996, Daniels 1999, see also Holmen 1957). Apart from sparsely vegetated, dry barrens, the dominant vegetation in Centrum Sø and its near surroundings is an open *Dryas integrifolia*-vegetation with *Salix arctica*, several Carices and many mosses and lichens on the extensive xeric-mesic sites, with frostboils on loamy soil. Steppe vegetation occurs locally in warm, sheltered sites, while *Cassiope tetragona* heaths occur in pockets with snow accumulation. The wetlands are characterized by several types of *Eriophorum* (*triste* and *scheuchzeri*), *Carex stans*, *Juncus* (*biglumis* and *triglumis*) and *Pleuropogon sabine*-vegetation with many mosses. The same principally applies for Romer Sø, Musk Ox Valley (however extensive wetlands occur here), the head of Danmark Fjord and the valley bottom and down and midslope parts of the mountain bording the valley of Campanuladal to the north. The Bristol Plateau shows an open polar desert-like vegetation. The vegetation around Gletscher Sø has a sparse vegetation on rockey barrens and around some lakes. The ice-cap forelands have polar desert vegetation.

The vegetation at Station Nord is poor in vascular plant species and vegetation types. Dwarf shrubs and Carices are lacking. Open polar desert herb vegetation with abundant *Saxifraga oppositifolia* and *Papaver radicatum* s.l. covers most of the polar desert landscape (Bay 1997).

MATERIAL AND METHODS

Lichens were collected at numerous sample plots situated in Kronprins Christian Land and Lambert Land. The collected material, a total of about 2000 specimens of lichens, lichenicolous fungi and other fungi, was studied with Zeiss light microscopes. Standard TLC methods were used for identification of some specimens of *Cladonia*, *Lepraria* and other greyish white, leprose, crustose lichens. The material is deposited at the Botanical Museum, University of Copenhagen (C).

Annotated list of lichens and lichenicolous fungi

The following list of lichens and lichenicolous fungi is based on the author's collections. Nomenclature follows Santesson (1993) with some exceptions. Annotations are given as regards the substrate of the lichens. Collections, which have been distributed previously from herbarium C as part of "Lichenes Groenlandici Exsiccati" (LGE), are stated by their numbers. Selected references are cited.

ACAROSPORA DISCRETA (Ach.) Arnold. 6c, 9a, 11a, 13a. On boulders and rocks.

A. HOSPITANS H. Magn. 13a. On sandstone.

A. IMPRESSULA Th. Fr. 11a. On sandstone. New to Greenland.

A. MOLYBDINA (Wahlenb.) A. Massal. 11a. On sandstone rock.

A. NITROPHILA H. Magn. 5b. On exposed siliceous rock and birdstone.

A. PICEA H. Magn. 7, 8, 9a, 10, 13a. On exposed basaltic stones and rocks. New to Greenland.

A. RHIZOBOLA (Nyl.) Alstrup. 4, 6c, 7, 11a, 13a. On sand and loess in dry places on mountain slopes, on sandy river banks and in rock fissures.

A. SCABRIDA Hedl. ex H. Magn. 11a, 11b, 13a. On sandstone and basalt.

A. SCHLEICHERI (Ach.) A. Massal. 6c, 11a. On loess and soil on S-slopes and rocks in dry areas.

A. SMARAGDULA (Wahlenb.) A. Massal. 2. On gneissic rocks.

A. VERONENSIS A. Massal. 4, 6c, 11a, 13a. On ± calcareous rocks and boulders.

ADELOLECIA KOLAENSIS (Nyl.) Hertel & Rambold. 9a. On basalt.

A. PILATI (Hepp) Hertel & Hafellner. 5b. On siliceous stones.

ALECTORIA NIGRICANS (Ach.) Nyl. 1, 2, 7. On soil and mosses (*Racomitrium lanuginosum*) among stones in fell-fields, mostly on acid rocks near the coast.

A. OCHROLEUCA (Hoffm.) A. Massal. 1, 2. Among stones in fell-fields in gneissic area near the coast.

ARTHONIA DESTRUENS Rehm. 6c, 11a. Parasitic on *Xanthoria elegans* on birdstones and *Xanthoria sorediata* in a temporary riverbed. In Greenland the species has been reported on *Lecanora leptacina* near Qeqertarsuaq/Godhavn. It is also known from species of *Xanthoria* and *Physciaceae* in Europe.

A. EPIPHYSCIA Nyl. 4, 11a. Parasitic on *Physcia caesia* and *P. dubia*. Sparse. Widespread on species of *Physciaceae, Xanthoria parietina, Caloplaca saxicola* and *Phaeorrhiza nimbosa*.

A. EXCENTRICA Th. Fr. 4, 5a, 6d, 11a, 11b. On *Leprocaulon subalbicans* and *Lepraria frigida*.

A. LAPIDICOLA (Taylor) Branth & Rostrup. 7. On limestone.

A. MOLENDOI (Frauenf.) R. Sant. 1, 6c, 9a, 10. Parasitic on *Xanthoria elegans* on birdstone. In Greenland known from Qeqertarsuaq/Godhavn and Kangerlussuaq/Søndre Strømfjord area on *Caloplaca saxicola, Xanthoria elegans* and *Phaeophyscia* sp. Also known from Scandinavia and the Alps.

A. PELTIGEREA Th. Fr. 13a. Parasitic on *Peltigera didactyla* in *Salix arctica*-vegetation. Known from Disko Island on *Solorina bispora*, more frequent on *Peltigera* in Europe.

A. PELTIGERINA (Almq.) H. Olivier. 11a, 11b. On *Peltigera lepidophora* and *P. didactyla*. It is known from Disko Island and Scandinavia.

A. STEREOCAULINA (Ohlert) R. Sant. 5b. On *Stereocaulon depressum*. Known from *Stereocaulon alpinum* at Kangerlussuaq/Søndre Strømfjord (as *A. nephromiaria*, Alstrup & Hawksworth 1990) and from Europe.

ARTHRORHAPHIS ALPINA (Schaerer) R. Sant. 1, 2, 3b, 4, 5a, 5b, 11a, 11b, 12b, 13a, 13b, 14. Common on mineral soil, rarely on mosses in open heath and fell-fields in non-calcareous areas (Hansen & Obermayer 1999). Also on *Baeomyces rufus* in *Cassiope*-vegetation.

ASPICILIA ANNULATA (Lynge) Thomson. 9a, 11a, 13a. On sandstone in dry riverbed and ravine.

ASPICILIA BENNETTII (Lynge) Alstrup & E. S. Hansen comb. nov. Basionym: *Lecanora bennettii* Lynge, Skrifter om Svalbard og Ishavet 81: 90-91, 1940. 13a. On sandstone in N-sloping stone desert and on top of hill.

A. CALCAREA (L.) Mudd. 5a. On stone in streambed.

A. CONTORTA (Hoffm.) Kremp. 5b. Exposed limestone on S-slope near icecap.

A. ELEVATA (Lynge) Thomson. 2, 4, 5b, 6b, 6d, 7, 8, 9a, 10, 11a, 11b, 13a. On limestone and sandstone rocks at streams, on exposed basalt top and in N-sloping stone desert.

ASPICILIA EXPANSA (Lynge) Alstrup & E. S. Hansen comb. nov. Basionym: *Lecanora expansa* Lynge, Skrifter om Svalbard og Ishavet 81: 96-97, 1940. 5a. On stone in stoneridge.

A. MASTOIDEA (Lynge) Creveld. 2, 9a, 11a. On basalt and sandstone.

A. MASTRUCATA (Wahlenb.) Th. Fr. 2. On gneiss.

A. NIKRAPENSIS Darb. 4, 6b, 6d, 7, 8, 9a, 11a, 11b. On calcareous stones and rocks, on sandstone and on basalt.

A. PERRADIATA Nyl. 10. On limestone.

A. SUBLAPPONICA (ZAHLBR.) Oxner. 11b. On sandstone in ravine.

BAEOMYCES CARNEUS Flörke. 1, 5a, 11a, 11b, 13a, 13b. On loess and mosses both in rather

dry and rather moist places, with *Cassiope* on N- and E-slopes, near rivers and with *Dryas integrifolia* and *Carex* spp. on S-slopes.

B. PLACOPHYLLUS Ach. 1, 4, 11a, 11b, 12c. On rather moist, acid to slightly calcareous soil at rivers and in ravines and N-slopes, often with *Cassiope tetragona*.

B. RUFUS (Huds.) Rebent. 1, 4, 11a, 11b. Frequent at Campanulasø. On rather moist, non-calcareous soil, with *Cassiope tetragona*. Occasionally with *Dryas integrifolia* and *Carex* spp. on slopes and in ravines.

BIATORA SUBDUPLEX (Nyl.) Printzen. 1, 2. On mosses and humus in open heaths.

BISPORA CHRISTIANSENII D. Hawksw. 5a, 6b, 8, 11. Parasitic in the hymenium of *Protoblastenia incrustans*, *Lecanora hagenii* f. *saxifragae* and unknown host on limestone rocks and pebbles. The species is widespread and occurs on many different host species.

B. LICHENUM Diederich. 6b, 9a. In apothecia of *Protoblastenia calva* and *Cephalophysis leucospila*.

BRODOA OROARCTICA (Krog) Goward. 3, 4. On basaltic and quartzitic stones.

BRYOCAULON DIVERGENS (Ach.) Kärnefelt. 4. On a thin layer of soil in fell-field.

BRYORIA CHALYBEIFORMIS (L.) Brodo & D. Hawksw. 1, 2, 4, 11a, 11b. On mosses and soil on wind-exposed hilltops, on N-slopes, in ravines and on a hilltop with *Dryas integrifolia*, in areas without limestone. LGE 593.

BUELLIA BADIA (Fr.) A. Massal. 11a. Parasitic on *Lecidea tesselata*.

B. DISCIFORMIS (Fr.) Mudd. 2. Among mosses on soil rich in humus in heath.

B. ELEGANS Poelt. 4, 5a, 6b, 6c, 6d, 7, 8, 9a, 9b,10, 11a. Very common on loess and calcareous soil in desert- and steppe areas, sparse on soil in exposed stoneridges at high altitudes. Associated with *Dryas integrifolia* – *Carex* spp. New to Greenland. LGE 596 (Fig. 2).

B. EPIGAEA (Pers.) Tuck. 4, 5b, 11a. On soil.

B. IMSHAUGII Hafellner. 13a. On *Dimelaena oreina*.

B. INSIGNIS (Nägeli ex Hepp) Th. Fr. 2, 12a. On mossy soil over exposed stone.

B. NIVALIS (Bagl. & Carestia) Hertel. 9a, 11a. On *Xanthoria elegans* on birdstone and on bone. It is a widespread species known to grow on species of *Caloplaca*, *Xanthoria* and *Lecanora subradiosa*.

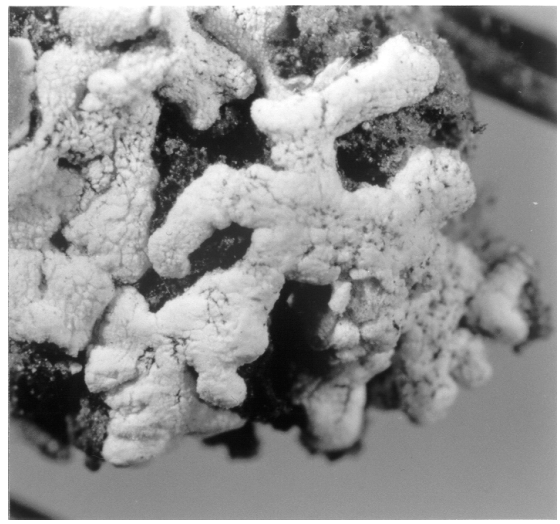

Fig. 2. *Buellia elegans* Poelt. Thallus growing on sandy soil in Græselvdal (x14). A slight infection with *Lichenostigma semiimmersa* Haffellner is seen. Photo: F. Rasmussen & E.S. Hansen.

B. PAPILLATA (Sommerf.) Tuck. 1, 2, 4, 5a, 5b, 7, 10, 11a, 13a. Common on mosses, soil and dead plants in open heaths, fell-fields and *Cassiope*-vegetation.

B. PULVERULENTA (Anzi) Jatta. 2, 6c, 6d, 9a, 13a. On *Physconia muscigena* and *Physcia dubia* on birdstones and in other exposed places. Rather frequent and known from several places in West Greenland. Widespread in arctic to temperate areas.

B. PUNCTATA (Hoffm.) A. Massal. 2, 11a. On *Salix* in *Cassiope*-vegetation.

B. STIGMATEA Körber. 11a. On S-facing sandstone rock.

B. TERRICOLA A. Nordin. 11a. On soil rich in humus.

CALOPLACA ALCARUM Poelt. 1. On coastal gneissic rocks together with *Lecanora contractula* and *Candelariella vitellina*.

C. AMMIOSPILA (Wahlenb.) H. Olivier. 1, 2, 13a. On soil and mosses in heathland and on windswept hill.

C. APPROXIMATA (Lynge) H. Magn. 11a. On sandstone in temporary riverbed and on moist N-slope.

C. CASTELLANA (Räsänen) Poelt. 4, 5a, 6b, 6c, 6d, 7, 8, 9a, 10, 11a, 11b. At first a lichenicolous lichen, later becoming independent. Common on *Rhizocarpon geminatum* on sandstone and on *Placynthium asperellum* and *P. nigrum* on calcareous sandstone and limestone, respectively.

C. CELATA Th. Fr. 11a, 11b. On dead *Saxifraga oppositifolia* and dead *Dryas integrifolia*.

C. CERINA (Ehrh. ex Hedwig) Th. Fr. 1, 2, 4, 6d, 7, 9a, 11a, 13a. Common on plant remains and mosses in heaths; also on old dung, bones, driftwood and old *Peltigera*.

C. CITRINA (Hoffm.) Th. Fr. 11a. On sandstone rock.

C. DECIPIENS (Arnold) Blomberg & Forssell. 6c, 8, 9a, 9b, 11a, 13a. On loess, mosses and birdstones, bones of musk ox, mainly in calcareous areas. In Greenland previously known from a few localities in central West Greenland. LGE 625.

C. DIPHYODES (Nyl.) Jatta. 5a. On stone in streambed, with *Aspicilia calcarea*.

CALOPLACA ELAEOPHORA (E.S. Hansen, Poelt & Søchting) Alstrup & E. S. Hansen stat. nov. Basionym: *C. lithophila* var. *elaeophora* E. S. Hansen, Poelt & Søchting, Meddelelser om Grønland, Bioscience 25: 35, 1987. 6b. On exposed boulder on NE-slope. The variety was described on the basis of one collection from Disko Island. The find of a new North Greenland collection justifies its status as a separate species.

C. EPIPHYTA Lynge. 6c, 11a, 11b. On plant remains, *Placynthium asperellum* and hare spilling in dry places.

C. EPITHALLINA Lynge. 9a. On unknown lichen on sandstone rocks on hilltop.

C. FLAVOVIRESCENS (Wulfen) Dalla Torre & Sarnth. 5a, 9a. On limestone above waterfall and on basalt.

C. FRAUDANS (Th. Fr.) H. Oliv. 4, 6b, 11a. On sandstone rocks and boulders.

C. INSULARIS Poelt. 4, 6b, 9a. On *Aspicilia nikrapensis* and *Aspicilia* sp. on calcareous sandstone and limestone boulder.

C. JUNGERMANNIAE (Vahl) Th. Fr. 5a. On mosses between rocks.

C. LITHOPHILA H. Magn. 6c, 6d, 9a, 11a. On calcareous sandstone boulders mostly at streams. Also on birdstone.

C. PAULII Poelt. 6b, 6c, 6d. On limestone near watercourses. Sometimes on birdstones.

C. SAXICOLA (Hoffm.) Nordin. 6c. On S-facing limestone at river.

C. SAXIFRAGARUM Poelt. 5a, 7, 9a, 11a. On dead *Saxifraga oppositifolia*, *Cassiope tetragona*, *Silene acaulis* and other plant remains in sheltered places.

C. SINAPISPERMA (Lam. & DC.) Maheu & Gillet. 5b, 13a. On soil on exposed mountain top and on S-slope.

C. SOROCARPA (Vainio) Zahlbr. 1. On bone.

C. TETRASPORA (Nyl.) H. Olivier. 11b. On mosses over stone.

C. TIROLIENSIS Zahlbr. 1, 2, 4, 5a, 5b, 6d, 10, 11a, 11b. Common on mosses and plant remains in fell-fields, among *Cassiope tetragona* on rocks, in *Dryas*-communities, on twig of *Salix arctica*, on spilling of hare and musk ox and on bone.

C. TOMINII Savicz. 3, 4, 6a, 6c, 7, 8, 9a, 10, 11a. On sand, soil, loess, humus and mosses in xerotherm places on southfacing slopes, rocks and at birdstones. LGE 610.

CANDELARIELLA AURELLA (Hoffm.) Zahlbr. 2, 3a, 3b, 4, 5b, 6a, 6b, 6c, 6d, 7, 8, 9a, 9b, 10, 11a, 11b, 13a, 13d. Common on limestone, calcareous sandstone, basalt, calcareous soil, bone, hare-dung, birdstones and dead *Silene acaulis*. Sometimes epiphytic on *Collema substellatum*, *Phaeophyscia sciastra*, *Physconia muscigena* and *Placynthiella* spp.

C. CANADENSIS H. Magn. 1, 2, 3b, 11a, 13a. On sand and soil on exposed ridge and hilltop.

C. KUUSAMOENSIS Räsänen. 1, 2, 4, 11a, 13d. On humus and mosses in moist places, sometimes over *Melanelia infumata*.

C. VITELLINA (Hoffm.) Müll. Arg. 2, 4, 7, 11a, 11b. On exposed basalt and sandstone rocks at river.

CARBONEA AGGREGANTULA (Müll. Arg.) Diederich & Triebel ined. 1, 11b. On *Lecanora leucococca* and *L. polytropa*. New to Greenland.

C. ATRONIVEA (Arnold) Hertel. 9a. On exposed boulder. New to Greenland (Fig. 3).

C. VITELLINARIA (Nyl.) Hertel. 4. On *Candelariella vitellina*.

C. VORTICOSA (Flörke) Hertel. 5a. On stone in streambed.

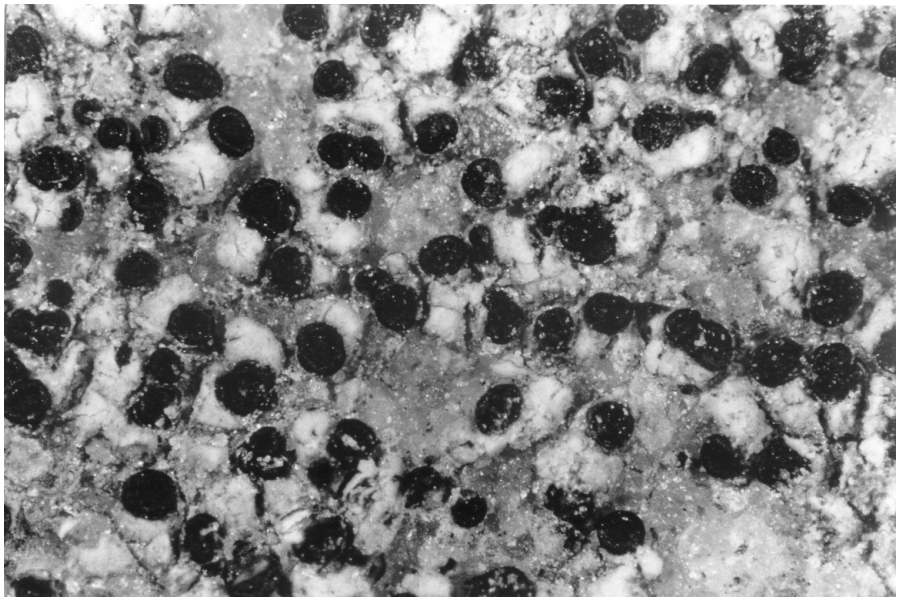

Fig. 3. *Carbonea atronivea* (Arnold) Hertel. Fertile thallus growing on sandstone in Musk Ox Valley (x18). Photo: F. Rasmussen & E. S. Hansen.

CATAPYRENIUM CINEREUM (Pers.) Körber. 4, 5a, 11a, 11b, 13b. On loess and soil rich in humus in desert-like areas and on dry slopes. Also on bone.

C. DAEDALEUM (Kremp.) Stein. 5a, 9a, 13a. On soil on hill-top, in windswept pass, between boulders and on soil over limestone at temporary river.

C. LACHNEUM (Ach.) R. Sant. 1, 11a. On clayey soil in fell-field with *Rinodina mniarea* and on soil over flat rocks with periodically seeping water. Also on mosses.

C. SQUAMULOSUM (Ach.) Breuss. 9a. On loess on S-slope.

CATILLARIA CHALYBEIA (Borrer) A. Massal. 9a, 11a, 11b. On limestone in dry slope.

C. CONTRISTANS (Nyl.) Zahlbr. 9b. On moist soil below snowbed. New to Greenland.

C. MUSCICOLA Lynge. 9a. On mosses between boulders.

C. SUBNEGANS (Nyl.) Arnold. 9a. On sand with *Nostoc* sp. New to Greenland.

CEPHALOPHYSIS LEUCOSPILA (Anzi) H. Kilias & Scheid. 6b, 7, 9a, 11a. On exposed limestone.

CERCIDOSPORA LICHENICOLA (Zopf) Hafellner. 11a. On *Peltigera rufescens*. Known from species of *Solorina* and *Peltigera* in Europe and Greenland.

CETRARIA ACULEATA (Schreber) Th. Fr. 4. In mosses on small hilltop.

C. COMMIXTA (Nyl.) Th. Fr. 4, 5b. On rocks and stone in exposed stoneridge.

C. ISLANDICA (L.) Ach. 1, 2. Among mosses in fell-field.

C. MURICATA (Ach.) Eckfeldt. 1, 2, 3, 4, 11a. On mosses in heathland and on exposed hill-top. In Campanuladal on S-slope in *Dryas-Carex* spp.-vegetation.

CETRARIELLA DELISEI (Bory ex Schaerer) Kärnefelt & A. Thell. 1, 2, 3, 4, 5a, 11a, 11b, 12b, 12c. On mosses and soil in rather moist places outside the limestone area, in ravines and on rocks along watercourses and ice-caps. LGE 581, 615.

CLADONIA BOREALIS S. Stenroos. 2. On soil rich in humus in fell-field.

C. COCCIFERA (L.) Willd. 11a. On sandy soil in *Dryas*-vegetation.

C. MACILENTA Hoffm. 11a. On sandy soil in *Dryas-vege*tation.

C. MACROPHYLLA (Schaerer) Stenh. 9a, 11a, 13a. On soil in *Cassiope*-heath and most *Dryas*-heath.

C. MACROPHYLLODES Nyl. 2. On soil in *Cassiope*-vegetation. LGE 614.

C. POCILLUM (Ach.) Grognot. 1, 2, 3, 4, 5a, 6b, 6c, 6d, 7, 8, 9a, 9b, 10, 11a, 11b, 13a,

13b, 14. Very common on soil and mosses in moist and dry communities both in lime-rich and in lime-free areas. LGE 578, 606, 617.

Clauzadea monticola (Schaerer) Hafellner & Bellem. 9a. On calcareous sandstone.

Collema ceraniscum Nyl. 2, 4. Over mosses in moist areas.

C. coccophorum Tuck. 6a, 6b, 6c, 6d, 8. On loess over rocks in steppe-vegetation in dry calcareous areas. Often around birdstones. New to Greenland. LGE 624.

C. fuscovirens (With.) J. R. Laundon. 6d, 9a. On rocks at waterfalls.

C. glebulentum (Nyl. ex Cromb.) Degel. 11a. On stones at lake and on rocks with trickling water.

C. substellatum H. Magn. 6a, 6b, 6c, 6d, 7, 8, 9a, 9b, 10. Very frequent in desert- and steppe-vegetation on loess and sand in calcareous areas. The species has previously been reported from North Greenland by E.S. Hansen (1993,1995). LGE 599.

C. cfr. tenax (Sw.) Ach. 6c, 6d, 9a, 11a. On soil in moist areas.

C. undulatun Flotow var. granulosum Degel. 4, 7. On mosses on soil.

Cystocoleus ebeneus (Dillwyn) Thwaites. 11a. On slightly calcareous soil at river.

Dacampia engeliana (Saut.) A. Massal. 4. On *Solorina saccata*. New to Greenland.

D. hookeri (Borr.) A. Massal. 1, 4, 7, 8, 9a, 10. On mineral soil and soil rich in humus in fell-fields, open heaths and on creeping soil on N-slope with *Cassiope tetragona*. Initially growing parasitically on *Solorina saccata*, later becoming an independant lichen.

Dactylina ramulosa (Hook.) Tuck. 1, 2, 4, 11b. On soil and mosses in exposed, moist sites and in ravine near river. LGE 592.

Dactylospora rimulicola (Müll. Arg.) Hafellner. 13a. On *Rhizoplaca melanophthalma* on sandstone. New to Greenland.

D. urceolata (Th. Fr.) Arnold. 11a. On *Lecanora epibryon* in moist *Dryas-veg*etation on S-slope.

Dermatocarpon luridum (With.) J. R. Laundon. 6b. On stone in riverbed. New to Greenland.

D. meiophyllizum Vainio. 7, 9a. On moist, calcareous rocks. New to Greenland.

D. miniatum (L.) W. Mann. 6d, 9a. On rocks at waterfall and on boulder in stream.

Dimelaena oreina (Ach.) Norman. 4, 5a, 7, 8, 10, 11a, 11b, 13a, 13c. Common on exposed rocks and boulders in non-calcareous, relatively warm areas. Nitrophilous.

Diploschistes muscorum (Scop.) R. Sant. 4, 7, 8, 9a, 11a, 13a. Common at Campanuladal, sparse at loc. 13. On soil and mosses in fell-fields, open heaths and steppe-vegetation, associated with *Dryas integrifolia*. LGE 597.

Eiglera flavida (Hepp) Hafellner. 9a. On limestone rock at rivulet.

Endocarpon pusillum Hedw. 6a, 6c, 7, 9a, 9b, 10, 11a, 11b. Frequent on calcareous soil and loess in desert- and steppe-vegetation, on exposed stoneridges and on hummocks and early snowbeds in limestone area. Also over basalt.

Endococcus rugulosus Nyl. 6d, 11a. On unknown host and on *Rhizocarpon geminatum* on siliceous rocks at stream.

Ephebe hispidula (Ach.) Horw. 6d, 9a. On limestone at stream.

Epilichen glauconigellus (Nyl.) Hafellner. 2. On *Baeomyces carneus*.

E. scabrosus (Ach.) Clem. 5a. On *Baeomyces rufus* on moist soil between boulders.

Farnoldia hypocrita (A. Massal.) Fröberg. 6b, 6d. On limestone rock at stream.

Flavocetraria cucullata (Bellardi) Kärnefelt & A. Thell. 1, 2, 3. On soil in heathland.

F. nivalis (L.) Kärnefelt & A. Thell. 1, 2, 3, 4, 5a, 11a, 11b. On mosses and soil in rather moist, cool places outside the limestone area, either in fell-fields or in heaths with *Dryas integrifolia*, *Carex* spp. and *Saxifraga oppositifolia*.

Fulgensia bracteata (Hoffm.) Räsänen. 1, 2, 3a, 4, 5a, 6a, 6b, 6c, 6d, 7, 8, 9a, 9b, 10, 11a, 13a. Common on soil, sand and loess in steppe- and desert-vegetation on S-slopes, at river banks and between boulders, often with *Dryas integrifolia* and *Carex misandra*. LGE 577, 619.

F. desertorum (Tomin) Poelt. 6c, 6d, 7, 8, 10, 11a, 13a. On sandy soil and loess in dry stoneridges and S-slopes. The species has previously been reported from Jørgen Brønlund Fjord in Peary Land (Hansen 1993).

Fuscopannaria praetermissa (Nyl.) P. M. Jørg. 2, 11a, 11b. On mosses and soil rich in hu-

mus over sandstone and basalt in rather moist places.

GLYPHOLECIA SCABRA (Pers.) Müll. Arg. 6b, 6c, 7, 8. Frequent on rocks composed of limestone and dolomite. Also on birdstones. LGE 595.

GRAPHIUM APHTHOSAE Alstrup & D. Hawksw. 2, 9, 11a, 11b, 13. On *Peltigera aphthosa* and *P. britannica* mainly in *Cassiope*-vegetation on N- and NE-slopes, often together with *Stigmidium peltideae*.

GYPSOPLACA MACROPHYLLA (Zahlbr.) Timdal. 6b, 6c, 6d, 7, 8, 9a, 10, 11a, 13a. On loess and sandy soil in desert- and steppe-vegetation dominated by *Dryas integrifolia* and *Carex* spp., mostly in calcareous areas.

HYMENELIA ARCTICA (Lynge) Lutzoni. 9a, 11a, 11b, 13a. On limestone and sandstone rocks at rivers and lakes.

H. CYANOCARPA (Anzi) Lutzoni. 5a. On stone in riverbed.

H. HETEROMORPHA (Kremp.) Lutzoni. 9a. On limestone rock at stream.

HYPOGYMNIA AUSTERODES (Nyl.) Räsänen. 4, 11a, 11b. On soil, mosses, twigs, basalt, limestone and sandstone rocks without Ca.

H. SUBOBSCURA (Vainio) Poelt. 4, 11a. On soil in protected places with *Dryas integrifolia*, and on dead *Saxifraga oppositifolia*.

IONASPIS ODORA (Ach.) Stein. 4, 5a, 7, 9a. On sandstones submersed in temporary river and in other moist places. LGE 580.

I. SUAVEOLENS (Fr.) Th. Fr. 4, 5a, 6c, 6d, 8, 9, 11a, 11b, 13a, 13b. On stones composed of sandstone and limestone at rivers and lakes. Also on seepage rocks.

I. VENTOSA P. M. Jørg. & R. Sant. 6d. On calcareous rocks. New to Greenland.

LASIOSPHAERIOPSIS STEREOCAULICOLA (Lindsay) O. Eriksson & R. Sant. 4, 5a, 5b, 11b. On *Stereocaulon depressum*, *S. incrustatum* and *S. rivulorum*. Occurring in, for example, fell-fields and riverbeds.

LECANORA ARGOPHOLIS (Ach.) Ach. 11b, 13a. On sand, basalt and exposed sandstone rocks.

L. CAVICOLA Creveld. 11b. On sandstone rock in ravine, together with *Miriquidica lulensis*, *Pleopsidium chlorophanum*, *Pseudephebe minuscula* and *Umbilicaria decussata*. New to Greenland.

L. CONTRACTULA Nyl. 1. On coastal gneissic rocks together with *Caloplaca alcarum*.

L. CRENULATA Hook. 4, 6b, 6c, 9a, 9b, 11a. On limestone rock, birdstone, bone and calcareous sand in rather exposed sites.

L. DISPERSA (Pers.) Sommerf. 6c, 6d, 9a, 11a, 13a. On exposed calcareous stone, birdstone and bone.

L. EPIBRYON (Ach.) Ach. 1, 2, 3, 4, 5a, 5b, 6d, 7, 8, 9a, 9b, 10, 11a. Common on plant remains in fell-fields and heaths and on mosses between boulders.

L. FLOTOWIANA Sprengel. 6c, 7, 8, 9a, 11a, 14. On limestone, calcareous sandstone and bone. Also on *Placynthium asperellum*. New to Greenland.

L. FRUSTULOSA (Dicks.) Ach. 11a. On rock at river.

L. FUSCESCENS (Sommerf.) Nyl. 11a. On dead *Dryas integrifolia*.

L. GANGALEOIDES Nyl. 11a, 11b. On sandstone, silicate rock at river and on birdstone.

L. GEOPHILA (Th. Fr.) Poelt. 13a. On sand on SW-slope.

L. HAGENII (Ach.) Ach. f. SAXIFRAGAE Anzi. 4, 5a, 5b, 6a, 6b, 6c, 6d, 7, 9a, 11a, 11b, 13a. Common on plant remains. Also on loess.

L. LEUCOCOCCA Sommerf. 1, 2, 4, 5b, 9, 11a, 11b, 13a, 13c, 13d. On sandstone rocks in moist places. Also on basaltic rocks.

L. LUTEOVERNALIS Brodo. 1, 4, 5a, 11a. On soil rich in humus and on mosses. LGE 616.

L. MARGINATA (Schaerer) Hertel & Rambold. 1, 2, 3, 4, 5a, 5c, 6d, 7, 8, 9a, 10, 11a, 13a, 14. Common on limestone and calcareous sandstone in exposed and windswept places and at streams. LGE 584, 626.

L. MURALIS (Schreb.) Rabenh. 4, 5a. On stones on S-slope.

L. PERPRUINOSA Fröberg. 4, 6c, 8. On limestone rocks. New to Greenland.

L. POLYTROPA (Ehrh. ex Hoffm.) Rabenh. 2, 3, 4, 5b, 6d, 10, 11a, 11b, 12b, 12c, 13a, 13d. On exposed stones and rocks composed of gneiss, basalt and sandstone without lime. LGE 586.

L. SWARTZII (Ach.) Ach. 5a. On stone in gravelbed.

L. UMBRINA (Ach.) A. Massal. 11a. On sandstone. New to Greenland.

LECIDEA ATROBRUNNEA (Ramond ex Lam. & DC.) Schaerer. 2, 4, 5a, 6b, 11a, 12c, 13a. On exposed siliceous stones on stoneridges and mountain tops.

L. ATROMARGINATA H. Magn. 2, 4, 5a, 5b, 11a. On pure sandstone on stoneridges.

L. AURICULATA Th. Fr. 1, 4, 5b, 6b, 6c, 7, 9a, 11a, 11b, 13a. On exposed, windswept siliceous stones.

L. BRACHYSPORA (Th. Fr.) Nyl. 11a. On sandstone rock in temporary riverbed.

L. CONFERENDA Nyl. 9a. On basaltic stones.

L. CONFLUENS (Weber) Ach. 11b. On sandstone rock in ravine, together with *Rhizocarpon geminatum* and *Muellerella pygmaea*.

L. HAERJEDALICA H. Magn. 6b, 6d, 9a, 11a. On sandstone rocks with and without carbonate.

L. LACTEA Flörke. 5b, 11b. On exposed siliceous rocks and on mosses in ravine.

L. LAPICIDA (Ach.) Ach. 4, 5a, 6c, 9a, 11a. On sandstone rocks.

L. LEUCOTHALLINA Arnold. 5b, 6b. On exposed siliceous rocks.

L. MOLYBDOCHROA Hertel. 11a, 11b, 12b, 13a. On sandstone rocks and basalt.

L. PLANA (J. Lahm) Nyl. 5a, 13a. On exposed rocks, together with *Dimelaena oreina*.

L. PRAENUBILA Nyl. 13a. On sandstone boulder in stream.

L. RAMULOSA Th. Fr. 1, 2, 4, 6b, 6c, 6d, 9a, 11a, 11b. On soil rich in humus, often in *Cassiope*-heaths, at rivers and in snowbeds, rarely in *Dryas-vege*tation. Often associated with *Solorina bispora* and *Stereocaulon rivulorum*.

L. SILACEA Ach. 5b, 11a. On siliceous stones.

L. TESSELATA Flörke. 4, 5a, 5b, 6b, 6c, 6d, 7, 8, 9a, 9b, 10, 11a, 11b, 13a. Very common on calcareous sandstone (including birdstones), limestone, compacted sand and loess in steppe-communities. Often together with *Lecidella bullata*, *Glypholecia scabra*, *Sporastatia testudinea* and *Rhizocarpon pusillum*.

LECIDELLA BULLATA Körber. 2, 4, 5a, 5b, 6b, 6c, 6d, 9a, 10, 11a, 12b, 13a, 13c. Very common on exposed sandstone, limestone, birdstones, compacted sand and loess. Associated with *Lecidea tesselata*, *Aspicilia calcarea*, *Miriquidica garovaglii*, *Pseudephebe minuscula* and *Rhizocarpon norvegicum*. LGE 621.

L. CARPATHICA Körber. 5b. On exposed stone on S-slope. New to Greenland.

L. EFFUGIENS (B. Nilson) Knoph & Hertel. 11b. On sandstone rock in temporary watercourse with *Lecanora flotowiana* and *Candelariella aurella*.

L. PATAVINA (A. Massal.) Knoph & Hertel. 4, 6b, 6c, 6d, 9a, 11a, 13a. On limestone and sandstone in rather moist situations.

L. STIGMATEA (Ach.) Hertel & Leuckert. 4, 5b, 9a, 11a, 13a, 13b. On sandstone, limestone and bones, sometimes on birdstones. Associated with species such as *Caloplaca cerina*, *C. decipiens*, *Candelariella aurella*, *Lecanora crenulata*, *Rhizocarpon badioatrum* and *Cetraria commixta*.

L. WULFENII (Hepp) Körber. 2, 5a, 5b, 11. On mosses and plant remains between boulders and on soil in *Cassiope*-vegetation, together with *Arthrorhaphis alpina*, *Leprocaulon subalbicans* and *Arthonia excentrica*.

LEPRARIA FRIGIDA J. R. Laundon. 5a, 5b, 11a, 13b. On sand on E-slope. LGE 598 (sub nomen *Leproloma vouauxii*).

LEPROCAULON SUBALBICANS (I. M. Lamb) I. M. Lamb & A. M. Ward. 2, 5b, 6d, 11a, 11b. On mosses and soil in moist places associated with *Arthrorhaphis alpina*, *Caloplaca tiroliensis* and *Cladonia pocillum*. Often parasitized by *Arthonia excentrica*.

LEPTOGIUM CORNICULATUM (Hoffm.) Minks. 6d, 11b, 13a. On mosses at stream and between *Cassiope tetragona*. New to Greenland.

L. LICHENOIDES (L.) Zahlbr. 2, 4, 6d, 9a, 11a, 11b. On mosses and soil rich in humus near snowbeds and rivers and at birdstones. Often associated with *Cassiope tetragona*.

LEPTOSPHAERULINA PELTIGERAE (Fuck.) Riedl. 2, 6d. On *Peltigera rufescens* in snowbed on N-slope and in fell-field. New to Greenland.

LICHENOSTIGMA SEMIIMMERSA Hafellner. 7. Lichenicolous fungus on *Buellia elegans*. New to Greenland.

LOPADIUM PEZIZOIDEUM (Ach.) Körber. 2. On humus and mosses together with *Cladonia borealis*.

MEGASPORA VERRUCOSA (Ach.) Hafellner & V. Wirth. 2, 4, 5a, 5b, 6d, 7, 8, 9a, 10, 11a, 11b. Common on plant remains and mosses between boulders, in snowbeds and in *Saxifraga oppositifolia* heaths. Also on birdstones and musk ox excrements

MELANELIA DISJUNCTA (Erichsen) Esslinger. 2, 11b. On gneissic rocks and sandstone.

M. INFUMATA (Nyl.) Esslinger. 2, 4, 5b, 7, 9a, 10, 11a, 11a, 11b, 13a. Common on mosses, basaltic soil and rocks influenced by uric acid. LGE 607.

M. SOREDIATA (Ach.) Goward & Ahti. 11a. On mosses and rocks.

MERISMATIUM COCCISPORUM (Norman) Vouaux. 11a. On *Rhizocarpon geminatum* on sandstone.

M. HETEROPHRACTUM (Nyl.) Vouaux. 11a. Parasitic on unidentified host. New to Greenland.

M. NIGRITELLUM (Nyl.) Vouaux. 6c, 11a, 13a. On old *Peltigera rufescens* and unknown host in *Dryas-veg*etation. New to Greenland.

MICAREA INCRASSATA Hedl. 5a, 6d. On soil rich in humus in snowbeds.

MIRIQUIDICA DEUSTA (Stenh.) Hertel & Rambold. 5b, 9a. On siliceous rocks and stones.

M. GAROVAGLII (Schaerer) Hertel & Rambold. 2, 4, 5a, 5b, 6d, 11a, 11b, 12b, 13a, 13c. Common on gneissic rocks and sandstone without carbonate. Sometimes on birdstones.

M. LULENSIS (Hellbom) Hertel & Rambold. 4, 11a, 11b, 12b. On sandstone rocks and siliceous stones in temporary riverbed and ravine.

MUELLERELLA LICHENICOLA (Sommerf. ex. Fr.) D. Hawksw. 1, 2, 4, 5a, 5b, 6b, 6c, 6d, 7, 8, 9a, 10, 11a, 11b, 13, 14. Very common on *Xanthoria elegans*, *Caloplaca* spp., *Lecidella alaiensis*, *Lecidea tesselata*, *Lecanora leucococca*, *L. polytropa*, *L. marginata*, *L. flotowiana*, *L. hagenii* f. *saxifragae*, *Psora cerebriformis* and *Tephromela aglaea*.

M. PYGMAEA (Körber) D. Hawksw. 4, 5b, 6a, 6b, 6c, 6d, 7, 9a, 10, 11a, 11b, 13a, 13d. Very common on *Caloplaca lithophila*, *Catillaria chalybeia*, *Fulgensia bracteata*, *F. desertorum*, *Lecanora hagenii* f. *saxifragae*, *L. polytropa*, *Lecidea tesselata*, *Lecidea haerjedalica*, *Lecidella alaiensis*, *L. bullata*, *Rhizocarpon geminatum*, *R. parvum*, *R. superficiale*, *Tephromela aglaea*, *Protoblastenia rupestris*, *Toninia athallina*, *Xanthoria elegans* and *X. sorediata*.

MYCOBILIMBIA HYPNORUM (Lib.) Kalb & Hafellner. 13a. On dead *Cassiope*.

M. LOBULATA (Sommerf.) Hafellner. 1, 2, 4, 7. On soil.

M. SABULETORUM (Schreb.) Hafellner. 6d, 11a. On soil and humus.

M. TETRAMERA (DeNot.) Clauzade, Diederich & Cl. Roux ined. 11a, 13a. On a thin layer of soil over big sandstone boulder and on exposed stoneridge.

NEUROPOGON SPHACELATUS (R. Br.) Alstrup & E. S. Hansen comb. nov. Basionym: *Usnea sphacelata* R. Br., Chloris Melvilliana 49, 1823. Syn. *Neuropogon sulphureus* (König) Hellbom. 1, 2, 3, 11a, 11b, 12b. On gneiss, basalt and sandstone boulders in moist places. LGE 591.

OCHROLECHIA FRIGIDA (Sw.) Lynge. 1, 2, 4, 5a, 8, 9a, 10, 11a, 11b, 13a, 14. Common on mosses, lichens and plant remains in non-calcareous, moist places.

O. UPSALIENSIS (L.) A. Massal. 1, 2, 4, 11a. On mosses, soil and dead plants.

PANNARIA HOOKERI (Borrer ex Sm.) Nyl. 1, 2. On gneissic rocks and over mosses.

P. PEZIZOIDES (Weber) Trevis. 2. On mosses in heath.

PARMELIELLA TRIPTOPHYLLA (Ach.) Müll. Arg. 2, 4, 11a. On mosses and soil rich in humus in protected places.

PELTIGERA APHTHOSA (L.) Willd. 4, 11a, 11b, 13a, 13b, 14. In *Cassiope*- and *Vaccinium*-vegetation on moist N-slopes, in marshes and below snowbeds.

P. BRITANNICA (Gyelnik) Holtan-Hartwig & Tønsberg. 2. On mosses in marsh. New to Greenland.

P. DIDACTYLA (With.) J. R. Laundon. 2, 4, 9a, 11a, 13a. On mosses and soil.

P. LEPIDOPHORA (Nyl. ex Vainio) Bitter. 1, 2, 4, 11a, 11b. On mosses and soil.

P. LEUCOPHLEBIA (Nyl.) Gyelnik. 2, 3, 13a. On mosses in marshes and in *Cassiope*-heath. LGE 594.

P. RUFESCENS (Weiss.) Humb. 1, 2, 3, 4, 5a, 6d, 7, 8, 9a, 9b, 11a, 11b, 13a. Very common on soil and mosses in moist areas such as snowbeds and on creeping soil. Also in heaths dominated by *Saxifraga oppositifolia*, in *Cassiope*-vegetation and in fell-fields.

P. SCABROSA Th. Fr. 3, 9b. On soil in heath and on turf on N-slope.

P. VENOSA (L.) Hoffm. 2, 11a. On soil and mosses in heath dominated by *Dryas integrifolia* and *Carex* spp.

PERTUSARIA CHIODECTONOIDES Bagl. ex A. Massal. s. l. 4, 11b. On sandstone in ravine. The thallus is rusty brown. New to Greenland.

P. CORIACEA (Th. Fr.) Th. Fr. 2. Over mosses and soil in heath.

P. DACTYLINA (Ach.) Nyl. 3, 3b, 4. On mosses and soil.

P. GLOMERATA (Ach.) Schaerer. 11a. On plant remains and dead vegetation on exposed hill.

P. OCULATA (Dicks.) Th. Fr. 4. On mosses in snowbed.

P. PANYRGA (Ach.) A. Massal. 4. On dead *Saxifraga oppositifolia* in heath.

PHAEOPHYSCIA CONSTIPATA (Norrl. & Nyl.) Moberg. 6d, 11a. On soil at birdstone and on E-slope with *Potentilla-Poa*-vegetation.

P. KAIRAMOI (Vainio) Moberg. 4. On mosses and plant remains in heath.

P. SCIASTRA (Ach.) Moberg. 4, 6b, 6c, 6d, 7, 9a, 11a, 14. On ± calcareous stones and on mosses, especially at birdstones. Also on mosses at streams.

PHAEORRHIZA NIMBOSA (Fr.) H. Mayrhofer & Poelt. 1, 4, 5a, 5b, 6b, 6c, 6d, 7, 8, 9a, 10, 11a, 11b, 13a, 14. Common on mineral soil and mosses at birdstones, on stoneridges and in steppe-communities, both in dry and moist situations.

P. SAREPTANA (Tomin) H. Mayrhofer & Poelt var. SPHAEROCARPA (Th. Fr.) H. Mayrhofer & Poelt. 6b. On loess.

PHAEOSPOROBOLUS ALPINUS R. Sant., Alstrup & D. Hawksw. 1, 2, 3b, 4, 11a. On *Ochrolechia frigida*, *O. upsaliensis*, *Baeomyces placophyllus*, *Cladonia borealis*, *Flavocetraria nivalis*, *Lecanora luteovernalis*, *Megaspora verrucosa*, *Pertusaria coriacea* and *Umbilicaria decussata*. The species is here found on many host lichens, in other areas it is almost restricted to *Ochrolechia* spp., especially *O. frigida*.

PHYSCIA CAESIA (Hoffm.) Fürnr. 2, 3b, 4, 6d, 7, 8, 9a, 10, 11a. On silicious birdstones and slightly calcareous rocks and dolomite. LGE 579.

P. DUBIA (Hoffm.) Lettau. 1, 2, 4, 5b, 6b, 6d, 7, 8, 9a, 10, 11a, 13a, 13d. Common on stones and soil at birdstones and in other nitrophilous places. Also on bone.

PHYSCONIA MUSCIGENA (Ach.) Poelt. 1, 2, 3, 4, 5b, 6c, 6d, 7, 8, 9a, 10, 11a, 13a, 13d, 14. Very common at birdstones and on mosses in nitrophilous and moist sites.

PLACIDIOPSIS PSEUDOCINEREA Breuss. 6b. On calcareous soil between boulders.

PLACYNTHIELLA ULIGINOSA (Schrader) Coppins & P. James. 11a. On bone.

PLACYNTHIUM ASPERELLUM (Ach.) Trevis. 1, 2, 4, 5a, 5b, 5c, 6b, 6c, 10, 11a, 11b. On gneiss, ±calcareous sandstone and basalt at streams and other moist places.

P. cfr. FILIFORME (Garov.) Choisy. 7. On limestone.

P. NIGRUM (Huds.) Gray. 4, 5a, 6b, 6c, 6d, 8, 9a, 9b, 11a, 11b. On limestone, calcareous sandstone, calcareous sand and basalt near lakes and streams. Rarely on loess.

P. PANNARIELLUM (Nyl.) H. Magn. 11a. On sandstone.

P. SUBRADIATUM (Nyl.) Arnold. 6b, 7. On exposed limestone and dolomite. New to Greenland. LGE 620.

PLEOPSIDIUM CHLOROPHANUM (Wahlenb.) Zopf. 2, 4, 11a, 11b. On underside of siliceous boulder and in ravine.

POLYBLASTIA CUPULARIS A. Massal. 6b, 6c, 6d. On limestone.

P. FUSCOARGILLACEA Anzi. 4, 5a, 5b, 6c, 11a. On stones in streambeds and at bank of lake. New to Greenland.

P. PEMINOSA (Nyl.) Zahlbr. 13a. On sandstone in stream. New to Greenland.

P. SCHISTICOLA Servit. 9a. On limestone, submersed in a temporary rivulet. This species was described from northern Sweden and by Santesson (1993) called a doubtful species. The Greenland specimen fits the description very well. The spores are rather unusual for a *Polyblastia*, oval c. 23 x 17 µm, hyaline and muriform with about 10 cells. In Sweden it was found on schist, apparently not submersed. New to Greenland.

P. SENDTNERI Kremp. 3, 5a, 6b, 6c, 6d, 7, 9a, 9b, 11a, 13a. Common on moist soil at rivers and lakes, in snowbeds and in *Dryas*- and *Cassiope*-heaths.

P. THELEODES (Sommerf.) Th. Fr. 9a. On submersed limestone.

POLYCOCCUM SPORASTATIAE (Anzi) Arnold. 11a. On *Sporastatia testudinea* on sandstone. New to Greenland.

POLYSPORINA FERRUGINEA (Lettau) M. Steiner. 5a. On calcareous sandstone.

P. LAPPONICA (Ach. ex Schaerer) Degel. 13a. On *Lecidea plana* on exposed calcareous rocks.

P. SIMPLEX (Davies) Vezda. 2, 4, 5a, 6b, 6c, 6d, 8, 9a, 9b, 11a, 13a. On exposed limestone, dolomite and silicious rocks covered by calcareous dust.

PORPIDIA CONTRAPONENDA (Arnold) Knoph & Hertel. 5a. On sandstone in S-facing gravelbed. New to Greenland.

P. FLAVICUNDA (Ach.) Gowan. 4, 5b. On sandstone and quartzite.

P. MELINODES (Körber) Gowan & Ahti. 1. On gneissic rocks.

P. SPEIREA (Ach.) Kremp. 1, 4, 5a, 11b. On gneiss and sandstone.

PRONECTRIA ROBERGEI (Mont. & Desm.) Lowen. 11a. On *Peltigera aphthosa* in *Cassiope*-vegetation. New to Greenland.

PROTOBLASTENIA CALVA (Dicks.) Zahlbr. 5a, 6b, 6c, 6d, 7, 8, 11a. On limestone, calcareous sandstone and dolomite in moist situations. LGE 622.

P. INCRUSTANS (DC.) J. Steiner. 4, 6b, 6c, 7, 8, 9a, 11a. On limestone rocks and dolomite.

P. RUPESTRIS (Scop.) J. Steiner. 4, 6d, 11b. On limestone and calcareous sandstone.

P. SIEBENHAARIANA (Körber) J. Steiner. 6b, 11a. On limestone.

P. TERRICOLA (Anzi) Lynge. 4, 5a, 6c, 6d, 7, 8, 9a, 10, 11a, 11b, 13a, 13b, 14. Very common on sandy and clayey, calcareous soil.

PROTOPARMELIA BADIA (Hoffm.) Hafellner. 1, 2. On gneissic rocks.

PSEUDEPHEBE MINUSCULA (Nyl. ex Arnold) Brodo & D. Hawksw. 1, 2, 4, 5b, 6d, 9a, 10, 11a, 11b, 12b, 12c, 13a, 13c, 13d. On gneiss, quartzite, sandstone and basalt. LGE 587.

P. PUBESCENS (L.) M. Choisy. 3, 11a. On basalt and sand.

PSORA CEREBRIFORMIS W. A. Weber. 6c. On loess on S-facing slope. New to Greenland (Fig. 4).

P. DECIPIENS (Hedw.) Hoffm. 1, 3, 4, 5a, 6c, 6d, 7, 8, 9a, 9b, 10, 11a, 11b, 13a. Common on sandy and clayey, calcareous soil, loess and gravel, especially in *Dryas-veg*etation. LGE 583.

P. RUBIFORMIS (Ach.) Hook. 1, 2, 3, 4, 7, 11a, 11b, 13a, 13c, 13d, 14. On non-calcareous sand and gravelly soil. LGE 609, 618.

P. VALLESIACA (Schaerer) Timdal. 4, 6b, 6c, 6d, 7, 8, 9a, 10, 11a. On calcareous, sandy or clayey soil and loess in desert- and steppe-vegetation, in open heaths, on windswept barren ground and between boulders.

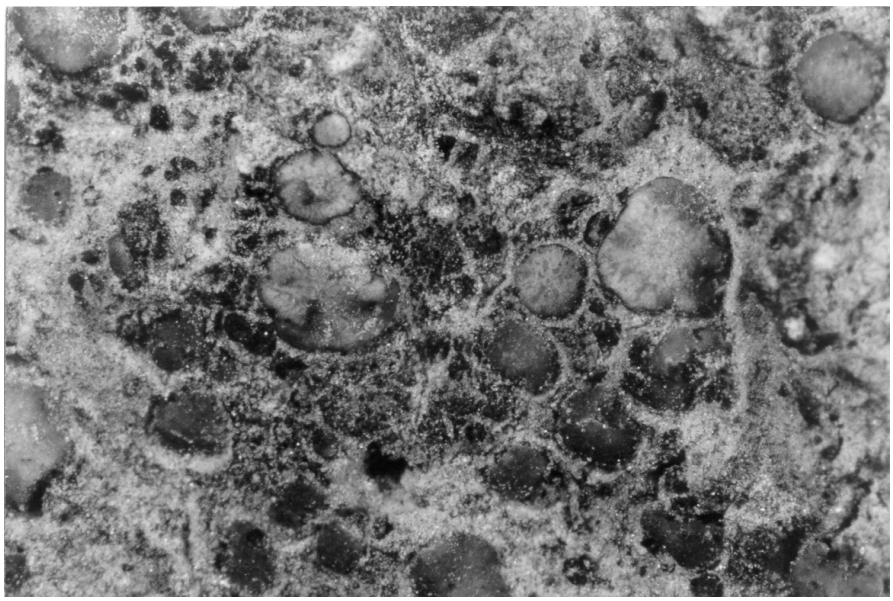

Fig. 4. *Psora cerebriformis* W. A. Weber. Sterile thallus growing on loess on S-slope on mountain N of Centrum Sø (x18). Photo: F. Rasmussen & E. S. Hansen.

PSOROMA HYPNORUM (Vahl) Gray. 2, 13a. On mosses and soil in heaths and in *Salix arctica-Carex*-vegetation.

RHIZOCARPON ARCTOGENUM Gelting. 11a. On sandstone in temporary riverbed.

R. ATROFLAVESCENS Lynge. 4, 6a, 6c, 7, 8. On erratic, calcareous stones and basalt boulder.

R. BADIOATRUM (Flörke ex Spreng.) Th. Fr. 13 a. On stone in stream.

R. DISPORUM (Nägeli ex Hepp) Müll. Arg. 2, 4. On siliceous rocks.

R. GEMINATUM Körber. 1, 2, 3, 4, 5a, 6c, 6d, 7, 8, 9a, 10, 11a, 11b, 12b, 13a, 13d, 14. Very common on ± calcareous sandstone, on quartzite and on basalt influenced by nitrogen.

R. GEOGRAPHICUM (L.) DC. 2, 3b, 10, 11a, 11b, 12c, 13a. On gneiss and exposed sandstone without carbonate.

R. GRANDE (Flörke) Arnold. 4. On siliceous rocks.

R. INARENSE (Vainio) Vainio. 4. On rock.

R. INTERMEDIELLUM Räsänen. 5b, 6b, 6d. On sandstone.

R. JEMTLANDICUM (Malme) Malme. 2. On gneiss.

R. NORVEGICUM Räsänen. 9a, 11a, 11b, 13a. On exposed sandstone.

R. PARVUM Runemark. 5b, 5c, 6a, 6c, 6d, 9a, 11a, 11b, 12b, 13a. On sandstone and basalt.

R. PRAEBADIUM (Nyl.) Zahlbr. 1,2. On sandstone and gneiss. LGE 613.

R. PUSILLUM Runemark. 4, 5b, 9a, 9b, 10, 11a, 11b, 13a, 13c, 14. Very common on *Sporastatia testudinea* on non-calcareous rocks, later becoming independent.

R. RITTOKENSE (Hellb.) Th. Fr. 1, 11a, 13a. On sandstone.

R. SUPERFICIALE (Schaerer) Vainio. 4, 5b, 6b, 9a, 11a, 11b, 12b, 13a, 13c, 13d. Common on exposed non-calcareous sandstone and basalt. LGE 605.

RHIZOPLACA MELANOPHTHALMA (DC.) Leuckert & Poelt. 2, 4, 5b, 5c, 6b, 6c, 6d, 7, 9a, 10, 11a, 13a, 13c, 13d, 14. On non-calcareous rocks, especially birdstones. LGE 582, 611.

RIMULARIA FURVELLA (Nyl. ex Mudd) Hertel & Rambold. 2, 4, 5a, 13a. On birdstone composed of sandstone and on granite rocks.

RINODINA CACUMINUM (Th. Fr.) Malme. 4, 11b. On siliceous rocks including sandstone.

R. MNIAREA (Ach.) Körber (incl. *R. cinnamomea* (Th. Fr.) Räsänen). 1, 2, 4, 5b, 7, 11a, 13a. On mosses and soil.

R. OLIVACEOBRUNNEA C. W. Dodge & G. E. Baker. 6d, 13a. On plant remains.

R. ORCULARIS H. Mayrhofer & Poelt. 6b. On exposed limestone. New to Greenland.

R. ROSCIDA (Sommerf.) Arnold. 2, 4, 5a, 6b, 6c, 6d, 11a, 13a. On loess, mosses and plant remains and on soil at birdstones. Also on bones and hare-pellet.

R. TURFACEA (Wahlenb.) Körber. 1, 2, 4, 5a, 6d, 9a, 11a, 11b. On mosses and on *Physconia muscigena*.

RYMBOCARPUS NEGLECTUS (Vainio) Diederich & Etayo. 2, On *Lepraria frigida*.

SAGIOLECHIA PROTUBERANS (Ach.) A. Massal. 6d. On limestone.

SARCOGYNE CLAVUS (DC.) Kremp. 8, 11a. On sandstone in temporary riverbed.

S. PRIVIGNA (Ach.) A. Massal. 13b. On sandstone. New to Greenland.

S. REGULARIS Körber. 6b. On limestone in windswept place.

SCHAERERIA FUSCOCINEREA (Nyl.) Clauzade & Cl. Roux. 9a. On calcareous rock.

SCUTULA KREMPELHUBERI Körber. 9b. On *Solorina bispora*, together with *Stigmidium solorinarium*, on mosses. New to Greenland.

SOLORINA BISPORA Nyl. 2, 4, 5a, 6c, 7, 8, 9a, 9b, 10, 11a. On rather moist, calcareous soil in *Dryas*- and *Cassiope*-vegetation.

S. SACCATA (L.) Ach. 1, 2, 4, 5a, 6d, 9a, 9b, 10, 11a, 13a. On moist, calcareous soil rich in humus, and on loess, mostly in *Cassiope*-vegetation and between boulders in fellfields.

S. SPONGIOSA (Ach.) Anzi. 2, 4, 8, 11a. On slightly calcareous soil at river and on mosses in moist heath.

SPHAERELLOTHECIUM ARANEOSUM (Rehm ex Arnold) Zopf. 2, 4, 11a, 14. On *Ochrolechia frigida* and *O. upsaliensis*.

S. MINUTUM Hafellner. 2. On *Sphaerophorus fragilis*. The genus *Sphaerellothecium* is probably represented by several species in the investigated area. They will be published separately later on.

SPHAEROPHORUS FRAGILIS (L.) Pers. 2. On siliceous rock.

S. GLOBOSUS (Huds.) Vainio. 2. Among mosses in open heath.

SPORASTATIA POLYSPORA (Nyl.) Grummann. 6d, 11a. On non-calcareous boulders and rocks in rather moist places.

S. TESTUDINEA (Ach.) A. Massal. 1, 2, 3, 4, 5a, 5b, 5c, 6b, 7, 8, 9a, 9b, 10, 11a, 11b, 13a, 13c, 14. On non-calcareous sandstones and basalt. LGE 589.

STAUROTHELE AREOLATA (Ach.) Lettau. 3b, 4, 6c, 9a, 10, 13a. On ± calcareous sandstone in moist places.

S. FISSA (Taylor) Zwackh. 13a. On sandstone at temporary rivulet.

STEREOCAULON ALPINUM Laurer. 1, 2, 3, 4, 9a, 11a, 11b, 12b, 13a, 14. On mosses and soil in *Cassiope*-heaths and in fell-fields.

S. ARENARIUM (Savicz) I. M. Lamb. 3b. On gravelly sand.

S. BOTRYOSUM Ach. 1, 2, 4. On gneiss.

S. CONDENSATUM Hoffm. 6d, 11a, 13c, 13d. On moist mineral soil over basalt and on loess and sand.

S. DEPRESSUM (Frey) I. M. Lamb. 5a, 5b, 12c. On mineral soil.

S. GROENLANDICUM (Dahl) I. M. Lamb. 2, 3, 4. On gravel and stones in fell-fields.

S. INCRUSTATUM Flörke. 5a, 9b, 11a, 11b, 13a, 13b. On moist mineral soil in riverbeds, near lakes and in heaths.

S. RIVULORUM H. Magn. 1, 2, 3, 4, 5a, 5b, 6d, 7, 8, 9a, 10, 11a, 11b, 13a, 13b, 14. Very common on rather moist mineral soil. LGE 588.

STIGMIDIUM CONSPURCANS (Th. Fr.) Triebel. 2, 4, 11b, 13a, 14. On *Psora rubiformis*.

S. PELTIDEAE (Vainio) R. Sant. 2, 4, 11b. On *Peltigera aphthosa*, *P. britannica* and *P. rufescens*.

S. SCHAERERI (A. Massal.) Trevis. 8. On *Dacampia hookeri*. New to Greenland.

S. SOLORINARIUM (Vainio) D. Hawksw. 2, 9a, 9b, 11a. On *Solorina bispora* and *S. saccata* between hummocks, in snowbeds and along rivers. Alstrup & Hawksworth (1990) included this species in *S. peltideae*, but Roux & Triebel (1994) showed it to be a separate species.

TELOSCHISTES CONTORTUPLICATUS (Ach.) Clauzade & Rondon. 7, 11a. On soil at birdstone and among mosses in fell-fields.

TEPHROMELA AGLAEA (Sommerf.) Hertel & Rambold. 11a, 11b, 13a. On sandstone boulders ± influenced by nitrogen compounds.

T. ARMENIACA (DC.) Hertel & Rambold. 4, 5b, 13a. On sandstone in exposed places.

THAMNOLIA VERMICULARIS (Sw.) Schaerer. 1, 2, 3, 7, 11a, 11b, 13a. Among mosses in open heaths and fell-fields at the coast, inland in *Dryas*-communities. LGE 612.

THELIDIUM UMBROSUM A. Massal. 9a. On limestone in temporary stream. New to Greenland.

THELOCARPON EPIBOLUM Nyl. 2, 11a. On *Peltigera aphthosa* and *P. britannica* in *Cassiope*-heaths.

T. SPHAEROSPORUM H. Magn. 11a. On mineral soil on dry E-slope. New to Greenland.

THROMBIUM EPIGAEUM (Pers.) Wallr. 11a. With mosses in *Cassiope*-heath on moist S-slope.

TONINIA ARCTICA Timdal. 4, 5b, 7, 8, 10. On sandy and clayey soil in steppe-vegetation and open heaths. LGE 585, 623.

T. ATHALLINA (Hepp) Timdal. 6c, 6d, 12b. On calcareous stones and birdstones.

T. ROSULATA (Anzi) H. Olivier. 6b, 6c, 9a. On loess and dry sandy soil in steppe-vegetation.

T. SEDIFOLIA (Scop.) Timdal. 4, 6c, 6d, 7, 8, 9a, 9b, 10, 11a, 13a. On loess and mineral soil.

T. TRISTIS (Th. Fr.) Th. Fr. 4, 6c, 9a, 11a. On loess and calcareous soil in rather dry places.

T. TRISTIS (Th. Fr.) Th. Fr. ssp. SCHOLANDERI (Lynge) Timdal. 11a. Between mosses on dry soil in *Dryas*-community.

T. VERRUCAROIDES (Nyl.) Timdal. 11a, 11b. On soil in *Cassiope*-heath and on *Placynthiella* sp.

TREMOLECIA ATRATA (Ach.) Hertel. 1, 2, 4, 5a, 5b, 11a, 11b. On non-calcareous rocks and stones.

TRIMMATOSTROMA LICHENICOLA M. S. Christ. & D. Hawksw. 6b, 6c, 6d, 7, 8, 9a, 11a, 13a. In apothecia of *Candelariella aurella*, *Xanthoria elegans* and *Protoblastenia calva*.

UMBILICARIA CYLINDRICA (L.) Del. ex Duby. 1, 2, 3, 4, 5b, 5c, 6a, 6d, 7, 8, 9a, 10, 11a, 11b, 13a, 13c, 13d. On sandstone and gneiss.

U. DECUSSATA (Vill.) Zahlbr. 1, 2, 4, 11a, 13a. On sandstone boulder in block-scree and on birdstone. Also on gneiss manured by musk oxen.

U. HYPERBOREA (Ach.) Hoffm. 2. On gneiss. LGE 590.

U. KRASCHENINNIKOVII (Sav.) Schol. 2, 4, 5b, 10, 11a, 11b, 11b, 13a, 13d. On siliceous rocks including sandstone and basalt.

U. LYNGEI Schol. 1, 2, 3, 4, 11a, 11b, 13d. On gneiss, sandstone and basalt boulders along rivers and in other moist places. LGE 576.

U. PROBOSCIDEA (L.) Schrader. 2, 5b, 11a, 11b, 12b. On exposed gneiss at the coast. Inland on sandstone in block-scree and near icecaps.

U. RIGIDA (Du Rietz) Frey. 12b. On exposed sandstone.

U. TORREFACTA (Lightf.) Schrader. 2, 11a, 11b. On exposed gneiss and sandstone.

VERRUCARIA CALCISEDA DC. 7, 9a. On limestone in stream. New to Greenland.

V. FLOERKEANA Dalla Torre & Sarnth. 4. On siliceous stone. New to Greenland.

V. LATEBROSA Körber s. l. 6c. On sandstone. New to Greenland.

V. MURALIS Ach. 6b, 13 b. On limestone and sandstone. New to Greenland.

V. NIGRESCENS Pers. var. LAEVIUSCULA Nyl. 9a. On sandstone submersed in stream. New to Greenland.

V. TRISTIS (A. Massal.) Kremp. 6d. On limestone in NW-slope. New to Greenland.

V. UMBRINULA Nyl. 5a. On gravel. New to Greenland.

WENTIOMYCES PELTIGERICOLA D. Hawksw. 11b, 13b. On *Peltigera aphthosa* in heaths with *Cassiope tetragona* or *Vaccinium uliginosum* and *Empetrum nigrum* ssp. *hermaphroditicum*.

XANTHORIA BOREALIS R. Sant. & Poelt. 2, 4, 6b, 6c, 6d, 7, 8, 10, 11a. On birdstones.

X. ELEGANS (Link) Th. Fr. 1, 2, 4, 5a, 5b, 5c, 6b, 6c, 6d, 7, 8, 9a, 9b, 10, 11a, 11b, 13a, 13c, 13d, 14. Very common on calcareous stones, dolomite, basalt and birdstones. Also on bone and mosses. LGE 575.

X. ELEGANS (Link) Th. Fr. var. SPLENDENS (Darb.) Christ. ex Poelt. 4, 9a, 11b. On gravel in moist places, e.g. occasionally inundated in riverbeds. At loc. 11b it almost covered the entire bottom of a riverbed in a ravine. Normally developed *X. elegans* was found several meters higher on sunexposed, vertical rocks. Intermediate forms were not found at this locality or in other places. LGE 608.

X. SOREDIATA (Vainio) Poelt. 1, 3, 4, 6b, 6d, 7, 9a, 11a. On limestone, sandstone, quartzite and basalt in ravines, along streams and in other protected places.. LGE 600.

Other fungi (excl. Myxomycetes, lichenicolous and lichenized fungi)

Previous investigations

The first major works on the fungi of Greenland were those of Rostrup (1888, 1891). These works include a great number of microfungi, but relatively few macrofungi. Lind (1926, 1933) added considerably to the knowledge of micromycetes in East and North West Greenland, and Dennis (1981) dealt with the fungi (all microfungi) on Jensen's Nunataks, West Greenland. The knowledge of the macromycetes has especially been increased throuh the works of Lange (1948, 1955). Fungi seems not to have been reported before from the area dealt with here.

AMPHISPHAERELLA ERIKSSONII G. Mathiassen. 6a. On lignum of *Salix*. This recently described species (Mathiassen 1993) is so far known from *Salix* spp. in Norway and Sweden. New to Greenland.

CORTINARIUS SP. 6a, 13b. On loess in *Dryas*- and *Salix arctica*-vegetation.

DIDYMELLA PRAESTABILIS Rehm. 11a. On dead *Festuca baffinensis*. This species was known from grasses in Scandinavia and the Tatra Mts. (Eriksson 1967b). New to Greenland.

GEOPORA ARENICOLA (Lév.) Kers. 9a, 13a. On sand at bank of lake and river.

GIBBERA ULIGINOSA B. Eriksson. 11b. On dead *Vaccinium uliginosum*. The species is known from dead leaves of *Vaccinium uliginosum* in Sweden and Finland (Eriksson 1974). New to Greenland.

GRAPHYLLIUM PENTAMERUM (P.A.Karst.) Barr. 9a. On *Carex*. It is a very common species on graminaceous plants in Greenland (Rostrup 1888), Scandinavia and Russia (Eriksson 1967a). It also occurs on *Dryas* in Svalbard (Elvebakk et al. 1966).

ISOTHEA RHYTISMOIDES (Babington ex Berk.) Fr. 9a. On dead leaves of *Dryas integrifolia*. This species attacks leaves of *Dryas* in the British Islands (Ellis & Ellis 1997), Scandina-

via (Eriksson 1992) and Svalbard (Elvebakk et al. 1966). It has been reported as *Laestadia rhytismoides* from Greenland by Rostrup (1888) and as *Hypospila rhytismoides* by Lind (1926).

LACCARIA PUMILA Fayod. 6a In *Salix arctica*-vegetation. Common in Greenland and on Svalbard (Gulden & Torkelsen 1996).

LEPTOSPHAERIA HENDERSONIAE (Fuck.) L. Holm. 6a. On lignum of *Salix arctica*. The species is known from *Salix* in Norway, Sweden, Germany, Austria and Italy (Mathiassen 1989, Holm 1957, Eriksson 1992). New to Greenland.

LEPTOSPHAERIA SP. 9b. On dead leaves of *Vaccinium uliginosum*. Asci with 6 spores. Ascospores 23–27 × 9–11 µm, 3-septate, dark brown.

LEWIA SCROPHULARIAE (Desm.) Barr & Simmons. 6a. On dead leaves of *Cassiope tetragone*. *L. scrophulariae* is known from dead herbaceous stems in Greenland (Rostrup 1888, as *Pleospora vulgaris*), Scandinavia (Eriksson 1992), Switzerland (Crivelli 1983) and British Islands (Ellis & Ellis 1997). A *Pleospora drabae* Schröter reported on *Draba* spp. in Greenland by Rostrup (1888) is the same or a closely related species.

LYCOPERDON UMBRINUM Pers. 6d, 9a, 11a. In *Cassiope tetragone*-heath and on moist soil.

MELAMPSORA EPITEA Thüm. 5a, 6a, 9a, 13a. On living leaves of *Salix arctica*. This is a variable and widely distributed species occurring on many host species. Specimens occurring on *Salix* have often been regarded as a separate species, *M. arctica* Rostrup, described from Greenland.

MELANOMMA SANGUINARIUM (P. Karst.) Sacc. 6a. On lignum of *Salix arctica*. This species is known from *Alnus*, *Fagus*, *Salix*, *Sorbus* and *Ulmus* in Finland, Sweden Germany and Austria (Holm 1957, Eriksson 1992). New to Greenland.

MYCOSPHAERELLA TASSIANA (de Not.) Johannson. 11a. On dead leaves of *Papaver radicatum*. Very common on many herbaceous plants in Greenland (Rostrup 1888, Lind 1926), Svalbard (Elvebakk et al. 1966) and Scandinavia (Eriksson 1992).

PHAEOSPHAERIA SILENE-ACAULIS (de Not.) Holm. 6c. On dead Silene acaulis. This is a widespred species on *Silene acaulis*, also on *Minuartia stricta* in Norway (Holm 1957) and *Stellaria longipes* in Svalbard (Elvebakk et al. 1966). It is previously reported from Greenland (Rostrup 1888).

PHOMOPSIS SALICINA (Westr.) Died. 6a. On Lignum of *Salix arctica*. This species is known from *Salix* in British Islands (Ellis & Ellis 1997). New to Greenland.

PLEOSPORA ANDROSACES Fuckel. 6c, 9a, 9b, 11a. On dead *Silene acaulis*. It is known from *Silene acaulis* in Greenland (Lind 1926), British Islands (Ellis & Ellis 1997), Svalbard (Elvebakk et al. 1966) and Switzerland (Crivelli 1983).

P. GRAMINEARUM Wehm. 6a. On dead leaves of *Lesquerella arctica*. This species is very common on different herbaceous plants in the Alps (Crivelli 1983). It is known from northern Sweden (Eriksson 1992). New to Greenland.

P. HELVETICA Niessl. 5a, 6a, 9a, 9b, 11a, 12b, 13a. On dead leaves of *Armeria scabra*, *Chamaenerium latifolium*, *Dryas integrifolia*, *Lesquerella arctica*, *Oxyria digyna*, *Papaver radicatum*, *Polygonum viviparum*, *Potentilla hookeri*, *Salix arctica*, *Saxifraga oppositifolia*, *Silene acaulis* and on bone of arctic hare. The species was first identified as *P. herbarum*, but according to Holm & Holm (1994) numerous similar collections from Svalbard were redetermined to the present species, and we follow this opinion. It was also reported from Greenland by Rostrup (1888) and Lind (1926) as *Pleospora herbarum* and *Pyrenophora chrysospora*.

P. PYRENAICA Niessl. 6a. On dead *Lesquerella arctica*. This species is known from *Arabis pumila* and *Draba* spp. in Switzerland, Germany, France and Spain (Crivelli 1983). New to Greenland.

P. SP. 6c. On old musk ox horn. Asci clavate 120–130 × 28–30 µm, ascospores 8, dark, (sub-)muriform, 30–34 × 15.5–19 µm. Hamathecium of anastomosing hyphae up to 5 µm thick.

PLEUROPHOMOPSIS SALICICOLA Petrak. 6a. On lignum of *Salix arctica*.

RUTSTROEMIA CALOPUS (Fr.) Rehm. 11a. On dead grass buried in mosses.The genus was re-

vised by White (1941). The collection was referred to this species because of the size of the asci and ascospores, although the cup-shaped disc is up to 8 mm diam. in contrast to 2–4 mm given by White. However White made a note telling that the material available to him was unsatisfactory. This species is known from dead grasses in Sweden, Germany and France (White 1941). New to Greenland.

SCLEROPLEELLA HYPERBOREA (Fuckel) L. Holm. 13a. On dead leaves of *Cassiope tetragona*. According to Holm (1975) this species is quite common on *Cassiope tetragona* in Scandinavia and probably throughout the range of the host. New to Greenland.

SELENOPHOMA SP. 6c, 9b. The size of pycnidia, the conidiogenous cells and the conidia falls within the range of *S. straussiana* (Sacc.) Petrak, a species known from *Dianthus* in Bulgaria. On dead leaves of *Kobresia* and stem of *Papaver radicatum*.

SEPTORIA CARICIS Passer. 9a.On dead leaves of *Carex*. This species is known from dead leaves of *Carex* spp. in the British Islands (Ellis & Ellis 1997). New to Greenland.

SPORORMIELLA INTERMEDIA (Auersw.) S. E. Ahmed & Cain ex Kobayasi. 6a. On dung of fox. This species was known from dung of several animals including foxes in Argentina, Mexico U.S.A., Canada and Europe (Ahmed & Cain 1971). New to Greenland.

TEICHOSPORA PRUNIFORMIS (Nyl.) Karsten. 13a. On lignum of *Salix arctica*. This species occurs on wood of *Populus tremula* and *Salix* spp. in Sweden (Eriksson 1992). New to Greenland.

VENTURIA CHLOROSPORA (Ces.) P.A. Karst. 6b. On dead leaves of *Salix arctica*. Common on dead leaves of *Salix* in Greenland (Rostrup 1888, Lind 1926), British Islands (Ellis & Ellis 1997) and Sweden (Eriksson 1992).

WETTSTEININA DRYADIS (Rostrup) Petrak. 9a. On dead leaves of *Dryas integrifolia*. This species is known from dead leaves of *Dryas* spp. in Greenland (Rostrup 1888, Lind 1926), British Islands (Ellis & Ellis 1997), Sweden (Eriksson 1992), Canada and Switzerland (Shoemaker & Babcock 1987) and Svalbard (Holm & Holm 1993).

Myxomycetes

Fructifying collections were not found in the field, but were developed from litter in laboratory and identified by Henrik F. Gøtzsche.

DIDYMIUM SQUAMULOSUM (Alb. & Schwein.) Fr. 9a, 11a.

PERICHAENA VERMICULARIS (Schwein.) Rostrup. 9a, 13a.

PHYSARUM OBLATUM Macbr. 13a. New to Greenland.

TRICHIA CONTORTA (Ditmer) Rostrup. 13a.

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REFERENCES

Ahmed, S. I. & Cain, R. F. 1971. Revision of the genera *Sporomia* and *Sporormiella*. *Canadian J. Bot.* 50: 419–477.

Alstrup, V. & Hawksworth, D. L. 1990. The lichenicolous fungi of Greenland. *Meddel. Grønland, Biosci.* 31: 1–90.

Bay, C. 1992. A phytogeographical study of the vascular plants of northern Greenland – north of 74° northern latitude. *Meddel. Grønland, Biosci.* 36: 1–102.

Bay, C. 1997. Floristical and ecological characterization of the polar desert zone of Greenland. *J. Veg. Sci.* 8: 685-696.

Crivelli, P. G. 1983. *Ueber die heterogene Ascomycetengattung Pleospora Rabh*. ADAG Administration & Druck AG, Zürich. 213 pp.

Daniels, F. J.A. 1999. Oases and deserts between ice and ocean. *German Research* 1999: 10–15.

Daniels, F. J.A. & Alstrup, V. 1996. On the vegetation of Eastern North Greenland. *Acta Bot. Neerl.* 45:583.

Dennis, R. W. G. 1981. The Fungi of Jensen's Nunataks, West Greenland. *K. norske Vidensk. Selsk. Skr.* 3: 1–20.

Ellis, M. B. & Ellis, J. P. 1997. *Microfungi on land plants*. New enlarged edition. Richmond Publishing, Slough. 868 pp.

Elvebakk, A, Gjærum, H. B. & Sivertsen, S. 1996. Part4, fungi 2. Myxomycota, Oomycota, Chytridiomycota, Zygomycota, Ascomycota, Deyteromycota, Basidiomycota: Uredinales and Ustilaginales. *Norsk Polarinstitutt Skrifter* 198: 207–259.

Eriksson, B. 1974. On Ascomycetes on Diapensiales and Ericales in Fennoscandia 2. Pyrenomycetes. *Svensk Bot. Tidskr.* 68: 192–234.

Eriksson, O. 1967a. On graminicolous Pyrenomycetes from Fennoscandia 1. Dictyosporous species. *Arkiv Bot.* 6: 339–380.

Eriksson, O. 1967b. On graminicolous Pyrenomycetes from Fennoscandia 3. Amerosporous and Didymosporous species. *Arkiv Bot.* 6: 441–466.

Eriksson, O. 1992. *The non-lichenized pyrenomycetes of Sweden*. SBT – förlaget, Lund. 208 pp.

Escher, J. C. & Jones, K. A. 1994. Caledonian thrusting and shearing in Lambert Land. Express Report Eastern North Greenland and North-East Greenland 1994. *Geological Survey of Greenland*: 27–38.

Gulden, G. & Torkelsen, A-E. 1996. Part 3. Fungi 1. Basidiomycota: Agaricales, Gastromycetales, Aphyllophorales, Exobasidiales, Dacrymycetales and Tremellales. *Norsk Polarinstitutt Skrifter* 198: 173–206.

Hansen, E. S. 1993. *Collema substellatum* and *Fulgensia desertorum*, new to Greenland. *Lichenologist* 25: 451–458.

Hansen, E. S. 1995. The lichen flora of the Jørgen Brønlund Fjord area, northern Greenland. *Bibl. Lichenol.* 57: 187–198.

Hansen, E.S. & Obermayer. W. 1999. Notes on *Arthrorhaphis* and its lichenicolous fungi in Greenland. *Bryologist* 102: 104–107.

Higgins, A. K. (ed.) 1995. Express Report: Eastern North Greenland and North East Greenland 1995. *Geological Survey of Greenland*. 171 pp.

Holm, L. 1957. Études taxonomiques sur les Pléosporacées. *Symb. Bot. Upsaliensis* 14 (3): 1–188.

Holm, L. 1975. Taxonomic notes on Ascomycetes. VIII. Microfungi on *Cassiope tetragona*. *Svensk Bot. Tidskr.* 69: 143–160.

Holm, L. & Holm, K.1993. Dryadicolous ascomycetes from Svalbard. *Arctic and alpine mycology 3*. *Bibliotheca Mycologici* 150: 53–62.

Holm, L. & Holm, K. 1994. Svalbard Pyrenomycetes. An annotated checklist. *Karstenia* 34: 65–78.

Holmen, K. 1957. The vascular plants of Peary Land, North Greenland. *Meddel. Grønland* 124: 1–149.

Jepsen, H. F. & Sønderholm, M. 1994. Sedimentological studies of the Hagen Fjord Group and 'Rivieradal sandstones' (Late Proterozoic), eastern North Greenland. Express Report Eastern North Greenland and North-East Greenland 1994. *Geological Survey of Greenland*: 39–48.

Lange, M. 1948. Macromycetes I. The Gastromycetes of Greenland. *Meddel. Grønland* 147 (4): 1–32.

Lange, M. 1955. Macromycetes II. Greenland Agaricales. *Meddel. Grønland* 147 (11): 1–69.

Lind, J. 1926. Micromycetes from North-western Greenland found on plants collected during the jubilee expedition 1920–1923. *Meddel. Grønland* 71:159–180

Lind, J. 1933. Micromycetes. *Meddel. Grønland* 104 (6): 1–5.

Mathiassen, G. 1989. Some corticolous and lignicolous Pyrenomycetes s. lat. (Ascomycetes) on *Salix* in Troms, N. Norway. *Sommerfeltia* 9. 100 pp.

Mathiassen, G. 1993. Some corticolous and lignicolous Pyrenomycetes s. lat. (Ascomycetes) on *Salix* along a mid-Scandinavian transect. *Sommerfeltia* 20. 180 pp.

Peel, J. S. & Sønderholm, M. (ed.) 1991. Sedimentary basins of North Greenland. *Bull. Grønlands geol. Unders.* 160. 164 pp.

Rostrup, E, 1888. Fungi groenlandiae. *Meddel. Grønland* 3: 517–590.

Rostrup, E. 1891. Tillæg til Grønlands Svampe. *Meddel. Grønland* 3: 593–643.

Roux, C. & Triebel, D. 1994. Révision des espèces de *Stigmidium* et de *Sphaerellothecium* (champignons lichénicoles non lichénisés, Ascomycetes) correspondant à *Pharcidia epicymatica* sensu Keissler ou à *Stigmidium schaereri* auct. *Bull. Soc. linn. Provence* 45: 451–542.

Santesson, R. 1993. *The lichens and lichenicolous fungi of Sweden and Norway*. SBT-förlaget, Lund. 240 pp.

Shoemaker, R. A. & Babcock, C. E. 1986. *Wettsteinia*. *Canadian J. Bot.* 65: 373–405.

White, W. L. 1941. A monograph of the genus *Rutstroemia* (Discomycetes). *Lloydia* 4: 153–240.

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Supplement to the second checklist of lichenized, lichenicolous and allied fungi of Estonia

Inga Jüriado, Piret Lõhmus & Lauri Saag
Institute of Botany and Ecology, University of Tartu, 38 Lai Street, 51005 Tartu, Estonia. E-mail: jyriado@ut.ee

Abstract: The supplement to the second checklist of lichenized, lichenicolous and allied fungi of Estonia is mainly based on the floristical data of three recent lichenological studies. 13 new taxa for Estonian lichen flora are reported: *Bacidia biatorina*, *Calicium pinastri*, *Chaenothecopsis hospitans*, *Dimerella lutea*, *Fuscidea praeruptorum*, *Lecanora norvegica*, *Lepraria cacuminum*, *Leproloma vouauxii*, *Micarea elachista*, *Mycobilimbia epixanthoides*, *Psilolechia clavulifera*, *Pyrenula laevigata*, *P. nitidella*. New localities of very rare and rare species, changes in frequency classes of species and new distribution regions for 71 species are presented. At the moment, together with the earlier reports, the total number of species of lichenized, lichenicolous and allied fungi in Estonia is 893.

Kokkuvõte: I. Jüriado, P. Lõhmus ja L. Saag. Täiendused Eesti samblike, lihhenikoolsete ja samblikele süstemaatiliselt lähedaste seeneliikide teisele nimekirjale.

Eesti samblike, lihhenikoolsete ja samblikele süstemaatiliselt lähedaste seeneliikide teise nimekirja täiendused põhinevad peamiselt kolme hiljuti valminud lihhenoloogilise uurimuse floristilistel andmetel. Teatatakse 13 Eesti lihhenofloorale uue taksoni leiust: *Bacidia biatorina*, *Calicium pinastri*, *Chaenothecopsis hospitans*, *Dimerella lutea*, *Fuscidea praeruptorum*, *Lecanora norvegica*, *Lepraria cacuminum*, *Leproloma vouauxii*, *Micarea elachista*, *Mycobilimbia epixanthoides*, *Psilolechia clavulifera*, *Pyrenula laevigata*, *P. nitidella*. Täiendatakse andmeid 71 taksoni sageduse ja leviku kohta Eestis. Käesolevaks ajaks on Eestist teada 893 liiki samblikke, lihhenikoolseid või samblikele süstemaatiliselt lähedasi seeni.

INTRODUCTION

The second checklist of lichenized, lichenicolous and allied fungi of Estonia was published over a year ago (Randlane & Saag 1999). Together with the list of 851 species, data on the ecology, distribution and frequency of these taxa in Estonia were also presented.

This supplement to the second checklist is mainly based on the floristical data of three recent lichenological studies in Estonia. In his bachelor's thesis, Lauri Saag (2000) provided an overview of Estonian sterile sorediate crustaceous lichens including an identification key for 63 sterile taxa. The study was carried out on herbarium materials (about 900 specimens) from which ca 600 were analysed using TLC. Two master's theses (Jüriado 2000, Lõhmus 2000) presented data on lichen floras in different forest types and substrates in Estonia. Extensive field work was carried out for that purpose. The study by Jüriado (2000) was part of a larger project Estonian Forest Conservation Area Network (co-operation project of DANCEE and Estonian Ministry of Environment). This paper explored species composition of lichens in 70 forest subcompartments of different forest site types in north-eastern and south-western Estonia. The paper by Lõhmus (2000) analysed composition of lichen floras on snags (both with and without bark) and on living trees. The study was carried out in Alam-Pedja Nature Reserve, in south-eastern Estonia.

RESULTS

In the current supplement 13 new species for Estonian lichen flora together with their frequency, distribution and ecology data are reported. New localities of very rare and rare species, changes in frequency classes of species and also new distribution regions in comparison with Randlane & Saag (1999) are presented for 71 taxa. 43 of the species estimated as very rare or rare by Randlane & Saag (1999) were found during the field work and the frequency class was changed for 29 of them. The most drastic increase can be seen in the number of localities reported for *Hypocenomyce sorophora* and *Loxospora elatina*, as previous floristical studies have paid little attention to the sterile sorediate crustaceous lichens. Two new species for Estonian lichen flora *Lecanora norvegica* and

Mycobilimbia epixanthoides also appeared to be not rare in our country. Although all the new species were expected in Estonia, the occurrence of some of them is remarkable. For example, *Dimerella lutea* is endangered in Sweden (Thor & Arvidsson 1999) and has disappeared in Finland (Vitikainen et al. 1997); *Bacidia biatorina, Pyrenula laevigata* and *P. nitidella* are nemoral species, which are rare or endangered in Sweden (Thor & Arvidsson 1999). As most of the forests studied by Jüriado and Lõhmus were mature or older than 100 year, several species considered specific for old-forest were found. The taxa *Dimerella lutea, Bacidia biatorina, Pyrenula laevigata, P. nitidella* and *Micarea elachista*, which are new for Estonia, are also considered to be old-forest species (Rose 1992, Cieslinski et al. 1996).

Since the second checklist of lichenized, lichenicolous and allied fungi of Estonia was published in 1999 (Randlane & Saag 1999), 42 new species have been reported from Estonia by different authors: by Halonen et al. (2000) – 6 lichen species and 10 lichenicolous fungus species, by Martin et al. (2000) – 8 lichen species, by Suija (2000) 5 lichenicolous fungus species; the current supplement adds 12 lichen and 1 lichenicolous fungus species. At the moment, the total number of species of lichenized, lichenicolous and allied fungi in Estonia is 893.

LIST OF SPECIES

Frequency classes, distribution regions and symbols are given following Randlane & Saag (1999): rr – very rare (1-2 localities in Estonia), r – rare (3-5 localities), st r – rather rare (6-10 localities), st fq – rather frequent (11-20 localities), fq – frequent (21-50 localities), fqq – very frequent (51 or more localities); NW – north-western part of the mainland of Estonia, NE – north-eastern part, SE – south-eastern part, SW – south-western part, WIs – western islands of Estonia; # – lichenicolous fungus, + – non-lichenized fungus.

Changes in frequency classes of species are indicated with →, new frequency classes and new distribution regions in comparison with Randlane & Saag (1999) are typed in **bold**. The nomenclature of the new species for Estonian lichen flora (typed in bold) is given according to Santesson (1993), except *Lepraria cacuminum* for which the taxonomical position is followed by Leuckert et al. (1995), for *Calicium pinastri* by Tibell (1999) and the nomenclature of *Mycobilimbia epixanthoides* remains unsolved. The new locality data referred by Halonen et al. (2000) and Martin et al. (2000) are also considered for the changes in frequency classes and distribution regions of species in Estonia. Detailed locality data are presented for very rare and rare taxa only. All the specimens referred to are kept in the herbarium of Institute of Botany and Ecology in University of Tartu (TU).

ARTHONIA APATETICA (A. Massal.) Th. Fr. – rr→**r**; **SW**: Pärnumaa Co., Orajõe Forestry (58°02'N 24°40'E), 15 July 1999 I. Jüriado, det. L. Martin, WIs: Saaremaa Co., Karjalasma Forestry (58°29'N 22°31'E), 12 Aug 1998 I. Jüriado.

A. DIDYMA Körb. – rr→**r**; WIs, **NE**: Lääne-Virumaa Co., Paasvere Forestry (59°05'N 26°45'E), 21 June 1999 I. Jüriado, Venevere Forestry (59°00'N 26°48'E), 2 July 1999 I. Jüriado.

A. LEUCOPELLAEA (Ach.) Almq. – fq→**fqq**; NE, SE, SW, WIs.

A. MEDIELLA Nyl. – st r→**st fq**; NW, NE, SE, SW, WIs.

A. SPADICEA Leight. – st fq→**fq**; NE, SE, SW.

A. VINOSA Leight. – st fq→**fq**; NW, NE, SE, SW, WIs.

ARTHOTHELIUM RUANUM (A. Massal.) Zwackh – st fq→**fq**; NW, NE, SE, **SW**, WIs.

BACIDIA ARCEUTINA (Ach.) Arnold – st fq→**fq**; **NE**, SE, SW, WIs.

'B.' BECKHAUSII Körb. – st r→**st fq**; **NE**, SE, SW, WIs.

B. BIATORINA (Körb.) Vain. – rr; **SW**: Pärnumaa Co., Surju Forestry (58°13'N 24°48'E), on bark of *Populus tremula*, 24 Aug 1999 I. Jüriado.

B. INCOMPTA (Borrer ex Hook.) Anzi – rr→**r**; WIs, **NE**: Lääne-Virumaa Co., Tudu Forestry (59°11'N 26°46'E), 16 Aug 1999 I. Jüriado, **SW**: Pärnumaa Co., Orajõe Forestry (58°02'N 24°32'E), 1 Oct 1999 I. Jüriado.

B. LAUROCERASI (Delise ex Duby) Zahlbr. – rr→**st r**; **NE**, SE, **SW**.

B. SUBINCOMPTA (Nyl.) Arnold – r→**st fq**; **NE**, SE, **SW**, WIs.

BACIDINA ARNOLDIANA (Körb.) V. Wirth & Vezda – rr→**r**; WIs, **NE**: Ida-Virumaa Co., Remniku

Forestry (59°03'N 27°37'E), 16 June 1999 I. Jüriado, det. L. Martin, **SE**: Halonen et al. 2000.

BIATORA CHRYSANTHA (Zahlbr.) Printzen – rr; NW, **SW**: Pärnumaa Co., Orajõe Forestry (58°02'N 24°40'E), 15 July 1999 I. Jüriado, det. L. Saag.

B. EFFLORESCENS (Hedl.) Räsänen – st r→**fq**; NW, **NE**, SE, SW, WIs.

B. OCELLIFORMIS (Nyl.) Arnold – st r→**st fq**; **NE**, SE, **SW**, WIs.

BIATORIDIUM MONASTERIENSE J. Lahm ex Körb. – rr; WIs, **NE**: Ida-Virumaa Co., Remniku Forestry (59°03'N 27°37'E), 16 June 1999 I. Jüriado, det. I. Jüriado & A. Suija.

BUELLIA GRISEOVIRENS (Turner & Borrer ex Sm.) Almb. – fq→**fqq**; NW, NE, SE, SW, WIs.

B. PHARCIDIA (Ach.) Malme – r; WIs, NE: Lääne-Virumaa Co., Paasvere Forestry (59°05'N 26°45'E), 21 June 1999 I. Jüriado.

CALICIUM PINASTRI Tibell – rr; **SE**: Tartumaa Co., Sirvaku (58°13'N 26°47'E), on bark of *Pinus sylvestris*, 31 May 1967 A.-L. Sõmermaa, det. L. Tibell, Viljandimaa Co., Tipu Forestry (58°20'N 25°12'E), on bark of *Pinus sylvestris*, 27 May 1973 A.-L. Sõmermaa, det. L. Tibell, (both specimens were reidentified from the material originally identified as *Calicium parvum*).

CETRELIA CETRARIOIDES (Delise ex Duby) W. L. Culb. & C. F. Culb. – rr→**r**; NE, SE, **SW**: Pärnumaa Co., Surju Forestry (58°13'N 24°48'E), 24 Aug 1999 I. Jüriado.

CHAENOTHECA CHLORELLA (Ach.) Müll. Arg. – st fq→**fq**; NW, NE, SE, **SW**, WIs.

C. HISPIDULA (Ach.) Zahlbr. – r; NW, WIs, SE: Tartumaa Co., Laeva Forestry (58°29'N 26°12'E), 19 July 1999 P. Lõhmus.

C. SUBROSCIDA (Eitner) Zahlbr. – st r→**st fq**; NW, NE, SE, SW, WIs.

C. XYLOXENA Nádv. – fq→**fqq**; NW, NE, SE, **SW**, WIs.

#CHAENOTHECOPSIS EPITHALLINA Tibell – r; NE, SW, WIs, **SE**: Tartumaa Co., Laeva Forestry (58°28'N 26°12'E), 18 June 1999 P. Lõhmus.

+C. HAEMATOPUS Tibell – rr→**r**; NE, **SE**: Tartumaa Co., Laeva Forestry (58°25'N 26°11'E), 4 July 1999 P. Lõhmus, Laeva Forestry (58°25'N 26°26'E), 24 Sept 1999 P. Lõhmus, **SW**: Pärnumaa Co., Jäärja Forestry (58°02'N 24°57'E), 25 Sept 1999 I. Jüriado, det. P. Lõhmus.

#C. HOSPITANS (Th. Fr.) Tibell – rr; **NE**: Jõgevamaa Co., Kursi Forestry (58°28'N 26°09'E), parasitic on the thallus of *Lecanora carpinea* on bark of *Quercus robur*, 26 July 2000 P. Lõhmus.

+C. PUSIOLA (Ach.) Vain. – rr→**st fq**; NE, SE.

+C. RUBESCENS Vain. – rr→**r**; NE: Lääne-Virumaa Co., Venevere Forestry (59°00'N 26°48'E), 2 July 1999 I. Jüriado, **SW**: Pärnumaa Co., Jäärja Forestry (58°00'N 24°50'E), 20 Sept 1999 I. Süda, det. I. Jüriado & P. Lõhmus.

+C. SAVONICA (Räsänen) Tibell – st r→**fq**; NW, NE, SE, **SW**, WIs.

COLLEMA NIGRESCENS (Huds.) DC. – rr; SW, **NE**: Ida-Virumaa Co., Oonurme Forestry (59°08'N 27°00'E), 12 Sept 1999 I. Süda, det. I. Jüriado.

C. SUBNIGRESCENS Degel. – r; WIs, NE: Ida-Virumaa Co., Iisaku Forestry (59°10'N 27°09'E), 17 Aug 1999 I. Jüriado, Lääne-Virumaa Co., Paasvere Forestry (59°07'N 26°46'E), 1 July 1999 I. Jüriado.

CYBEBE GRACILENTA (Ach.) Tibell – rr→**r**; NE, **SE**: Halonen et al. 2000, **SW**: Pärnumaa Co., Jäärja Forestry (58°02'N 24°42'E), 4 May 2000 T. Kivisilla, det. P. Lõhmus.

DIMERELLA LUTEA (Dicks.) Trevis. – rr; **NE**: Ida-Virumaa Co., Remniku Forestry (59°04'N 27°34'E), on bark of *Populus tremula*, 7 July 1999 I. Jüriado.

EVERNIA MESOMORPHA Nyl. – st r→**st fq**; NW, NE, SE.

FUSCIDEA ARBORICOLA Coppins & Tønsberg – r; NW, NE, **SE**: Valgamaa Co., Karula Forestry (57°41'N 26°28'E), 12 June 1999 I. Jüriado, det. L. Saag, SW: Pärnumaa Co., Jäärja Forestry (58°01'N 24°58'E), 26 Aug 1999 I. Jüriado, det. L. Saag.

F. PRAERUPTORUM (Du Rietz & H. Magn.) V. Wirth & Vezda – rr; **NE**: Jõgevamaa Co., Kursi Forestry (58°30'N 26°12'E), on bark of *Betula*, 12 June 1999 P. Lõhmus, det. J. Motiejunaite.

F. PUSILLA Tønsberg – rr→**st r**; NW, **NE**, **SE**, **SW**.

GYALECTA TURCIGENA (Ach.) Hepp – rr→**st r**; **NE**, SE, **SW**.

HAEMATOMMA OCHROLEUCUM var. PORPHYRIUM (Pers.) J. R. Laundon – r→**st r**; SE, **SW**, WIs.

HYPOCENOMYCE ANTHRACOPHILA (Nyl.) P. James & Gotth. Schneid. – rr→**r**; SW, **NE**: Ida-Virumaa Co., Remniku Forestry (59°02'N 27°35'E), 8 July 1999 I. Jüriado, Remniku

Forestry (59°03'N 27°32'E), 21 July 1999 I. Jüriado, Remniku Forestry (59°04'N 27°32'E), 22 July 1999 I. Jüriado.

H. CARADOCENSIS (Leight. ex Nyl.) P. James & Gotth. Schneid. – r→**st r**; NE, **SE**, WIs.

H. FRIESII (Ach.) P. James & Gotth. Schneid. – st r→**st fq**; NW, NE, SE, SW, WIs.

H. SOROPHORA (Vain.) P. James & Poelt – r→**fq**; **NE**, **SE**, **SW**, WIs.

LECANACTIS ABIETINA (Ach.) Körb. – fq→**fqq**; NW, NE, SE, SW, WIs.

LECANORA CADUBRIAE (A. Massal.) Hedl. – r→**st r**; NW, NE, SE, SW, WIs.

L. NORVEGICA Tønsberg – st fq; **NE**, **SE**, **SW**; corticolous on *Pinus sylvestris*, leg. I. Jüriado & P. Lõhmus, det. P. Lõhmus & L. Saag.

L. PHAEOSTIGMA (Körb.) Almb. – st r→**st fq**; NW, NE, SE, WIs.

'LECIDEA' ERYTHROPHAEA Flörke ex Sommerf. – r→**st r**; NW, SE, **SW**, WIs.

'L.' NYLANDERI (Anzi) Th. Fr. – st r→**fqq**; NW, **NE**, **SE**, **SW**, WIs.

LEPRARIA CACUMINUM (A. Massal.) Kümmerling & Leuckert – rr; **WIs**: Saaremaa Co., Viidumäe Nature Reserve (58°16'N 22°08'E), on bark of *Fraxinus excelsior*, 10 Aug 1999 L. Saag.

L. ELOBATA Tønsberg – r→**st r**; **NE**, SE, **SW**, WIs.

L. FRIGIDA J. R. Laundon – r; NW, NE, **SW**: Pärnumaa Co., Surju Forestry (58°13'N 24°48'E), 24 Aug 1999 I. Jüriado, det. L. Saag.

L. INCANA (L.) Ach. – fq→**fqq**; NW, **NE**, SE, **SW**, WIs.

L. JACKII Tønsberg – st fq→**fq**; NW, **NE**, SE, SW, WIs.

LEPROLOMA VOUAUXII (Hue) J. R. Laundon – r; **SE**: Valgamaa Co., Koiva, on sandstone, 07 June 1958 H. Trass, det. L. Saag, **SW**: Pärnumaa Co., Jäärja Forestry (58°02'N 24°57'E), on bark of *Alnus glutinosa*, 26 Aug 1999 I. Jüriado, det. L. Saag, Jäärja Forestry (58°00'N 24°53'E), on bark of *Betula*, 26 Sep 1999 I. Jüriado, det. L. Saag.

LOPADIUM DISCIFORME (Flot.) Kullh. – rr→**r**; SE, NE: Jõgevamaa Co., Kursi Forestry (58°31'N 26°16'E), 28 May 1999 P. Lõhmus.

LOXOSPORA ELATINA (Ach.) A. Massal. – r→**fq**; NW, NE, SE, SW, **WIs**: Martin et al. 2000.

MEGALARIA GROSSA (Pers. ex Nyl.) Hafellner – st r→**st fq**; NW, **NE**, SW, WIs.

MICAREA ELACHISTA (Körb.) Coppins & R. Sant. – rr; **NE**: Ida-Virumaa Co., Remniku Forestry (59°06'N 27°32'E), on bark of *Pinus sylvestris*, 18 Aug 1999 I. Jüriado, det. I. Jüriado & L. Martin, **SW**: Pärnumaa Co., Laiksaare Forestry (58°05'N 24°37'E), on bark of *Pinus sylvestris*, 27 July 1999 I. Jüriado, det. I. Jüriado & L. Martin.

M. HEDLUNDII Coppins – rr→**r**; NE, **SE**: Halonen et al. 2000, **SW**: Pärnumaa Co., Laiksaare Forestry (58°06'N 24°45'E), 1 Oct 1999 I. Jüriado, det. I. Jüriado & L. Martin.

M. MELAENA (Nyl.) Hedl. – st fq→**fq**; NW, NE, SE, SW.

M. MELANOBOLA (Nyl.) Coppins – r; NW, NE, SE, **SW**: Pärnumaa Co., Laiksaare Forestry (58°03'N 24°39'E), 27 July 1999 I. Jüriado, det. I. Jüriado & L. Martin.

M. MISELLA (Nyl.) Hedl. – r; NW, SE, WIs: Saaremaa Co., Kihelkonna Forestry, (58°20'N 22°08'E), 16 Aug 1998 I. Jüriado.

M. PELIOCARPA (Anzi) Coppins & R. Sant. – st r→**st fq**; NW, NE, SE, **SW**, **WIs**: Martin et al. 2000.

MYCOBILIMBIA CARNEOALBIDA (Müll. Arg.) comb. ined. – st r→**st fq**; NW, NE, SE, SW, **WIs**: Martin et al. 2000.

M. EPIXANTHOIDES (Nyl.) comb. ined. – st r; **NE**, **SW**; corticolous on deciduous trees (*Populus tremula*, *Alnus incana*, *Quercus robur*) and on mosses growing on deciduous trees, leg. I. Jüriado, det. I. Jüriado & L. Saag.

MYCOBLASTUS FUCATUS (Stirt.) Zahlbr. – r→**st fq**; NW, **NE**, **SE**, **SW**, WIs.

M. SANGUINARIUS (L.) Norman – st fq→**fq**; NW, NE, SE, SW, WIs.

NORMANDINA ACROGLYPTA (Norman) Aptroot – rr→**r**; NW, WIs, **SW**: Pärnumaa Co., Orajõe Forestry (58°01'N 24°41'E), 14 July 1999 I. Jüriado, det. I. Jüriado & T. Randlane.

OCHROLECHIA MICROSTICTOIDES Räsänen – st r→**fq**; NW, NE, **SE**, SW, WIs.

O. SZATALAËNSIS Verseghy – rr→**r**; NW, WIs, **NE**: Ida-Virumaa Co., Oonurme Forestry (59°08'N 27°00'E), 12 Sept 1999 I. Süda, det. I. Jüriado, Lääne-Virumaa Co., Paasvere Forestry (59°05'N 26°45'E), 21 June 1999 I. Jüriado, Tudu Forestry (59°12'N 26°56'E), 10 Aug 1999 I. Jüriado.

OPEGRAPHA OCHROCHEILA Nyl. – rr; NW, **SW**: Pärnumaa Co., Audru Forestry (58°19'N 24°09'E), 18 Sept 1999 I. Süda, det. I. Jüriado.

O. VIRIDIS (Pers. ex Ach.) Behlen & Desberger – r→**st r**; **NE**, **SW**, WIs.

PACHYPHIALE FAGICOLA (Hepp) Zwackh – r→**st r**; **NE**, SE, WIs.

PERTUSARIA PUPILLARIS (Nyl.) Th. Fr. – r; SE, SW, NE: Lääne-Virumaa Co., Tudu Forestry (59°11'N 26°46'E), 16 Aug 1999 I. Jüriado, det. L. Saag.

PSILOLECHIA CLAVULIFERA (Nyl.) Coppins – rr; **SW**: Pärnumaa Co., Laiksaare Forestry (58°03'N 24°40'E), on wood of dead deciduous tree, 28 July 1999 I. Jüriado, det. I. Jüriado & L. Martin.

PYRENULA LAEVIGATA (Pers.) Arnold – r; **SW**: Pärnumaa Co., Audru Forestry (58°20'N 24°10'E), on bark of *Fraxinus excelsior*, 19 Sept 1999 I. Süda, det. I. Jüriado, Laiksaare Forestry (58°03'N 24°40'E), on bark of dead deciduous tree, 28 July 1999 I. Jüriado, Orajõe Forestry (58°01'N 24°38'E), on bark of *Fraxinus excelsior*, 13 July 1999 I. Jüriado.

P. NITIDELLA (Flörke ex Schaer.) Müll. Arg. – r; **NE**: Ida-Virumaa Co., Jõhvi Forestry (59°26'N 27°26'E), on bark of *Fraxinus excelsior*, 10 Sept 1999 I. Süda, det. I. Jüriado, **SW**: Pärnumaa Co., Laiksaare Forestry (58°03'N 24°39'E), on bark of *Ulmus glabra*, 27 July 1999 I. Jüriado, Orajõe Forestry (58°02'N 24°41'E), on bark of *Fraxinus excelsior* and *Alnus incana*, 3 Oct 1999 I. Süda, det. I. Jüriado.

RINODINA EFFLORESCENS Malme – r→**st r**; NW, **NE**, **SW**, WIs.

ROPALOSPORA VIRIDIS (Tønsberg) Tønsberg – rr; NW, **NE**: Ida-Virumaa Co., Remniku Forestry (59°04'N 27°38'E), 8 July 1999 I. Jüriado, det. L. Saag.

SCLEROPHORA CONIOPHAEA (Norman) J. Mattsson & Middelb. – rr→**r**; NW, NE, **SE**: Jõgevamaa Co., Kursi Forestry (58°29'N 26°09'E), 26 June 2000 P. Lõhmus, Põlvamaa Co., Valgjärve (58°05'N 26°38'E), 3 Oct 2000 P. Lõhmus, **SW**: Pärnumaa Co., Halinga Forestry (58°37'N 24°06'E), 25 Aug 1999 I. Jüriado.

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REFERENCES

Cieslinski, S., Czyzewska, K., Falinski, J. B., Klama, H., Mulenko, W. & Zarnowiec, J. 1996. Relicts of the primeval (virgin) forest. Relict phenomena. *Phytocoenosis* 8: 197–216.

Jüriado, I. 2000. *Lichen flora in different forest site types in the north-eastern and south-western Estonia* (in Estonian). M. Sc. thesis in Institute of Botany and Ecology, University of Tartu (manuscript).

Halonen, P., Kukwa, M., Motiejunaite, J., Lõhmus, P. & Martin, L. 2000. Notes on lichens and lichenicolous fungi found during the XIV Symposium of Baltic Mycologists and Lichenologists in Järvselja, Estonia. *Folia Cryptog. Estonica* 36: 17–21.

Leuckert, Ch., Kümmerling, H. & Wirth, V. 1995. Chemotaxonomy of *Lepraria* Ach. and *Leproloma* Nyl. ex Crombie, with particular reference to Central Europe. *Bibl. Lichenol.* 58: 245–259.

Lõhmus, P. 2000. *Snags and their lichen flora of old peatland forests in Estonia* (in Estonian). M. Sc. thesis in Institute of Botany and Ecology, University of Tartu (manuscript).

Martin, L., Randlane, T. & Martin, J. 2000. Lichens of Vormsi Island. *Folia Cryptog. Estonica* 36: 65–81.

Randlane, T. & Saag, A. (eds) 1999. Second checklist of lichenized, lichenicolous and allied fungi of Estonia. *Folia Cryptog. Estonica* 35: 1–132.

Rose, F. 1992. Temperate forest management: its effects on bryophyte and lichen floras and habitats. In *Bryophytes and Lichens in a Changing Environment* (eds Bates, J. W. & Farmer, A. M.), pp. 211–233. Clarendon Press, Oxford.

Saag, L. 2000. *Sterile sorediose crustaceous lichens in Estonia* (in Estonian). B. Sc. thesis in Institute of Botany and Ecology, University of Tartu (manuscript).

Santesson, R. 1993. *The lichens and lichenicolous fungi of Sweden and Norway*. SBT-förlaget, Lund. 240 pp.

Suija, A. 2000. Lichenicolous fungi – new to Estonia. *Folia Cryptog. Estonica* 37: 119–120.

Thor, G. & Arvidsson, L. (eds) 1999. *Rödlistade lavar i Sverige – Artfakta*. [Swedish Red Data Book of Lichens]. ArtDatabanken, SLU, Uppsala. 528 pp.

Tibell, L. 1999. Caliciales. *Nordic Lichen Flora* 1: 20–71.

Vitikainen, O., Ahti, T., Kuusinen, M., Lommi, S. & Ulvinen, T. 1997. Checklist of lichens and allied fungi of Finland. *Norrlinia* 6: 1–123.

Folia Cryptog. Estonica, Fasc. 37: 27–38 (2000)

Mycobiota of the Teberda State Biosphere Reserve (Polyporales, Boletales, Agaricales, Russulales)

Kuulo Kalamees[1] & Rustam Botashev[2]

[1]Institute of Zoology and Botany, Estonian Agricultural University, 181 Riia St., EE 51014, Tartu, Estonia.
E-mail: kuulo@zbi.ee

[2]Moscow State University, Department of Geobotany, Biological Faculty, 119899 Moscow, Russia.
E-mail: botash@herba.msu.ru

Abstract: We report the results of the first comprehensive study of macromycetes in the Teberda State Biosphere Reserve in the Northern Caucasus (Russia). During the fungal seasons of 1996-1999, 278 species of macromycetes (Polyporales s.str., Boletales, Agaricales and Russulales) where collected.

Kokkuvõte: K. Kalamees ja R. Botashev. Teberda Riikliku Biosfääri Kaitseala seenestik (Polyporales s.str., Boletales, Agaricales, Russulales).

Esitatakse esmakordne ülevaade Teberda Riiklikul Biosfääri Kaitsealal kasvavatest suurseentest seltsides Polyporales s.str., Boletales, Agaricales ja Russulales. Aastatel 1996-1999 registreeriti autorite poolt kaitsealal kokku 278 liiki.

INTRODUCTION

The Teberda State Biosphere Reserve is situated within the Republic of Karachaevo Cherssia (Russian Federation) in the western part of the Greater Caucasus, mostly occupying the northern slope of the Caucasian Main Mountain Range at altitudes of 1200-3200 m above sea level. Geologically the area is represented by Pre-Cambrian granites with occasional patches of gneiss. The soil cover in the forest zone is dominated by mountain brown soils (Vladychenskij & Grishina, 1986). The climate in the Teberda Reserve is generally warm and humid: the range of both diurnal and annual temperatures is relatively narrow, making the climate rather similar to maritime. Average temperature is 14.5°C in summer and -2.1°C in winter (Polivanova, 1986).

The plant cover of the Reserve displays vertical zonation typical of mountainous regions. The forest zone as well as the subalpine and alpine zones are well expressed.

In the forest zone (1200-2000 m above sea level), 2/3 of the area is occupied by coniferous forests, mostly consisting of *Pinus sylvestris*, *Abies nordmanniana* and *Picea orientalis*. *Pinus* forests are primarily situated in the northern part of the reserve. *Abies* and *Picea* forests are characteristic of shelving slopes and flat areas between them. Since *Fagus orientalis* is often present in such forests, too, *Fagus-Picea-Abies* mixed forests are also common, in particular at lower altitudes. *Abies* forests, occurring on the upper boundary of the forest zone, are followed by the zone of subalpine curvisilvae with *Betula litwinowii*. In the flood plain of the Teberda River valley there occur alder groves in which *Alnus incana* is mixed with *A. glutinosa*. Birch groves with *Betula pendula* Roth are common in the central part of the forest zone.

The subalpine zone is dominated by grasslands with *Zerna variegata* and *Festuca varia*, occasionally by *Rhododendron caucasicum* bush communities. The alpine zone is characterized, besides grasslands with *Festuca varia* , particularly by alpine lichen heaths, alpine snowbed communities, *Geranium gymnocaulon-Hedysarum caucasicum* meadows and dwarf shrubs with *Salix kazbekensis*.

MATERIAL AND METHODS

Four orders of macromycetes (*Basidiomycota*: *Hymenomycetes*) were studied: Polyporales s. str., Boletales, Agaricales and Russulales. They were treated and the taxons were arranged mainly in accordance with the key-book of Hansen & Knudsen (1992), with some modifications by Kovalenko (1989) and Antonín & Noordeloos (1997).

The material for the present investigation was collected from May through September 1996-1999 by route and stationary methods. Altogether, 23 stationary observation areas were established in various plant cover types; their size in the forest zone was 10x20 m, in the subalpine and alpine zones, 10x10 m. In the main fungal season, in August-September, stationary areas were visited every 7-10 days, at other times of the year, on average twice a month. Route studies were performed irregularly, within the bounds of possibility.

The following geographical localities were visited: Oriuchat (1500-3000 m above sea level), Baduk (1400-3000), Dombai (1400-2800), Gitche-Murudzhu (1600-2800), Khadzhibey (1700-3200), Kel'-bashi (1300-1800), Malaya Khatipara (1250-2850), Mukhu (1200-1800), Ullu-Murudzhu (1400-2300), Shumka (1400-1600) and Teberda (1250).

The following types of plant cover were investigated:

1. *Abies-Picea* forest with *Hylocomium*, *Dicranum*, *Rhytidiadelphus* layer and sparse *Pinus* and *Betula* trees;
2. *Pinus-Betula-Fagus-Abies* forest with sparse *Acer* trees and dense forb layer;
3. *Fagus-Picea-Abies* forest with forb layer;
4. *Betula-Populus-Abies* forest with young *Taxus* trees;
5. *Abies-Picea-Pinus* forest;
6. Subalpine elfin birch woodland (curvisilvae);
7. *Populus tremula-Betula-Carpinus-Quercus-Picea* forest;
8. *Fagus-Abies* forest;
9. *Betula-Fagus-Populus* forest;
10. *Festuca varia* grassland with young *Pinus* plants;
11. *Pinus* forest with *Calamagrostis arundinacea*;
12. *Alnus glutinosa* forest;
13. Alpine lichen heath;
14. Alpine snowbed community;
15. Secondary subalpine grassland;
16. *Geranium gymnocaulon-Hedysarum caucasicum* meadow;
17. *Nardus* grassland;
18. Dwarf shrub (*Salix kazbekensis*) heath;
19. *Rhododendron caucasicum* bush community.

RESULTS

In the present investigation the species composition of the mycobiota of the Teberda State Biosphere Reserve was established with respect to the studied taxa. A total of 278 species from 74 genera and 17 families were identified for the area. All fungal taxons appear new for the Teberda Reserve, because any further investigations of mycobiota in Teberda have not been provided. The nearest region in the Northern Caucasus where the mycobiota has been thoroughly studied is the Caucasian State Nature Reserve (cf. Vaasma et al., 1986).

Using of permanent plots was evidently insufficient in our case, since they revealed only a small fraction of the overall species diversity. Therefore, the species collected from permanent plots are not marked as such in the following list of fungi. Nor did we attempt to characterize these species by sociological characteristics.

In the "List of species" below, the name is accompanied by the following data: geographical localities, altitude above sea level (m), plant cover types (denoted with numbers as given in Methods), trophic groups (denoted with the following abbreviations, cf. Kalamees, 1980): C - coprobionts, Fds - forest debris saprobionts, Fls - forest litter saprobionts, Fs - fungal saprobionts, Hbs - herb saprobionts, Hs - humus saprobionts, Ms - moss saprobionts, Mr - mycorrhizal fungi, Ws - wood saprobionts), substrates, time of occurrence (months), frequency (on a 6-point scale: 1 - very rare (in case of a single find the date is given), 2 - rare, 3 - rather rare, 4 - rather frequent, 5 - frequent, 6 - very frequent), collections investigated.

LIST OF SPECIES

POLYPORALES

Polyporaceae

LENTINUS CYATHIFORMIS (Schaeff.) Bres. - Shumka; 1350; 2; Ws (deciduous tree); 25.08.1999.

PHYLLOTOPSIS NIDULANS (Pers.: Fr.) Singer - Ullu-Murudzhu; 1200; 1; Ws (*Picea orientalis*); 23. 08.1999; TAA 175096.

PLEUROTUS CORNUCOPIAE (Paul. ex Pers.) Roll. - Baduk, Malaya Khatipara, Shumka; 1200-

1350; 2; Ws (deciduous trees); May to September; 6.

P. DRYINUS (Pers.: Fr.) P. Kumm. - Malaya Khatipara; 1350-1400; 2; Ws (*Abies nordmanniana*); August; 2.

P. OSTREATUS (Jacq.: Fr.) P. Kumm. - Baduk, Khadzhibey, Malaya Khatipara; 1200-1350; 2; Ws (deciduous trees); May to September; 2.

P. PULMONARIUS Fr. - Shumka, Ullu-Murudzhu; 1300-1400; 1; Ws (*Abies nordmanniana*); August; 3.

BOLETALES

Boletaceae

BOLETUS APPENDICULATUS Schaeff. - Malaya Khatipara; 1600-1700; 3; Mr (*Fagus orientalis*); July to August; 3.

B. BETULICOLA (Vassilkov) Pilát & Dermek - Ullu-Murudzhu; 1600; 1; Mr (*Betula pendula*); 23.08.1999.

B. CALOPUS Pers.: Fr. - Baduk, Dombai, Malaya Khatipara, Ullu-Murudzhu; 1200-1600; 1, 4,5; Mr; August to September; 5; TAA 175183, TAA 175192.

B. CLAVIPES (Peck) Pilát & Dermek - Baduk, Dombai, Ullu-Murudzhu; 1400-1600; 1; Mr; August to September; 4; TAA 175085.

B. EDULIS Bull.: Fr. - Malaya Khatipara, Ullu-Murudzhu; 1650-1700; 1; Mr (*Picea orientalis*, *Abies nordmanniana*); August; 3.

B. FECHTNERI Velen. - Baduk; 1600; 8; Mr (*Fagus orientalis*); August to September; 1.

B. LURIDIFORMIS Rostk. var. luridiformis (*B. erythropus* ss. Fr., auct. plur. non ss. Pers.) - Ullu-Murudzhu; 1400; 1; Mr; 24.08.1999; TAA 175138.

B. LURIDUS Schaeff.: Fr. - Ullu-Murudzhu, Malaya Khatipara; 1400-1650; 1, 8; Mr (*Fagus orientalis*); July to August; 4.

B. PULVERULENTUS Opat. - Ullu-Murudzhu; 1200; 5; Mr; 23.08. 1999; TAA 175111.

B. SATANAS Lenz - Baduk, Malaya Khatipara; 1650-1700; 8; Mr (*Fagus orientalis*); July to August; 1.

CHALCIPORUS PIPERATUS (Bull.: Fr.) Bat. - Baduk, Dombai, Malaya Khatipara, Ullu-Murudzhu; 1400-2000; 1, 6; Mr; August to September; 5.

LECCINUM AURANTIACUM (Bull.) Gray - Baduk, Malaya Khatipara; 1200-1400; 1, 9; Mr (*Populus tremula*); August to September; 2.

L. CARPINI (R. Schulz) M.M. Moser ex Reid (*L. griseum* (Quél.) Singer) - Malaya Khatipara; 1200; 9; Mr (*Carpinus betulus*); 29.08.1999.

L. CROCIPODIUM (Letell.) Watling - Malaya Khatipara; 1300; 9; Mr; 18.08.1998.

L. CF. HOLOPUS (Rostk.) Watling - Ullu-Murudzhu; 1600; 6; Mr (*Betula litwinowii*); 24.08.1999.

L. PERCANDIDUM (Vassilkov) Watling - Malaya Khatipara; 1450; 9; Mr (*Betula pendula*); July; 1.

L. SCABRUM (Bull.: Fr.) Gray - Baduk, Dombai, Malya Khatipara, Khadzhibey, Ullu-Murudzhu; 1250-2500; 1, 6, 9; Mr (*Betula pendula*, *B. litwinowii*); 5.

L. VERSIPELLE (Fr.) Snell - Dombai, Malaya Khatipara, Khadzhibey; 1300-2500; 6, 7; Mr (*Betula litwinowii*); August to September; 5; TAA 175260.

Gomphidiaceae

CHROOGOMPHUS RUTILUS (Schaeff.: Fr.) O.K. Mill. - Malaya Khatipara, Ullu-Murudzhu, Shumka; 1400-1650; 5; Mr (*Pinus sylvestris*); August to September; 4.

GOMPHIDIUS GLUTINOSUS (Schaeff.: Fr.) Fr. - Baduk, Ullu-Murudzhu; 1400-1600; 1; Mr (*Picea orientalis*); August to September; 4.

G. ROSEUS (Nees: Fr.) Fr. - Malaya Khatipara; 1400-1650; 5, Mr (*Pinus sylvestris*); 24.08.1997.

SUILLUS BOVINUS (L.: Fr.) Kuntze - Malaya Khatipara; 1350; 5; Mr (*Pinus sylvestris*); September; 3.

S. COLLINITUS (Fr.) Kuntze - Malaya Khatipara; 1600; 2; Mr (*Pinus sylvestris*); 19.08.1999.

S. GRANULATUS (L.: Fr.) Roussel - Malaya Khatipara, Ullu-Murudzhu, Shumka; 1200-2650; 1, 9, 10; Mr (*Pinus sylvestris*); August; 4.

S. LUTEUS (L.: Fr.) Roussel - Dombai, Malaya Khatipara, Ullu-Murudzhu; 1350-2000; 1, 5, 6; Mr (*Pinus sylvestris*); August to September; 4.

S. VARIEGATUS (Sw.: Fr.) Kuntze - Khadzhibey, Malaya Khatipara, Ullu-Murudzhu; 1350-1850; 5; Mr (*Pinus sylvestris*); August to September; 5.

XEROCOMUS BADIUS (Fr.) Kühner ex Gilb. - Malaya Khatipara; 1200-1400; 9; Mr; July; 2.

X. PASCUUS (Pers.) Krombh. (*X. chrysenteron* ss. auct. pl.) - Baduk, Dombai, Shumka; 1300-

2000; 1, 2; Mr (Ws); August; 5; TAA 175080, TAA 175261.

X. LANATUS (Rostk.) Singer (*X. spadiceus* (Fr.) Quél.) - Ullu-Murudzhu; 1200; 1; Mr; 23.08.1999; TAA 175097.

X. SUBTOMENTOSUS (L.: Fr.) Quél. - Baduk, Dombai, Malaya Khatipara; 1300-1800; 1; Mr; August; 4.

Paxillaceae

GYROPORUS CYANESCENS (Bull.: Fr.) Quél. var. CYANESCENS - Malya Khatipara; 1400; 1; Mr; 19.08.1999; TAA 175059.

HYGROPHOROPSIS AURANTIACA (J. Schröt.) Maire - Ullu-Murudzhu; 1200; 1; Ws (*Abies nordmanniana*); 23.08.1999; TAA 175086.

PAXILLUS FILAMENTOSUS (Scop.) Fr. - Teberda, Malaya Khatipara, Shumka; 1250-1300; 9, 12; Mr (*Alnus incana*); August to September; 2.

P. INVOLUTUS (Batsch: Fr.) Fr. - Malaya Khatipara, Shumka; 1300-1850; 9, 11; Mr; August to September; 4.

Strobilomycetaceae

PORPHYRELLUS PORPHYROSPORUS (Fr.) Gilb. (*P. pseudoscaber* Singer) - Baduk, Malaya Khatipara; 1400; 3; Mr; 3; TAA 175188, TAA 175190, TAA 175262.

STROBILOMYCES STROBILACEUS (Scop.: Fr.) Berk. (*S. floccopus* (Vahl: Fr.) P. Karst.) - Malaya Khatipara, Ullu-Murudzhu; 1300-1650; 8; Mr; 3.

AGARICALES

Agaricaceae

AGARICUS ARVENSIS Schaeff. - Malaya Khatipara, Mukhu; 2300-2850; 13, 14; Hs; June to September; 3.

A. AUGUSTUS Fr. - Ullu-Murudzhu; 1200-1600; 1, 2; Hs; July to August; 2.

A. CAMPESTRIS L.: Fr. - Baduk, Khadzhibey, Malaya Khatipara, Mukhu; 2300-2850; 13, 14; Hs; June to September; 5.

A. LANGEI (F.H. Møller) F.H. Møller - Ullu-Murudzhu; 1600; 1; Hs; August; 1.

A. SYLVICOLA (Vittad.) Peck - Baduk, Shumka, Ullu-Murudzhu; 1250-1600; 1, 9; Hs; August; 4.

A. XANTHODERMA Genev. - Baduk, Malaya Khatipara, Mukhu; 2600-2650; 10, 14; Hs; August to September; 3.

CYSTOLEPIOTA ROSEA (Rea) Singer - Shumka; 1250; 2; Hs; 18.08.1999; TAA 175263.

LEPIOTA CLYPEOLARIA (Bull.: Fr.) P. Kumm. - Baduk, Dombai, Malaya Khatipara, Ullu-Murudzhu; 1250-1800; 1, 2; Fls; August to September; 5; TAA 175263, TAA 175 264.

L. CRISTATA (Bolt.: Fr.) P. Kumm. - Shumka, Malaya Khatipara; 1400; 1, 2; Fls (Ws); August; 3; TAA 265.

L. VENTRIOSOSPORA D.A. Reid - Shumka; 1400; 2; Fls; 18.08.1999; TAA 175266.

MACROLEPIOTA PROCERA (Scop.: Fr.) Singer - Baduk; 1250; 9; Hs; August; 1.

M. CF. PROCERA (Scop.: Fr.) Singer (*M. procera* ss. Phillips) - Malaya Khatipara; 1350; 1; Hs; 19.08.1999.

M. RHACODES (Vitt.) Singer var. rhacodes - Ullu-Murudzhu; 2200; 15; Hs; 9.09.1996.

MELANOPHYLLUM ECHINATUM (Roth: Fr.) Singer (*M. haematospermum* (Bull.: Fr.) Kreisel) - Baduk; 1800; 6; Hs; 27.08.1999; TAA 175209.

Amanitaceae

A. CITRINA (Schaeff.) Pers. - Shumka, Malaya Khatipara; 1250-1650; 8, 9; Mr; 3.

A. CROCEA (Quél.) Singer - Malaya Khatipara, Ullu-Murudzhu; 1650; 1, 2; Mr; 2.

A. FRIABILIS (P. Karst.) Bas - Teberda; 1250; 12; Mr (*Alnus incana*); 31.05.1998.

A. GEMMATA (Fr.) Gillet - Malaya Khatipara; 1250; 2; Mr; 19.08.1999; TAA 175267.

A. MUSCARIA (L.: Fr.) Hook. - Baduk, Dombai, Malaya Khatipara, Ullu-Murudzhu; 1250-2200; 1, 6, 10, 11; Mr; 6.

A. PANTHERINA (DC.: Fr.) Krombh. - Malaya Khatipara; 1700; 2; Mr; 3.08.1998.

A. PHALLOIDES (Vaill.: Fr.) Link - Malaya Khatipara; 1250-1650; 8, 9; Mr; 3.

A. RUBESCENS (Pers.: Fr.) Gray - Baduk, Buu Ulgen, Dombai, Malaya Khatipara, Ullu-Murudzhu; 1250-2000; 1, 3, 8; Mr; 6.

A. VAGINATA (Bull.: Fr.) Vittad. var. ALBA Gillet - Malaya Khatipara; 1250; 2; Mr; 19.08.1999.

A. VAGINATA var. BADIA Gillet - Dombai, Malaya Khatipara, Ullu-Murudzhu; 1350-2000; 1, 6; Mr; 4.

A. VAGINATA var. VAGINATA - Baduk, Malaya Khatipara, Ullu-Murudzhu; 1250-1650; 1, 6; Mr; 5.

Bolbitiaceae

AGROCYBE EREBIA (Fr.: Fr.) Kühner - Baduk; 1800; 6; Hs; 27.08.1999.

A. SPHALEROMORPHA (Bull.: Fr.) Fayod - Malaya Khatipara; 2600-2750; 13; Hs; August to September; 1.

BOLBITIUS TITUBANS (Bull.: Fr.) Fr. (*B. vitellinus* Pers.: Fr.) Fr. - Baduk; 2000; 6; Hs; 27.08.1999.

CONOCYBE RICKENIANA P.D. Orton - Malaya Khatipara; 2750; 13; Hs; 22.08.1999; TAA 175268.

Coprinaceae

COPRINUS ATRAMENTARIUS (Bull.: Fr.) Fr. - Dombai, Malaya Khatipara; 1250-1800; 1, 2; Ws; 2.

C. MICACEUS (Bull.: Fr.) Fr. - Oriuchat, Baduk, Malaya Khatipara; 1300-1400; 2, 9; Ws; 2.

C. SYLVATICUS Peck - Malaya Khatipara; 1250; 9; Ws; 2; TAA 175269.

PANAEOLUS ATER (Lange) Kühner & Romagn. ex M. Lange - Malaya Khatipara, Kyell-Bashe; 2600-1750; 13; C; 2.

P. FIMIPUTRIS (Bull.: Fr.) Quél. (*Anellaria semiovata* (With.: Fr.) Pears. & Dennis) - Mukhu; 2400-2800; 14; C; 2.

P. RETIRUGIS (Fr.) Gillet - Malaya Khatipara, Mukhu; 2800; 12; C; 2.

PSATHYRELLA CANDOLLEANA (Fr.: Fr.) Maire - Teberda; 1350; 9; Hs; 2; TAA 175270.

Cortinariaceae

CORTINARIUS ANOMALUS (Fr.: Fr.) Fr. - Malaya Khatipara; 2200-2400; 6; Mr; 19.08.1999; LE 202461.

C. cf. BOLARIS (Pers.: Fr.) Fr. - Baduk; 1400; 1; Mr; 27.08.1999; TAA 175180.

C. CALOCHROUS (Pers.: Fr.) Fr. subsp. CALOCHROUS var. CALOCHROUS - Ullu-Murudzhu; 1750; 3; Mr; 22.08.1999; LE 202473. New for Russia.

C. CINNABARINUS Fr. - Baduk; 1700; 3; Mr; 23.08.1999; LE 202468.

C. DECIPIENS var. ATROCOERULEUS (M.M. Moser) H. Lindstr. - Baduk; 1700; 3; Mr; 23.08.1999; LE 202469.

C. FULMINEUS (Fr.) Fr. - Ullu-Murudzhu; 1600; 4; Mr; August; 1; LE 202467.

C. LANIGER Fr. - Baduk, Ullu-Murudzhu; 1500-1750; 3; August; 2; LE 202472.

C. MUCOSUS (Bull.: Fr.) Kickx - Dombai, Ullu-Murudzhu; 1750-2000; 3, 6; Mr; August; 2; LE 202459, TAA 175152.

C. OREOBIUS Favre - Malaya Khatipara; 2800; 18; Mr; 19.08.1999; LE 202458. New for Russia.

C. PORPHYROPUS (Alb. & Schwein.) Fr. - Ullu-Murudzhu; 1700; 4; Mr; 21.08.1999; LE 202465.

C. SATURNINUS (Fr.) Fr. - Baduk, Dombai, Ullu-Murudzhu; 1500-1750; 3; Mr; 3; LE 202460.

C. TRIVIALIS Lange - Baduk, Dombai, Malaya Khatipara, Ullu-Murudzhu; 1400-2000; 5, 6; Mr; 4; TAA 175153.

GALERINA ATKINSONIANA A.H. Sm. - Baduk, Malaya Khatipara, Ullu-Murudzhu; 1400-1600; 2, 8; Ws (*Picea orientalis*); August; 4.

G. MARGINATA (Batsch) Kühner - Baduk, Dombai, Malaya Khatipara, Teberda, Ullu-Murudzhu; 1400-1800; 1, 2, 6, 8, 12; Ws; May to September; 6.

G. PALLIDA (Pilát) E. Horak & M.M. Moser - Malaya Khatipara; 1400; 2; Ws; September; 2.

G. UNICOLOR (Vahl: Fr.) Singer - Dombai, Malaya Khatipara, Ullu-Murudzhu; 1400-1800; 1, 2, 6; Ws; August to September; 4; TAA 175091.

G. VITTIFORMIS (Fr.) Singer - Shumka; 1400; 1; Ws; August; 1; LE 202470.

GYMNOPILUS BELLULUS (Peck) Murrill - Baduk; 1400; 1; Ws; 27.08.1999.

G. MICROSPORUS (Singer) Singer - Shumka; 1400; 1; Ws (*Abies nordmanniana*); 25.08.1999; TAA 175166.

G. PENETRANS (Fr.: Fr.) Murrill - Malaya Khatipara, Ullu-Murudzhu; 1250-1600; 1, 2, 6; Ws; August to September; 3; TAA 175271.

G. SAPINEUS (Fr.: Fr.) Maire - Malaya Khatipara; 1400-1650; 2, 8; Ws; June to September; 3.

HEBELOMA STROPHOSUM (Fr.) Sacc. - Malaya Khatipara; 18; Mr; August; 1; LE 202462.

INOCYBE FUSCIDULA Velen. - Ullu-Murudzhu; 2000; 6; Mr; 21.08.1999; LE 202466.

I. GEOPHYLLA (Fr.: Fr.) P. Kumm. var. GEOPHYLLA - Dombai, Malaya Khatipara, Ullu-Murudzhu; 1600-2000; 1; Mr; 3.

I. GEOPHYLLA var. LILACINA (Peck) Gillet - Dombai, Malaya Khatipara; 1600-2000; 1, 6; Mr; 3.

I. NITIDIUSCULA (Britzelm.) Sacc. - Malaya Khatipara; 2750; 18; Mr; 20.08.1999; LE 202471.

I. RIMOSA (Bull.: Fr.) P. Kumm. - Malaya Khatipara; 2800; 18; Mr; 20.08.1999; LE 202463.

I. SALICIS Kühner - Malaya Khatipara; 2700; 16; August; Mr; 1.

I. WHITEI (Berk. & Broome) Sacc. (*I. geophylla* var. *lateritia* (Weinm.) Lange; *I. pudica* Kühner) - Malaya Khatipara; 1400; 1; Mr; 19.08.1999; TAA 175272.

Crepidotaceae

CREPIDOTUS CROCOPHYLLUS (Berk.) Sacc. - Malaya Khatipara, Teberda; 1250; 2, 9; Ws (*Abies nordmanniana*, *Populus tremula*); August; 3; TAA 175052.

C. MOLLIS (Schaeff.: Fr.) Staude var. MOLLIS - Malaya Khatipara; 1250; 9; Ws (*Populus tremula*); 29.08.1999.

C. MOLLIS (Fr.) Pilát var. CALOLEPIS - Malaya Khatipara; 1250; 9; Ws (*Populus tremula*); 29.08.1999.

TUBARIA CONSPERSA (Pers.: Fr.) Fayod - Ullu-Murudzhu; 1900; 6; Fls; 24.08.1999.

Entolomataceae

ENTOLOMA CORVINUM (Kühner) Noordel. - Malaya Khatipara; 2700; 13, 16; Hs; September; 1.

E. NIDOROSUM (Fr.) Quél. - Malaya Khatipara, Ullu-Murudzhu; 1250-1600; 6, 9; Fls; August; 2; TAA 175118.

E. RHODOPOLIUM (Fr.: Fr.) P. Kumm. - Malaya Khatipara, Ullu-Murudzhu; 1250-1600; 6, 9; Fls; August; 2.

E. TURCI (Bres.) M.M. Moser - Malaya Khatipara; 1600-1700; 10, 13; Hs; September; 2.

E. VERNUM Lundell (*Nolanea cucullata* (Favre) P.D. Orton) - Malaya Khatipara, Kyell-Bashe, Ullu-Murudzhu; 2750; 13, 17; Hs; June; 3.

Hygrophoraceae

CUPHOPHYLLUS VIRGINEUS (Wulf.: Fr.) Kovalenko (*Camarophyllu niveus* (Scop.) Wünsche) - Ullu-Murudzhu; 2600; 14; Hs; August to September; 2.

GLIOPHORUS LAETUS (Pers.: Fr.) Herink (*Hygrocybe laeta* (Pers.: Fr.) P. Kumm.) - Malaya Khatipara; 2700; 13; Hs; September; 2.

G. PSITTACINUS (Schaeff.: Fr.) Herink (*Hygrocybe psitacina* (Schaeff.: Fr.) P. Kumm.) - Malaya Khatipara; 2600; 10; Hs; August; 1.

HYGROCYBE CHLOROIDES (Malençon) Kovalenko (*H. tristis* (Pers.) F.H. Møller) - Malaya Khatipara; 2750; 14; Hs; August to September; 2.

H. CHLOROPHANA (Fr.) Wünsche - Malaya Khatipara, Ullu-Murudzhu; 2600; 16; Hs; September; 3.

H. CONICA (Schaeff: Fr.) P. Kumm. - Malaya Khatipara; 2800; 14; Hs; August to September; 3.

H. PERSISTENS (Britzelm.) Singer (*H. acutoconica* (Clem.) Singer) - Ullu-Murudzhu; 2600; 15; Hs; September; 2.

HYGROPHORUS AGATHOSMUS (Fr.) Fr. - Shumka; 1600; 8; Hs; September; 2.

PSEUDOHYGROCYBE INTERMEDIA (Pass.) Kovalenko (*Hygrophorus intermedius* Pass.) - Mukhu, Ullu-Murudzhu; 2500-2600; 10; Hs; September; 3.

Pluteaceae

PLUTEUS ATRICAPILLUS (Batsch) Fayod - Dombai,Teberda, Malaya Khatipara, Shumka, Ullu-Murudzhu; 1250-1600; 1, 2, 3, 9; Ws (*Abies nordmanniana*); May to September; 6; TAA 175273.

P. ATROMARGINATUS (Singer) Kühner - Malaya Khatipara, Ullu-Murudzhu; 1400-1600; 1, 2, 3; Ws (*Abies nordmanniana*); August to September; 4.

P. PHLEBOPHORUS (Ditm.: Fr.) P. Kumm. - Malaya Khatipara 1250-1400; 2, 4, 9; Ws (*Betula pendula*); August; 2.

P. PUNCTIPES P. D. Orton - Malaya Khatipara; 1450; 4; Ws; July; 1.

P. LUTEOVIRENS Rea - Baduk; 1600; 2; Ws (*Abies nordmanniana*); 27.08.199; TAA 175205.

P. NANUS (Pers.: Fr.) P. Kumm. - Teberda; 1250; 9; Ws; 18.08.1999; TAA 175274.

P. ROMELLII (Britzelm.) Sacc. - Malaya Khatipara; 1450; 4, 7; Ws; May to September; 3.

P. ROSEIPES Höhn. - Malaya Khatipara; 1500; 2; Ws; August; 1.

P. SALICINUS (Pers.: Fr.) P. Kumm. - Teberda, Malaya Khatipara, Ullu-Murudzhu; 1250-

1600; 1, 5, 9; Ws (*Abies nordmanniana*); 4; TAA 185087, TAA 175275, TAA 175276.

P. THOMSONII (Berk & Broome) Dennis - Malaya Khatipara; 1400-1500; 2, 8; Ws; September; 2.

P. UMBROSUS (Pers.: Fr.) P. Kumm. - Malaya Khatipara; 1400-1500; 8; Ws; September; 2.

VOLVARIELLA CAESIOCINCTA P. D. Orton - Malaya Khatipara; 1250; 9; Ws; 19.08.1999; TAA 175277.

Strophariaceae

CLITOCYBULA LACERATA (Scop. ex Lasch) Métrod - Malaya Khatipara; 1500; 3; Ws (*Abies nordmanniana*); 1.

HYPHOLOMA CAPNOIDES (Fr.: Fr.) P. Kumm. - Baduk, Dombai, Malaya Khatipara, Ullu-Murudzhu, Teberda; 1200-2000; 1, 2, 6, 9, 12; Ws; August to September; 6.

H. FASCICULARE (Huds.: Fr.) P. Kumm. - Dombai, Malaya Khatipara, Shumka; 1500-2000; 2, 6, 7; Ws; August to September; 4.

H. LATERITIUM (Schaeff.: Fr.) J. Schröt. - Baduk, Malaya Khatipara, Ullu-Murudzhu; 1500-1800; 1, 8; Ws; August to September; 3.

H. MARGINATUM (Pers.: Fr.) J. Schröt. - Malaya Khatipara; 1650; 8; Ws; September; 1.

H. RADICOSUM Lange - Malaya Khatipara; 1450; 8; Ws (*Abies nordmanniana*); 19.08.1999; TAA 175278.

KUEHNEROMYCES MUTABILIS (Schaeff.: Fr.) Kühner & A.H. Sm. - Baduk; 1600; 1; Ws; 27.08.1999.

PHOLIOTA JAHNII Tjall. & Bas (*Ph. adiposa* ss. Lange) - Malaya Khatipara; 1500; 3; Ws; August to September; 1.

PH. ALNICOLA (Fr.) Singer - Dombai, Ullu-Murudzhu; 1600-2000; 5, 6; Ws (*Abies nordmanniana*, *Betula litwinowii*); 2; TAA 175109, TAA 175155.

PH. AURIVELLUS (Batsch: Fr.) P. Kumm. - Malaya Khatipara; 1400-1600; 2, 8; Ws (*Abies nordmanniana*); August to September; 2.

PH. FLAMMANS (Batsch: Fr.) P. Kumm. - Malaya Khatipara; 1500; 2; Ws; August; 2.

PH. HETEROCLITA (Fr.: Fr.) Quél. - Ullu-Murudzhu; 1600; 5; Ws (*Betula pendula*); 23.08.1999; TAA 175112.

PH. cf. GUMMOSA (Lasch) Singer - Teberda; 1300; 9; Ws; 27.08.1999; TAA 175226.

PH. LENTA (Pers.: Fr.) Singer - Baduk, Dombai, Ullu-Murudzhu; 1400-2000; 1, 6; Ws; August to September; 4.

PH. LIMONELLA (Peck) Singer - Teberda; 1300; 9; Ws (*Fagus orientalis*); 27.08.1999; TAA 175227.

PH. LUBRICA (Pers.: Fr.) Singer - Malaya Khatipara; 1650; 2; Ws; August to September; 1.

PH. SQUARROSA (Weigel: Fr.) P. Kumm. - Malaya Khatipara; 1900; 11; Ws (*Pinus sylvestris*); August to September; 2.

PH. SQUARROSOIDES (Peck.) Sacc. (*Ph. ohropallida* (Romagn.) M.M. Moser) - Teberda; 1250; 9; Ws; 18.08.1999; TAA 175279.

PSILOCYBE MONTANA (Pers.: Fr.) P. Kumm. - Malaya Khatipara; 2850; 13; Ms; 22.08. 1999; TAA 175280.

P. MUSCORUM P.D. Orton - Malaya Khatipara; 2850; 13; Ms (*Polytrichum* sp.); 22.08.1999; TAA 175281.

STROPHARIA AERUGINOSA (Curtis: Fr.) Quél. - Dombai, Ullu-Murudzhu; 1600-2000; 1; Fls; August; 2.

S. CORONILLA (Bull.: Fr.) Quél. - Malaya Khatipara; 2700; 13; Hs; September; 1.

S. SEMIGLOBATA (Batsch: Fr.) Quél. - Teberda; 1350; 9; C; 27.08.1999; TAA 175225.

Tricholomataceae

ARMILLARIA GALLICA Marxm. & Romagn. - Malaya Khatipara; 1600; 6; Ws; September; 2.

A. MELLEA (Vahl: Fr.) P. Kumm. - Baduk, Malaya Khatipara, Teberda; 1250-1800; 1, 6, 9; Ws; September; 5; TAA 175203.

A. TABESCENS (Scop.) Emel - Malaya Khatipara; 1400; 7; Ws; September; 1.

CALOCYBE GAMBOSA (Fr.) Singer ex Donk - Malaya Khatipara; 2500; 10; Hs; May to June; 5.

C. IONIDES (Bull.: Fr.) Kühner ex Donk - Malaya Khatipara; 1600-1800; 6; Fls; August; 2.

CLITOCYBE CANDICANS (Pers.: Fr.) P. Kumm. - Malaya Khatipara, Ullu-Murudzhu; 2000-2500; 6, 19; Fls; August to September; 2; TAA 175126.

C. CLAVIPES (Pers.: Fr.) P. Kumm. - Ullu-Murudzhu; 2000; 6; Fls; August; 1.

C. ERICETORUM Quél. - Malaya Khatipara; 2700-2750; 10, 14; Hs; September; 1.

C. FRAGRANS (With.: Fr.) P. Kumm. (*C. suaveolens* (Schumach.: Fr.) P. Kumm.) - Baduk,

Malaya Khatipara, Ullu-Murudzhu; 1, 6; Fls; August; 4.

C. GEOTROPA (Bull.: Fr.) Quél. - Malaya Khatipara; 1600; 8; Fls; September; 2.

C. GIBBA (Pers.: Fr.) P. Kumm. - Baduk, Dombai, Shumka, Ullu-Murudzhu; 1, 2, 9; Fls; August; 6; TAA 175050, TAA 175142, TAA 175282.

C. MAXIMA (P. Gaertn., G. Mey. & Scherb.: Fr.) P. Kumm. - Ullu-Murudzhu; 2000; 6; Fls; 25.08.1999; TAA 175127.

C. ODORA (Bull.: Fr.) P. Kumm. - Baduk, Malaya Khatipara; 1650-2000; 1, 6; Fls; August; 2.

C. SQUAMULOSOIDES P.D. Orton - Malaya Khatipara; 2800; 10; Fls; August to September; 2.

CLITOCYBULA LACERATA (Lasch) Métrod - Baduk, Malaya Khatipara; 1600; 1; Ws (*Abies nordmanniana*); August; 3; TAA 175077, TAA 175204, TAA 175289.

COLLYBIA CIRRHATA (I. H. Shum.) P. Kumm.(*C. amanitae* (Batsch) Kreisel) - Ullu-Murudzhu; 1400-1600; 1; Fs; 24.08.1999.

C. COOKEI (Bres.) J. D. Arnold - Baduk, Ullu-Murudzhu; 1500-2000; 1, 6; Fs; August; 2.

C. TUBEROSA (Bull.: Fr.) P. Kumm. - Malaya Khatipara; 2600; 6; Fs; 20.08.1999.

CYSTODERMA AMBROSII (Bres.) Singer - Malaya Khatipara; 2700-2750; 13; Fls; August to September; 2.

C. AMIANTHINUM (Scop.) Fayod - Baduk; 1600; 1; Fls; August; 1; TAA 175181.

C. CARCHARIAS (Pers.) Fayod - Baduk, Malaya Khatipara; 1400; 1, 5; Fls; August; 3; TAA 175063, TAA 175194, TAA 175223.

C. FALLAX Smith & Singer - Shumka; 1350; 3; Fls; August; 2.

C. GRANULOSUM (Batsch: Fr.) Fayod - Baduk, Malaya Khatipara; 1600-2500; 1, 10, 13; Fls; August to September; 1; TAA 175189.

C. TERREI (Berk. & Broome) Harmaja - Baduk; 1600; 1; Fls; 27.08.1999; TAA 175189.

GYMNOPUS CONFLUENS (Pers.: Fr.) Antonín, Halling & Noordel. (*Collybia confluens* (Pers.: Fr.) P.Kumm.) - Baduk, Dombai, Shumka, Malaya Hatipar; 1300-2000; 1, 2, 6, 9; Fls; August; 5; TAA 175182.

G. DRYOPHILUS (Bull.: Fr.) Murrill (*Collybia dryophila* (Bull.: Fr.) P. Kumm.) - Malaya Khatipara, Shumka, Ullu-Murudzhu; 1300-2500; 1, 6, 9; Fls; August; 5.

G. FUSCOPURPUREUS (Pers.: Fr.) Antonín, Halling & Noordel. (*Collybia obscura* Favre) - Shumka; 1350; 9; Fls; 25.08.1999; TAA 175159.

G. HARIOLORUM (Bull.: Fr.) Antonín, Halling & Noordel. - Shumka, Ullu-Murudzhu; 1350-1800; 1, 9; Fls; 3; TAA 175130, TAA 175163, TAA 175178.

LACCARIA AMETHYSTEA (Bull.) Murrill - Baduk; 1600; 1; Mr; 27.08.1999; TAA 175200.

L. BICOLOR (Maire) P.D. Orton. - Malaya Khatipara; 1450; 7; Mr; 19.08.1999; TAA 175283.

L. LACCATA (Scop.: Fr.) Berk & Broome - Baduk, Dombai, Malaya Khatipara, Ullu-Murudzhu; 1250-2750; Mr; 1, 6; TAA 175067, TAA 175070, TAA 175079, TAA175141.

L. MONTANA Singer - Malaya Khatipara; 2850; 18; Mr; August; 2.

L. PUMILA Fayod (*L. altaica* Singer) - Malaya Khatipara; 2850; 18; Mr; 22.08.1999; TAA 175284.

L. TORTILIS (Bolton) Cooke - Malaya Khatipara; 2750; 18; Mr; August to September; 1.

LEPISTA GILVA (Pers.: Fr.) Roze - Dombai; 1600-2000; 1, 6; Fls; August; 2.

L. SORDIDA (Schumach.: Pers.) Singer - Mukhu; 2700; 17; Hs; September; 1.

LEUCOPAXILLUS GIGANTEUS (Sibth.: Fr.) Singer - Malaya Khatipara; 1600; 8; Fls; September; 1.

LYOPHYLLUM CESSANS (P. Karst.) Singer - Baduk; 1600; 3; Fls; 27.08.1999; TAA 175206.

L. CONNATUM (Schumach.: Fr.) Singer - Teberda; 1250; 9; Fls; 28.08.1999.

L. KONRADIANUM (Maire) Konrad & Maubl. (*L. fragile* Jul. Schäff.) - Ullu-Murudzhu; 2000; 6; Fls; 24.08.1999; TAA 175122, TAA 175123.

MARASMIUS ALLIACEUS (Jacq.: Fr.) Fr. - Baduk, Dombai, Teberda, Shumka; 1250-1700; 1, 2, 9; Fds; August to September; 6; TAA 175170.

M. ANDROSACEUS (L.: Fr.) Fr. - Baduk, Teberda, Malaya Khatipara, Shumka, Ullu-Murudzhu;1250-2000; 1, 2, 6, 8; Fds; July to September; 6.

M. BULLIARDII Quél. - Dombai, Malaya Khatipara; 2000-2150; 6, 8; Fds; August-September; 3; TAA 175151.

M. COHAERENS (Pers.: Fr) Cooke & Quél. - Malaya Khatipara; 1250; 9; Fds; 29.08.1999.

M. LUPULETORUM (Weinm.) Bres. - Malaya Khatipara; 2750; 19; Ws; September; 2.

M. OREADES (Bolton: Fr.) Fr. - Malaya Khatipara; 2500; 13; Hs; September; 2.

M. QUERCEUS Britzelm. (*M. prasiosmus* ss. auct. pl.) - Shumka, Teberda; 1250-1300; 9; Fds; August; 2; TAA 175173.

M. ROTULA (Scop.: Fr.) Fr. - Malaya Khatipara, Ullu-Murudzhu; 1400-2200; 2, 6, 9; Ws; August to September; 4.

M. SCORODONIUS (Fr.: Fr.) Fr. - Malaya Khatipara, Ullu-Murudzhu; 1600-2000; 6, 8; Fds; June to September; 3.

M. SICCUS (Schwein.) Fr. - Baduk; 2000; 6; Fds; 27.08.1999; TAA 175210.

M. EPIPHYLLUS (Pers.: Fr.) Fr. - Shumka; 1300; 9; Fds (*Populus tremula*); 25.08.1999; TAA 175158.

MARASMIELLUS RAMEALIS (Bull.: Fr.) Singer - Baduk; 2000; 6; Ws (*Lonicera* sp.); 27.08.1999; TAA 175211.

MICROMPHALE PERFORANS (Hoffm.: Fr.) Gray - Baduk, Malaya Khatipara, Shumka, Ullu-Murudzhu; 1600; Fds (*Abies nordmanniana, Picea orientalis*); August; 5.

MYCENA CROCATA (Schrad.: Fr.) P. Kumm. - Baduk, Dombai, Malaya Khatipara, Ullu-Murudzhu; 1300-2000; 1, 6, 9; Fds; August; 4.

M. EPIPTERYGIA (Scop.: Fr.) Gray var. *epipterygia* - Dombai, Malaya Khatipara; 1600-2000; 1, 6; Fds; August; 2.

M. EPIPTERYGIA var. VISCOSA (Maire) Ricken - Baduk, Dombai, Malaya Khatipara, Ullu-Murudzhu; 1400-1600; 1; Ws; August; 4.

M. GALERICULATA (Scop.: Fr.) Gray - Baduk, Malaya Khatipara, Ullu-Murudzhu, Teberda; 1250-2600; 1, 2, 6, 9; Ws; August; 5; TAA 175179.

M. LUTEOALCALINA Singer - Baduk, Teberda; 1300; 9; August; 2; TAA 175202.

M. METATA (Fr.) P. Kumm. - Baduk; 2000; 6; Fds; 27.08.1999; TAA 175 217.

M. NIVEIPES (Murrill) Murrill - Teberda; 1300; 9; Ws; 27.08.1999.

M. PELIANTHINA (Fr.) Quél. - Baduk; 2000; 6; Fds; 27.08.1999; TAA 175216.

M. PURA (Pers.: Fr.) P. Kumm. - Baduk, Dombai, Malaya Khatipara, Ullu-Murudzhu, Shumka, Teberda; 1250-2700; 1, 2, 6, 9, 15, 16; Fds, Hbs; July to September; 6.

M. ROSEA (Bull.) Gramberg - Dombai, Malaya Khatipara; 1600-1800; 1, 8; Fds; 2.

M. PTERIGENA (Fr.: Fr.) P. Kumm. - Malaya Khatipara; 1650; 2; Hbs; 3.09.1999.

M. MACULATA P. Karst. - Malaya Khatipara; 2000; 11; Ws; September; 2.

M. SANGUINOLENTA (Alb. & Schwein.: Fr.) P. Kumm. - Baduk; 1600; 1; Fds; 27.08.1999.

M. ZEPHYRA (Fr.: Fr.) P. Kumm. - Ullu-Murudzhu; 1600; 1; Fds; August; 2; TAA 175134.

MEGACOLLYBIA PLATYPHYLLA (Pers.: Fr.) Kotl. & Pouzar - Malaya Khatipara, Ullu-Murudzhu; 1250-1600; 1, 4, 8, 9; Ws; August to September; 4.

OMPHALINA EPICHYSIUM (Pers.: Fr.) Quél. - Malaya Khatipara; 1500; 2; Ws (*Abies nordmanniana*); July; 1.

O. GRISEOPALLIDUM (Desm.) Quél. - Malaya Khatipara; 2650; 13; Hs; September; 1.

O. RUSTICA (Fr.) Quél. - Malaya Khatipara; 2750; 13; Hs; September; 1.

OUDEMANSIELLA MUCIDA (Schrad.: Fr.) Höhn. - Malaya Khatipara, Shumka; 1250-1600; 2, 8; Ws; August; 3.

PANELLUS MITIS (Pers.: Fr.) Singer - Dombai; 1600; 1; Ws (*Picea orientalis*); 25.08.1999.

P. RINGENS (Fr.) Romagn. - Dombai; 1600; 1; Ws (*Picea orientalis*); 25.08.1999.

P. STYPTICUS (Bull.: Fr.) P. Karst. - Malaya Khatipara;1300; 9; Ws; 29.08.99.

RHODOCOLLYBIA BUTYRACEA (Bull.: Fr.) Lennox f. *asema* (Fr.: Fr.) Antonín, Halling & Noordel. - Ullu-Murudzhu; 2000; 6; Fls; 24.08.1999; TAA 175116.

R. MACULATA (Alb. & Schwein.: Fr.) Singer (*C. maculata* (Alb. & Schwein.) P. Kumm.) - Malaya Khatipara; 1400; 5; Fls; 3.

STROBILURUS STEPHANOCYSTIS (Kühner & Romagn. ex Hora) Singer - Ullu Murudzhu; 2000; 6; Fds (*Pinus sylvestris*); 24.08.99; TAA 175120.

S. TENACELLUS (Pers.: Fr.) Singer - Malaya Khatipara; 1470-2000; 5, 11; Fds (*Pinus sylvestris*); 3.

TRICHOLOMA BUFONIUM (Pers.: Fr.) Gillet - Dombai; 1800; 1; Mr (*Abies nordmanniana*); 25.08. 1999; TAA 175146.

T. SAPONACEUM (Fr.) P. Kumm. - Baduk; 1600; 1; Mr; 25.08. 1999.

T. SEJUNCTUM (Sow.: Fr.) Quél. - Malaya Khatipara; 1600; 8; Mr; September; 1.

T. STIPAROPHYLLUM (S. Lundell) P. Karst. (*T. pseudoalbum* Bon) - Malaya Khatipara, Ullu-Murudzhu, Shumka; 1250-2000; 1,

6, 9; Mr (*Betula litwinowii, B. pendula*); 4; TAA 175 062.

T. VIRGATUM (Fr.: Fr.) P. Kumm. f. ROSEIPES Bon - Baduk; 1600; 1; Mr (*Abies nordmanniana*); 27.08. 1999; TAA 175184, TAA 175195.

TRICHOLOMOPSIS DECORA (Fr.) Singer - Baduk, Ullu-Murudzhu; 1400-1600; 1; Ws; August; 3; TAA 175083.

T. ORNATA (Fr.) Singer - Baduk; 1600; 1; Mr; 28.08. 1999; TAA 175199.

T. RUTILANS (Schaeff.: Fr.) Singer - Baduk, Malaya Khatipara, Ullu-Murudzhu; 1400-1650; 1, 5, 6; Ws; August; 4.

XEROMPHALINA CAMPANELLA (Batsch: Fr.) Kühner & Maire - Oriuchat, Baduk, Dombai, Khadzhibey, Malaya Khatipara, Ullu-Murudzhu, Teberda; 1250-2000; 1, 2, 3, 5, 7, 9; Ws; May to September; 6.

X. FELLEA Maire & Malençon - Malaya Khatipara, Ullu-Murudzhu; 1800-2000; 1, 6, 11; Fds; July to August; 4; TAA 175117, TAA 175129.

XERULA RADICATA (Relhan: Fr.) Dörfelt - Baduk, Dombai, Shumka; 1250-1600; 1, 2, 9; Ws; August; 4; TAA 175285.

RUSSULALES

Russulaceae

LACTARIUS AURANTIACUS (Pers.: Fr.) Gray (*L. mitissimus* (Fr.: Fr.) Fr.) - Baduk, Dombai, Malaya Khatipara, Ullu-Murudzhu; 1400-2400; 1, 5, 6; Mr; August to September; 5; TAA 175119.

L. AZONITES (Bull.) Fr. - Baduk, Malaya Khatipara; 1400; 7; Mr (*Quercus* sp.); September; 1.

L. BLENNIUS (Fr.: Fr.) Fr. - Baduk, Malaya Khatipara, Ullu-Murudzhu; 1250-2000; 2, 3, 6, 8; Mr (*Fagus orientalis*); July to September; 4; TAA 175222.

L. DELICIOSUS (L.: Fr.) Gray - Baduk, Malaya Khatipara, Ullu-Murudzhu; 1400-2200; 1, 5, 7, 11; Mr (*Pinus sylvestris*); August to September; 4.

L. DETERRIMUS Gröger - Baduk, Dombai, Malaya Khatipara, Ullu-Murudzhu, Shumka; 1400-1800; 1, 2, 3, 5, 9; Mr (*Picea orientalis*); August to September; 6.

L. GLYCIOSMUS (Fr.: Fr.) Fr. - Baduk, Ullu-Murudzhu; 1400-2000; 1, 6; Mr; August; 2.

L. OBSCURATUS (Lasch) Fr. - Teberda; 1350; 12; Mr (*Alnus incana*); May; 2.

L. PALLIDUS Pers.: Fr. - Shumka; 1600; 9; Mr (*Fagus orientalis*); 25.08.1999.

L. PIPERATUS (L.: Fr.) Gray - Malaya Khatipara; 1450-1800; 2, 5; Mr; August to September; 2.

L. PLUMBEUS (Bull.: Fr.) Gray (*L. necator* (Bull.: Fr.) P. Karst.) - Malaya Khatipara, Ullu-Murudzhu; 1300-1650; 1, 2, 3; Mr; August to September; 2.

L. PSEUDOUVIDUS Kühner - Malaya Khatipara; 2870; 18; Mr (*Salix kazbekensis*); 20.08.1999; TAA 175286.

L. RUFUS (Scop.: Fr.) Fr. - Malaya Khatipara; 1450-1650; 2, 3; Mr; July to September; 2.

L. SCROBICULATUS (Scop.: Fr.) Fr. - Dombai, Malaya Khatipara, Ullu-Murudzhu; 1400-1650; 1; Mr; August to September; 4.

L. REPRAESENTANEUS Britzelm. - Baduk; 1650; 1; Mr; 27.08.1999.

L. SPINOSULUS Quél. - Dombai, Malaya Khatipara, Ullu-Murudzhu; 1250-2000; 6, 9; Mr (*Betula litwinowii, B. pendula*); July to August; 4; TAA 175156.

L. TORMINOSUS (Schaeff.: Fr.) Gray - Dombai, Ullu-Murudzhu; 2000; 6; Mr (*Betula litwinowii*); 2.

L. TRIVIALIS (Fr.: Fr.) Fr. - Baduk, Ullu-Murudzhu; 1400-1650; 1; Mr; August; 2.

L. UTILIS (Weinm.) Fr. - Ullu-Murudzhu; 1650; 1; Mr; August; 2.

L. VELLEREUS (Fr.: Fr.) Fr. - Baduk, Malaya Khatipara; 1400-1600; 4, 7, 8; Mr; August to September; 3.

L. VIETUS (Fr.: Fr.) Fr. - Ullu-Murudzhu; 2000; 6; Mr (*Betula litwinowii*); 23.08.1999.

L. VOLEMUS (Fr.: Fr.) Fr. - Malaya Khatipara; 1600; 3; Mr; September; 2.

RUSSULA ACRIFOLIA Romagn. - Malaya Khatipara; 5; 2400; Mr (*Pinus sylvestris*); August; 2.

R. AQUOSA Leclair - Baduk, Malaya Khatipara; 1600; 1, 3; Mr; August to September; 2.

R. CHLOROIDES Krombh. - Shumka; 1600; 1; Mr; 25.08.1999.

R. DELICA Fr. - Malaya Khatipara; 1600-2200; 1, 8, 11; Mr; August to September; 3.

R. ELAEODES (Bres.) Bon - Baduk; 1600; 1; Mr; 27.08. 1999; TAA 175287.

R. EMETICA (Schaeff.: Fr.) Pers. - Malaya Khatipara; 1600; 3; Mr; August; 1.

R. FOETENS (Pers.: Fr.) Fr. - Dombai, Malaya Khatipara; 1300-2000; 2, 3, 6; Mr; August to September; 3.

R. GRACILLIMA (Schaeff.: Fr.) Pers. (*R. gracilis* Burl.) - Malaya Khatipara, Ullu-Murudzhu; 2000; 6; Mr (*Betula litwinowii*); 2; TAA 175288.

R. NANA Britzelm. (*R. alpina* (A. Blytt) F.H. Møller & Jul. Schäff.) - Malaya Khatipara; 2850; 18; Mr (*Salix kazbekensis*); 3.

R. NIGRICANS Fr. - Malaya Khatipara, Ullu-Murudzhu; 1200-1800; 1, 8; Mr; August to September; 2.

R. OCHROLEUCA (Pers.) Fr. - Malaya Khatipara; 2600; 1; Mr; 22.08.1999.

R. RISIGALLINA (Batsch) Sacc. (*R. lutea* Huds.: Fr.) Gray) - Ullu-Murudzhu; 2000; 6; Mr (*Betula litwinowii*); 24.08.1999.

R. XERAMPELINA (Schaeff.) Fr. (*R. erythropus* Pelt.) - Baduk, Dombai, Malaya Khatipara, Ullu Murudzhu; 1300-2200; 1, 3, 7, 11; August to September; 4.

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REFERENCES

Antonín, V. & Noordeloos, M.E. 1997. A monograph of *Marasmius, Collybia* and related genera in Europe. Part. 2. *Libri Botanici* 17: 1-256.

Hansen, L. & Knudsen, H. (eds.). 1992. *Nordic macromycetes 2. Polyporales, Boletales, Agaricales, Russulales*. Copenhagen. 474 pp.

Kalamees, K. 1980. Trophic groups of Estonian agarics. *Scripta Mycol.* 9: 71-98. Tartu.

Kovalenko, A.E. 1989. *Ordo Hygrophorales*. *Definitorium fungorum URSS*. Leningrad. 176 pp.

Polivanova, N.N. (ed.). 1986. *Zapovednaya Teberda* (In Russian). Stavropol. 174 pp.

Vaasma, M., Kalamees, K. & Raitviir, A. 1986. Macrofungi of the Caucasian State Nature Reserve. *Scripta Mycol.* 13: 1-106. Tartu.

Vladychenskij, A.S. & Grishina, L.A. 1986. Soils of the Teberda Reserve (in Russian). In *Dinamika, struktura pochv i sovremennye pochvennye protsessy* (ed. Grishina, L.A.), pp. 65-87. Moscow.

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Species composition and dynamics of sporocarp production of macrofungi in pine forests with *Vaccinium myrtillus* in northern Latvia

Inguna Krastina
University of Latvia, Institute of Biology, 3 Miera iela, LV-2169 Salaspils, Latvia.
E-mail: inguna_krastina@hotmail.com

Abstract: A species composition and dynamics of sporocarp production of macrofungi was studied in three pine forest stands of northern Latvia, where *Vaccinium myrtillus* was the dominating shrub. The sporocarps were counted every second week during the mushroom season (August–October) of 1993–1997.

A total of 92 species were found. The genus *Cortinarius* was the predominating genus comprising to 69% of total sporocarp biomass. *Lactarius rufus, Leccinum scabrum, Paxillus involutus, Rozites caperatus, Russula decolorans, R. paludosa, Suillus bovinus* and *S. variegatus* were other productive mycorrhizal species. The most frequent saprotrophs were *Cystoderma amianthinum, Galerina spp., Marasmius androsaceus, Mycena filopes* and *M. galopus*. High year to year variation in the composition of species and sporocarp production was found. In pine forests with *Vaccinium myrtillus* mycorrhizal fungi composed 40–53% of total number of species, 30–73% of total number of sporocarps and 90–99% of total biomass.

Kokkuvõte: I. Krastina. Lehikseente liigiline koosseis ja viljakehade produktsiooni dünaamika Põhja-Läti mustikamännikutes.

Lehikseente liigilist koosseisu ja viljakehade produktsiooni dünaamikat uuriti kolmes Põhja-Läti mustikamännikus. Viljakehad koguti üle nädala augustist oktoobrini 1993–1997. Kokku leiti 92 liiki lehikseeni, 69% biomassist moodustasid perekonna vöödik liigid. Liigiline koosseis ja produktsioon varieerus uuritavatel aastatel tugevalt. Mükoriisamoodustajatest olid produktiivsemad männiriisikas, kasepuravik, tavavahelik, kitsemampel, tuhmuv pilvik, soopilvik, lehmatatik ja liivtatik. Sagedasemad saprobiondid olid kollane pisisirmik, perekond tanuki liigid, jõhvnööbik, jõhvmütsik, piimmütsik. Mustikamännikutes on mükoriisamoodustajaid lehikseeni 40–53% liikidest, 30–73% viljakehadest ja 90–99% biomassist.

INTRODUCTION

The results of the present study are based on the five years of fieldwork on sporocarp production of macrofungi in pine forests with *Vaccinium myrtillus* in the ground cover. Survey on fungi was performed as a part of wider an integrated biomonitoring program which included several ecologically important groups of organisms – fungi, vegetation, insects, soil fauna and vertebrates. This study started in 1993 and it is continuing at present. Pine forests for monitoring purposes were selected, because pine is an important forest tree in Latvia (40.2% of the total forest area), and it is very sensitive to environmental changes.

The monitoring of macrofungal communities has been based mainly on sporocarp surveys, because identification of species usually depends on the presence of reproductive structures. Sporocarp survey has a lot of advantages: most of sporocarps can be identified to species; extensive areas can be continuously monitored over a number of years and less-frequent species can be recorded. Such surveys can provide valuable information about seasonal and annual dynamics in sporocarp production. Unfortunately as regards ectomycorrhizal (EM) fungi, sporocarp production has been found to reflect the EM community in soil poorly (Danielson, 1984; Visser, 1995; Gardes & Bruns, 1996; Kårén & Nylund, 1996; Dahlberg et al., 1997).

Mycosociological studies are recommended to be extended over at least 3–5 years to encompass species, which do not fruit every year (Cooke, 1948, 1953; Barkman, 1987; Arnolds, 1981). The recommended size of sample plots in forest ecosystems is ± 1000 m^2 (Kalamees, 1968; Winterhoff, 1984; Barkman, 1987; Arnolds, 1992). Biomass of sporocarps and their frequency of appearance in plots are often preferred to comparisons of the sporocarp numbers (Hering, 1966; Richardson, 1970; Arnolds, 1981).

Several sporocarp surveys of fungi in coniferous forests of northern Europe were performed during last decades (Kalamees, 1975;

Kalamees & Silver, 1988, 1993; Ohenoja & Koistinen, 1984; Mehus, 1986; Brandrud, 1987; Hintikka, 1988; Salonen & Saari, 1990; Dahlberg, 1991; Gulden et al., 1992; Salo, 1993; Väre et al., 1996). In Latvia, no such investigations have been published yet.

The aim of the present study was to characterise macrofungal biota in pine forests with *Vaccinium myrtillus* vegetation: composition of species, seasonal and annual dynamics of sporocarp production.

MATERIAL AND METHODS

Sampling sites

Sampling of sporocarps was carried out during 1993–1997 in three *Pinus sylvestris* stands of secondary succession belonging to different age classes. Characterisation of the forest stands is given in Tab. 1. Sample sites were situated near Mazsalaca within the territory of the Northern Vidzeme Biosphere Reserve, in northern Latvia (Fig. 1.). All selected stands were on typical moderate sandy podsolic soils. The organic horizons were composed of 3–12 cm thick raw humus (moor); pH of soil was 2.7–3.2.

Fig. 1. Location of study sites (a black square) in the territory of Northern Vidzeme Biosphere Reserve.

Sampling

At each of the three forest sites, 25 permanent subplots, each of 2 × 20 m, were established with a total area of 1000 m^2. The subplots were permanently marked with bars of pinewood.

During 1993–1997, the sites were visited at intervals of 2 weeks from August to middle October (main season of sporocarp production); 6 visits were made in 1993, 5 visits in 1994–1996, and 4 visits in 1997.

At each visit, all sporocarps of agarics and boletes were counted, picked and left on the ground, in order to avoid double counting at next visit. Specimens not identified in the field were brought to laboratory for identification.

Only agarics and boletes (*Polyporales*, *Agaricales*, *Boletales* and *Russulales*) were considered. The nomenclature mainly followed Hansen & Knudsen (1992).

Each species was assigned to one of three functional groups, i.e. mycorrhizal fungi, lignicolous or terricolous saprotrophs, based on a review of literature (Urbonas et al., 1986; Salo, 1993; Väre et al., 1996). Such subdivision was considered to be proper because fungi belonging to different functional groups may react upon environmental factors differently.

Weather data were obtained from Rujiena's meteostation situated 20 km from sampling sites.

Analysis of data

The numbers of the sporocarps were converted into dry weight biomass for each species based on measurements from Ohenoja, Tuokkola and Pohjola (1993).

Sørensen's similarity index $K_s = 2c / a + b$, where **a** is the number of species in one plot, **b** is the number of species in other plot, and **c** is the number of species common to the two plots, has been calculated for each pair of plots for each of the years. Cluster analysis by using the unweighted pair group average method (MVSP package) has been performed.

Results

A total of 92 species were found in the plots during the 5-year study. Recorded species are listed in Tab. 2. In addition, several taxa remained identified at the genus level only (*Cortinarius*, *Galerina*, *Hebeloma*, etc.).

Total numbers of species found during five years were 75 at plot 1, 62 – at plot 2, and 71 – at plot 3. Annual numbers of recorded species ranged between 24 to 56 per plot, corresponding to 39–82% of all species found at each site during the period of observation (Tab. 3).

Table 1. Characteristics of the studied forest stands; * - spruce and birch is found in the sub-canopy

	Plot 1	Plot 2	Plot 3
Age of forest stand	40 - 50	60 - 80	150 - 200
Origin	Planted after clearcut	Possibly planted after clearcut	Possibly planted, on dryer parcels selfreproduction of pine takes place
Crown projection	0.67	0.64	0.73
Average height of pine (m)	13	31.5	35.0
Density of trees (No of trees/ha)			
Pinus sylvestris	1131	537	268
*Picea abies**	337	100	750
*Betula pendula**	56	25	44
Underwood	*Sorbus aucuparia* *Salix sp.*	*Juniperus communis* *Sorbus aucuparia* *Populus tremula*	*Juniperus communis* *Quercus robur*
Ground cover dominants	*Vaccinium myrtillus* *V. vitis-idaea* *Melampyrum pratense* *Hylocomium splendens* *Pleurozium schreberi*	*Vaccinium myrtillus* *V. vitis-idaea* *Melampyrum pratense* *Maianthemum bifolium* *Hylocomium splendens* *Pleurozium schreberi* *Ptilium crista-castrensis*	*Vaccinium myrtillus* *V. vitis-idaea* *Melampyrum pratense* *Lerchenfeldia flexuosa* *Calluna vulgaris* *Hylocomium splendens* *Pleurozium schreberi* *Dicranum scoparium* *Cladonia spp.*

47 (51%) of the recorded species were common at all three plots. The numbers of species occurring in two plots and only in one plot were 22 and 23, respectively. The number of species found in 1, 2, 3, 4 or in all 5 years of the survey are shown in Tab. 4.

The most frequent macrofungi at all three sites, especially in plots 2 and 3, were several unidentified *Cortinarius* (subgen. *Telamonia*) species. The other frequent species were *Cortinarius croceus, C. semisanguineus, Cystoderma amianthinum, Galerina spp., Lactarius rufus, Marasmius androsaceus, Mycena filopes, M. galopus,* and *Suillus variegatus*.

Distribution of species by their contribution to the annual biomass of whole sporocarps of plots shows that nearly 90% of the species did not reach 5% of the total plots' biomass during 5 years. The predominant species in the study regarding sporocarp biomass were *Cortinarius spp.* comprising up to 64% of the total sporocarps' biomass. The other dominant species (contributing more than 5% of total biomass of sporocarps per plot) were: *Boletus pinophilus, Cortinarius croceus, C. semisanguineus, Hypholoma capnoides, Lactarius rufus, Leccinum scabrum, Paxillus involutus, Rozites caperatus, Russula decolorans, R. paludosa, Suillus bovinus* and *S. variegatus*. The composition and ranking of the dominant species altered among plots and years (Tab. 5).

Obtained results show that the annual number of species and productivity (both numbers of sporocarps and biomass) considerably varied from year to year (Tab. 3). The most productive year in every respect was 1994, when the highest number of species, the highest number of sporocarps and the highest biomass

Table 2. Fungal species found in 1993–1997; numbers 0–5 indicate in how many years the species was found

Functional groups/ Species	Site 1	Site 2	Site 3
Mycorrhizal fungi			
1. *Amanita citrina* (Schaeff.) Pers..	0	4	3
2. *A. fulva* (Schaeff.) Pers..	0	3	3
3. *A. porphyria* (Alb. & Scchw.: Fr.) Mladz	3	2	3
4. *A. rubescens* (Pers.: Fr.) S. F. Gray	1	2	2
5. *A. virosa* (Fr.) Bertilloni	0	1	0
6. *Boletus badius* (Fr.) Fr..	1	2	2
7. *B. edulis* Bull.: Fr.	1	0	1
8. *B. pinophilus* Pilát & Dermek	0	0	5
9. *B. subtomentosus* L.: Fr.	4	2	0
10. *Cantharellus cibarius* Fr.	4	2	2
11. *Chroogomphus rutilus* (Schaeff.: Fr.) O. K. Miller	5	5	4
12. *Cortinarius croceus* (Schaeff.) Bigeard & Guilemin	5	4	4
13. *C. mucosus* (Bull.: Fr.) Kickx	0	3	2
14. *C. muscigenus* Peck	0	1	2
15. *C. sanguineus* (Wulf.: Fr.) Fr.	1	0	0
16. *C. semisanguineus* (Fr.) Gill.	5	5	5
17. *C. traganus* (Fr.: Fr.) Fr..	0	2	3
Cortinarius spp.	5	5	5
18. *Gomphidius roseus* (Fr.) Fr.	2	2	1
19. *Hygrophorus hypothejus* (Fr.: Fr.) Fr.	0	1	0
20. *H. olivaceoalbus* (Fr.: Fr.) Fr.	0	1	2
Hebeloma spp.	3	5	4
21. *Inocybe lanuginosa* (Bull.: Fr.) Kumm.	4	0	1
22. *Laccaria bicolor* (Maire) Orton	4	0	0
23. *L. laccata* (Scop.: Fr.) Berk. & Br.	5	1	1
24. *Lactarius helvus* (Fr.) Fr.	1	0	0
25. *L. necator* (J. F. Gmel.: Fr.) Pers.	1	2	3
26. *L. rufus* (Scop.: Fr.) Fr..	5	5	4
27. *L. torminosus* (Schaeff.: Fr.) Pers.	1	0	0
28. *L. vietus* (Fr.) Fr.	1	0	0
29. *Leccinum scabrum* (Bull.: Fr.) S. F. Gray	4	0	2
30. *L. versipelle* (Fr.) Snell	1	0	0
31. *P. involutus* (Batsch: Fr.) Fr..	4	2	3
32. *Rozites caperatus* (Pers.: Fr.) Karst.	1	4	4
33. *Russula consobrina* (Fr.: Fr.) Fr.	1	0	1
34. *R. decolorans* (Fr.) Fr.	4	4	5
35. *R. emetica* (Schaeff.: Fr.) Pers.	5	1	2
36. *R. fragilis* (Pers.: Fr.) Fr.	5	2	2
37. *R. paludosa* Britz.	5	4	5
Russula spp.	5	3	4

Table 2 (continued)

Functional groups/ Species	Site 1	Site 2	Site 3
38. *Suillus bovinus* (L.: Fr.) Roussel	4	3	2
39. *S. luteus* (L.: Fr.) Roussel	0	1	0
40. *S. variegatus* (Sw.: Fr.) O. Kuntze	5	5	5
41. *Tylopilus felleus* (Bull.: Fr.) P. Karst.	2	1	0
Terricolous saprotrophs			
42. *Baeospora myosura* (Fr.: Fr.) Sing.	4	4	4
43. *Cantharellula umbonata* (Gmel.: Fr.) Sing.	3	0	2
44. *Clitocybe candicans* (Pers.: Fr.) Kumm.	3	3	2
Clitocybe spp.	3	4	2
45. *Collybia butyracea* (Bull.: Fr.) Kumm.	1	0	1
46. *C. cirrata* (Pers.) Kumm.	5	5	5
47. *C. dryophila* (Bull.: Fr.) Kumm.	4	3	3
48. *C. maculata* (Alb. & Schw.: Fr.) Kumm.	1	0	1
49. *C. prolixa* (Fr.) Gill.	1	0	0
50. *C. putilla* (Fr.: Fr.) Sing.	1	0	0
51. *C. tuberosa* (Bull.: Fr.) Kumm.	3	1	4
Collybia spp.	0	2	1
Conocybe sp.	1	0	0
52. *Coprinus pellucidus* Karst.	0	1	0
Coprinus sp.	1	0	0
53. *Cystoderma amianthinum* (Scop.) Konr. & Maubl.	5	5	4
54. *C. carcharias* (Pers.) Konr. & Maubl.	0	0	1
55. *C. granulosum* (Batsch : Fr.) Kühn.	1	2	1
56. *Cortinarius vibratilis* (Fr.) Fr.	5	3	3
57. *Delicatula integrella* (Pers.) Konr. & Maubl.	1	2	1
Entoloma spp.	5	4	3
58. *Fayodia maura* (Fr.) Sing.	2	0	0
Galerina spp.	5	5	5
60. *Hygrophoropsis aurantiaca* (Wulf.: Fr.) Schroet	5	5	2
61. *Hypholoma polytrichi* (Fr.: Fr.) Sing.	5	5	2
Inocybe spp.	2	2	1
62. *Marasmius androsaceus* (L.: Fr.) Fr.	4	5	5
63. *Micromphale perforans* (Hoffm.: Fr.) S. F. Gray	0	3	5
64. *Mycena cinerella* Karst.	1	1	0
65. *M. clavicularis* (Fr.) Gill.	2	1	4
66. *M. epipterygia* (Scop.: Fr.) S. F. Gray	3	2	2
67. *M. filopes* (Bull.: Fr.) Kumm.	2	4	4
68. *M. galopus* (Pers.: Fr.) Kumm.	5	5	5
69. *M. rorida* (Fr.: Fr.) Quél.	1	2	2
70. *M. rosella* (Fr.) Kumm.	1	4	4
71. *M. rubromarginata* (Fr.: Fr.) Kumm.	1	0	0

Table 2 (continued)

Functional groups/ Species	Site 1	Site 2	Site 3
72. *M. sanguinolenta* (Alb. & Schw.: Fr.) Kumm.	5	4	5
73. *M. stipata* Maas G. & Schwöbel	5	3	1
74. *M. stylobates* (Pers.: Fr.) Kumm.	1	0	2
Mycena spp.	5	5	3
75. *Omphalina fibula* (Bull.: Fr.) Quél.	0	0	1
76. *O. setipes* (Fr.: Fr.) Quél.	0	0	1
Omphalina sp.	1	0	0
77. *Strobilurus stephanocystis* (Hora) Sing.	0	0	2
78. *Xeromphalia cornui* (Quél.) Favre	4	4	5
Lignicolous saprotrophs			
79. *Galerina marginata* (Batsch) Kühn.	1	0	1
80. *Gymnopilus penetrans* (Fr.) Murr.	4	1	2
81. *Hypholoma capnoides* (Fr.) Kumm.	5	3	2
82. *H. fasciculare* (Huds.: Fr.) Kumm.	3	1	1
83. *Mycena galericulata* (Scop.: Fr.) S. F. Gray	1	0	0
84. *M. purpureofusca* (Peck) Sacc.	1	1	0
85. *M. viridimarginata* Karst.	3	2	1
86. *Panellus mitis* (Pers.: Fr.) Sing.	4	1	1
87. *Paxillus atrotomentosus* (Batsch: Fr.) Fr.	2	0	2
88. *Pholiota flammans* (Batsch: Fr.) Kumm.	3	0	0
89. *Pluteus atriscapillus* (Batsch) Fayod	0	0	1
90. *Tricholomopsis decora* (Fr.) Sing.	2	0	0
91. *T. rutilans* (Schaeff.: Fr.) Sing.	5	1	3
92. *Xeromphalia campanella* (Batsch: Fr.) Kühn. & Maire	5	4	1

Table 3. Number of species, number of sporocarps and total biomass in all plots, 1993–1997

	1993	1994	1995	1996	1997
No. of species					
Plot 1	60	60	49	36	53
Plot 2	44	58	30	32	39
Plot 3	58	64	34	32	24
No. of sporocarps / ha					
Plot 1	23950	39060	13030	7830	39700
Plot 2	10610	54230	16290	17580	54820
Plot 3	27540	43850	17800	16620	-
Dry weight (kg / ha)					
Plot 1	10.9	13.9	4.5	5.6	3.6
Plot 2	4.3	21.9	3.4	5.3	5.6
Plot 3	11.6	23.7	2.9	6.4	-

were recorded. Another productive year in terms of sporocarp count was 1997. Though the recorded number of sporocarps in 1997 was almost equal with that of 1994, the total biomass of sporocarps was very low, because large quantities of small saprotrophic species of *Mycena* and *Galerina* occurred in late autumn, while the fruiting of mycorrhizal fungi was weak. 1995 and 1996 were considered as 'poor' years.

The year of maximum sporocarp production differed among species (Fig. 2). Many mycorrhizal species had their maximums in 1994 or 1993, e.g. in years, which were considered as normal in terms of moisture conditions. Succeeding two years were dry and overall productivity of fungi was low. An exception was some early summer species – *Russula decolorans*, *R. paludosa* and *Leccinum scabrum*. In 1997, several saprotrophic species, such as *Hypholoma capnoides*, *Hygrophoropsis aurantiaca*, *Galerina spp.*, *Mycena galopus* and *M. filopes*, had their maximums of sporocarp production.

It has been observed that different species had a different ability to increase their yield, when comparing the least productive year with the most productive year. Many species, even some with large and fleshy sporocarps, had a great capacity to increase their productivity. For example, in plot 3 the biomass of *Suillus variegatus* in 1994 was 10.2 kg (dry weight)/ha, while during the other years the biomass ranged between 0.3–1.2 kg/ha. Productivity of *Lactarius rufus* varied from 0.29–1.84 kg/ha, *Russula decolorans* from 0.1–1.85, *Cortinarius croceus* from 0.1–1.2 kg/ha. Less frequent species and species with small sporocarps varied even more in production of sporocarps.

Generally, contribution of species belonging to different functional groups was similar

Table 4. Number of species occurring in all 5 years of the study

No. of years	Plot 1	Plot 2	Plot 3
5	20	10	11
4	14	11	10
3	8	8	8
2	7	15	22
1	26	17	20

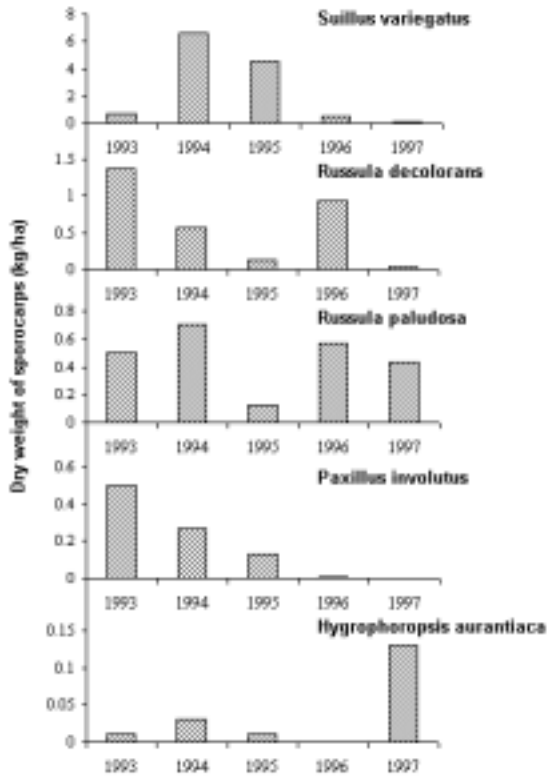

Fig. 2. Productivity of some macrofungi in different years.

at all stands and remained almost constant among years (Fig. 3). Only the year 1997 was exceptional, when the relative proportion of mycorrhizal fungi was lower than in previous years. If relative proportion of mycorrhizal species were 40–53% of the total number of species per plot during 1993–1996, then in 1997 it was only 28–33%. In all stands, the average dry weight biomass of mycorrhizal fungi contributed 90–97% of the total sporocarp biomass per year, whereas the average contribution of the number of EM sporocarps was lower – 41–57% of total.

Obtained results show that in the present study differences in mycobiota among plots were as remarkable as differences among years. The calculated K_s for composition of species were 0.39–0.80 within plots among years and 0.45–0.78 among plots within years. The K_s matrices are given in Tab. 6. The resulting dendrogram is given in Fig. 4. It is evident that composition of macrofungi species in 1997 was peculiar at all three stands. Similarity in

Table 5. Dominant species in all plots, 1993–1997; dw% – percentage biomass of total biomass

Site 1		Site 2		Site 3	
Year / Species	dw %	Year / Species	dw %	Year / Species	dw %
1993		1993		1993	
Lactarius rufus	16,8	*Cortinarius spp.*	32,4	*Cortinarius spp.*	23,7
Russula decolorans	15,4	*Russula decolorans*	14,0	*Russula decolorans*	16,0
Leccinum scabrum	12,8	*Suillus variegatus*	6,9	*Suillus variegatus*	10,6
Paxillus involutus	8,1	*Cortinarius croceus*	6,6	*Lactarius rufus*	9,3
Russula spp.	6,5	*Lactarius rufus*	5,6	*Russula paludosa*	5,4
Suillus variegatus	6,2	*Rozites caperatus*	5,3		
Russula paludosa	6,2				
Cortinarius spp.	5,9				
1994		1994		1994	
Suillus variegatus	31,8	*Cortinarius spp.*	43,1	*Suillus variegatus*	42,9
Cortinarius spp.	15,3	*Suillus variegatus*	24,1	*Cortinarius spp.*	24,6
Lactarius rufus	11,6	*Rozites caperatus*	10,7	*Lactarius rufus*	5,5
Russula paludosa	7,3	*Cortinarius croceus*	5,6		
Cortinarius croceus	5,5				
1995		1995		1995	
Suillus variegatus	18,4	*Cortinarius spp.*	48,2	*Cortinarius spp.*	41,2
Cortinarius spp.	17,8	*Cortinarius croceus*	11,5	*Boletus pinophilus*	8,9
Lactarius rufus	15,2	*Cortinarius semisanguineus*	10,2	*Suillus variegatus*	8,6
Paxillus involutus	7,5	*Suillus variegatus*	8,9	*Cortinarius semisanguineus*	*8,4*
Leccinum scabrum	5,1	*Suillus bovinus*	7,7	*Russula decolorans*	7,8
				Lactarius rufus	7,5
1996		1996		1996	
Russula decolorans	22,9	*Cortinarius spp.*	64,0	*Cortinarius spp.*	40,6
Russula paludosa	19,3	*Suillus variegatus*	11,3	*Rusula decolorans*	18,8
Cortinarius spp.	17,9	*Russula decolorans*	6,6	*Suillus variegatus*	12,3
Suillus variegatus	11,8			*Russula paludosa*	6,0
Lactarius rufus	10,3			*Lactarius rufus*	5,7
1997		1997		1997	
Cortinarius spp.	29,1	*Cortinarius spp.*	56,8	*Russula paludosa*	54,9
Russula paludosa	16,3	*Suillus bovinus*	9,0	*Boletus pinophilus*	25,9
Cortinarius semisanguineus	11,7	*Lactarius rufus*	6,6	*Russula decolorans*	9,6
Lactarius rufus	8,1	*Cortinarius semisanguineus*	5,0		
Hypholoma capnoides	6,2				

the composition of species was higher between plots 2 and 3 than between each of above-mentioned and plot 1. In the plot 1, the highest number of lignicolous species was recorded. The lowest contribution of *Cortinarius* species and higher productivity of such mycorrhizal species as *Lactarius rufus, Laccaria laccata, Paxillus involutus, Russula emetica,* and *Boletus subtomentosus* also were stated there. Several species occurred in the older stands only: *Amanita citrina, A. fulva, Cortinarius mucosus, C. muscigenus, C. traganus,* and *Rozites caperatus*. Collectively, species of *Cortinarius* very clearly favoured 68–80-year-old stand, but also occurred fairly abundantly in the oldest stand.

Table 6. K_s matrix based on species occurrence in plots 1, 2 and 3 during 1993–1997

	1/93	1/94	1/95	1/96	1/97	2/93	2/94	2/95	2/96	2/97	3/93	3/94	3/95	3/96	3/97
1/93	*														
1/94	.783	*													
1/95	.771	.804	*												
1/96	.667	.681	.771	*											
1/97	.637	.721	.700	.644	*										
2/93	.724	.680	.652	.658	.563	*									
2/94	.695	.724	.667	.587	.679	.752	*								
2/95	.511	.568	.597	.531	.593	.548	.628	*							
2/96	.505	.562	.538	.585	.561	.676	.644	.712	*						
2/97	.540	.592	.598	.541	.703	.578	.688	.647	.609	*					
3/93	.700	.661	.617	.574	.595	.738	.759	.545	.607	.571	*				
3/94	.710	.721	.667	.490	.661	.692	.783	.587	.602	.647	.738	*			
3/95	.511	.587	.617	.559	.588	.545	.578	.677	.703	.583	.565	.604	*		
3/96	.457	.489	.506	.515	.506	.560	.636	.600	.721	.600	.600	.596	.719	*	
3/97	.381	.415	.423	.414	.453	.418	.450	.538	.491	.581	.390	.488	.607	.630	*

DISCUSSION

Total numbers of species recorded in pine forests with *Vaccinium myrtillus* vegetation ranged from 62 to 75. These numbers were higher or equal to numbers of species recorded in other dry pine forest types of northern Latvia (Krastina, 1997). In general, the composition of species was similar to mycofloras observed in pine forests of Estonia, Finland and Norway (Kalamees, 1980; Ohenoja & Koistinen, 1984; Mehus, 1986; Hintikka, 1988; Salo, 1993; Väre et al., 1996).

It is difficult to compare our quantitative data with those of related investigations, because surveys have been performed in various forest types and different methods of studies have been applied. Nevertheless, some general similarities have been found.

We found that the production of sporocarps strongly varies from year to year within the same forest stand. In the present study the highest and lowest yields of sporocarps differed by factors 3.9, 6.4 and 8.2 in the plots 1, 2 and 3, respectively. Kalamees and Silver (1988, 1993) found that the production of edible fungi in the *Pinetum uliginosum* forest type in 1980–1981 differed by a factor of more than 20, but in the *P. myrtillosum*, *Cladonia* and *Calluna* forest types the difference were about 2–3-times. Other studies (Ohenoja & Koistinen, 1984; Mehus, 1986; Arnolds, 1988, 1991; Väre et al., 1996) also recorded high fluctuations in the sporocarp production. Some authors have expressed an opinion that a low sporocarp count, i.e., a 'poor year', is often followed the next year by a high count, a 'good year' (Guminska, 1962; Lange, 1978). However, other studies (Arnolds, 1988; Eveling et al.., 1990) neither found this nor did it occur in the present study. Weather conditions have been considered as the most important factor affecting the sporocarp production of macrofungi (Wilkins & Patric, 1940; Wilkins & Haris, 1946; Lange, 1978; Arnolds, 1988; Eveling et al., 1990; Ohenoja, 1993). Dahlberg (1991) found that 60–80% of the variation in sporocarps biomass of mycorrhizal fungi was attributable to weather conditions, whereas the biomass and growth of the host trees explained only 4%. Nevertheless the mechanisms responsible for differences in periodicity of sporocarp production are still insufficiently understood. Ohenoja (1993) have supposed that these differences are caused in by both genetic factors and environmental factors, such as weather conditions and availability of adequate sources for sufficient mycelial growth. The fact that the year of maximum sporocarp production differed among species partly can be explained by different phenology of species, i.e., that one growth season may be particulary favourable for some species but less so for the others.

The results show that only a few species (10%) occured as dominants regarding sporocarp biomass. Similar observations have been made by Kalamees (1975) in Estonian

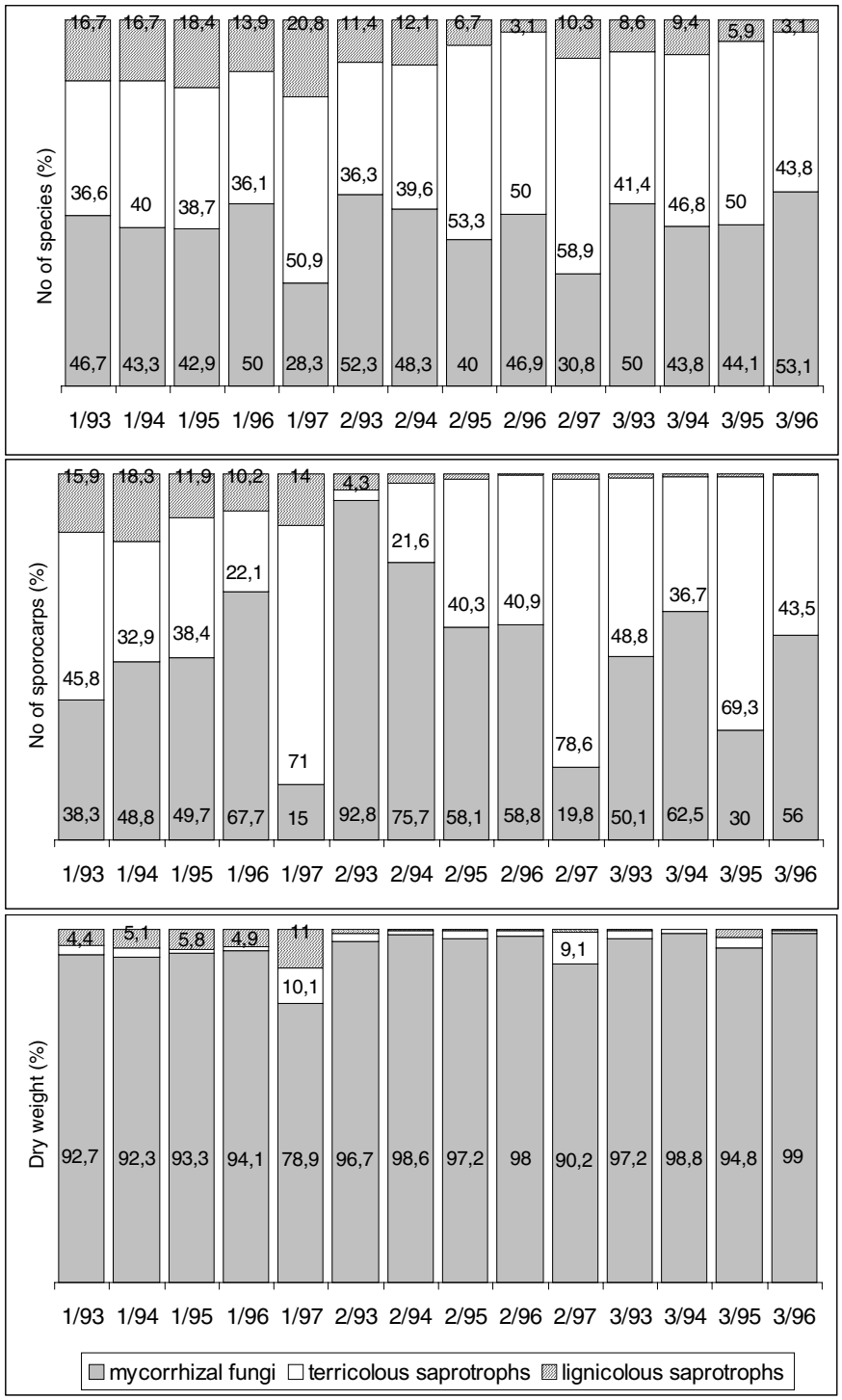

Fig. 3. Relative importance of functional groups at each stand in terms of number of species, number of sporocarps and biomass.

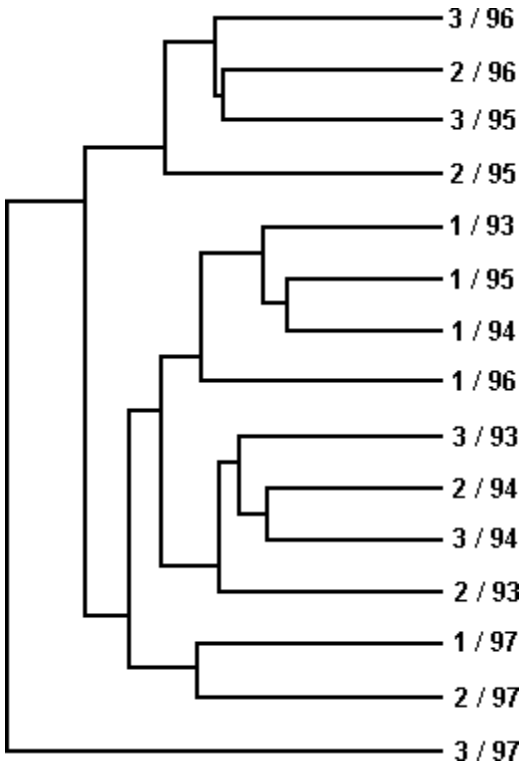

Fig. 4. Dendrogram showing the similarity in macrofungal biota.

spruce forests. The genus *Cortinarius* was predominant in the present study and seems to be often dominating in boreal coniferous forests, especially when Norway spruce is present (Brandrud, 1987; Salonen & Saari, 1990; Dahlberg, 1991). The other dominants, such as *Lactarius rufus, Leccinum scabrum, Rozites caperatus, Russula decolorans, R. paludosa, Paxillus involutus* and *Suillus variegatus* also have been noted as widespread and productive species of pine forests.

In the present study a fact has been ascertained that in pine forests with *Vaccinium myrtillus* mycorrhizal fungi normally compose 40–53% of total number of species, 30–73% of total number of sporocarps and 90–99% of total biomass. In dry oligotrophic pine forests of northern Latvia (*Cladinoso-callunosa* and *Vacciniosa* forest types), mycorrhizal fungi usually contribute 53–63% to the total number of species, decreasing in importance (38–48%) in richer forest types (Krastina, 1997). Gulden et al. (1992) found that in spruce forests of Norway and Germany the contribution of mycorrhizal fungi is 50–57%, 20–22% and 89–94% with regard to number of species, sporocarps and biomass, respectively.

Although some differences were found in the composition and productivity among the plots, our data too scanty to consider those were caused by differences in successional stages of stands. Plot 1 differed from the others by a large amount of woody debris, and this seems to be the main reason why more abundant and diverse flora of lignicolous species occurred there. It has been found that the logging waste and soil disturbance also favours the occurrence of *Lactarius rufus, Laccaria laccata,* and *Paxillus involutus* (Hintikka, 1988; Wästerlund & Ingelög, 1981). However, *L. rufus, L. laccata* and *P. involutus* also have been regarded as characteristic species of young pine forests, while *Cortinarius spp.,* the russulas (*Russula decolorans, R. paludosa*), and *Suillus variegatus* mostly favour older stands (Hintikka, 1988).

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REFERENCES

Arnolds, E. 1981. Ecology and coenology of macrofungi in grassland and moist heathlands in Drenhte: the Netherlands, Vol. 1. *Biblioth. Mycol.* 83.

Arnolds, E. 1988. Dynamics of macrofungi in two moist heathlands in Drenthe, The Netherlands. *Acta Bot. Neerl.* 37 (2): 291–305.

Arnolds, E. 1992. The analysis and classification of fungal communities with special reference to macrofungi. In *Fungi in Vegetation Science* (ed. Winterhoff, W.), pp. 7–47. Kluwer Academic Publishers, The Netherlands.

Barkman, J. J. 1987. Methods and results of mycocoenological research in the Netherlands. In *Studies on fungal communities* (ed. Pacioni, G.), pp. 7–38. University of l'Aquila, Italy.

Brandrud, T. E. 1987. Mycorrhizal fungi in 30 years old, oligotrophic spruce *(Picea abies)* plantation in SE Norway. A one-year permanent plot study. *Agarica* 8 (16): 48–58.

Cooke, W. B. 1948. A survey of literature on fungus sociology and ecology. *Ecology* 29: 377–382.

Cooke, W. B. 1953. A survey on literature on fungus sociology and ecology – II. *Ecology* 34: 211–222.

Dahlberg, A. 1991. I. Dynamics of ectomycorrhizal fungi in a Swedish coniferous forest: a five year survey of epigeous sporocarps. In *Ectomycorrhiza in coniferous forests: structure and dynamics of populations and communities*, pp. 1–23. Uppsala, Sweden.

Dahlberg, A., Jonsson, L. & Nylund, J-E. 1997. Species diversity and distribution of biomass above and below ground among ectomycorrhizal fungi in an old-growth Norway spruce forest in south Sweden. *Canad. J. Bot.* 75: 1323–1335.

Danielson, R. M. 1984. Ectomycorrhizal associations in jack pine in northeastern Alberta. *Canad. J. Bot.* 62: 454–461.

Eveling, D. W., Wilson, R. N. & Gillespie, E. S. 1990. Environmental effects on basidioma counts over fourteen years in a forest area. *Mycol. Res.* 94: 998–1002.

Gardes, M. & Bruns, T. D. 1996. Community structure of ectomycorrhizal fungi in a *Pinus muricata* forest: above- and below-ground views. *Canad. J. Bot.* 74: 1572–1583.

Gulden, G., Høiland, K., Bendiksen, K., Brandrud, T.E., Foss, B.S., Jenssen, H.B. & Laber, D. 1992. Macromycetes and air pollution. Mycoenological studies in three oligotrophic spruce forests in Europe. *Biblioth. Mycol.* 144, 71 pp.

Guminska, B. 1962. Mikoflora lesów bukowych Rabsztyne I Maciejowej. *Monogr. Bot.* 13: 3–85.

Hansen, L. & Knudsen, H. (eds) 1992. *Nordic Macromycetes. Vol.2. Polyporales, Boletales, Agaricales, Russulales*. Nordswamp, Copenhagen, 474 pp.

Hering, T. F. 1966. The terricolous higher fungi of four Lake District woodlands. *Trans. Brit. Mycol. Soc.* 49: 369–383.

Hintikka, V. 1988. On the macromycete flora in oligotrophic pine forests of different ages in South Finland. *Acta Bot. Fenn.* 136: 89–94.

Kalamees, K. 1968. Mycocoenological methods based on investigations in the Estonian forests. *Acta Mycol.* 4 (2): 327–335.

Kalamees, K. 1975. Agarikoviye gribi Estonii (Polyporales, Boletales, Russulales, Agaricales). Sistematika, ekologiya, rasprostraneniye. Avtoreferat. Tallinn, 110 pp.

Kalamees, K. 1980. The composition and seasonal dynamics of the fungal cover on mineral soils. *Scripta Mycol.* 9: 5–70.

Kalamees, K. & Silver, S. 1988. Fungal productivity of pine heaths in North-West Estonia. *Acta Bot. Fenn.* 136: 95–98.

Kalamees, K. & Silver, S. 1993. Productivity of edible fungi in pine forests of the Myrtillus and Vaccinium uliginosum site types in North-West Estonia. *Aquilo, Ser. Bot.* 31: 123–126.

Krastina, I. 1997. Macrofungi flora and communities in pine forests of northern Latvia. *Proc. Latvian Acad. Sci., Section B*, 51 (5/6): 241–248.

Kårén, O. & Nylund, J-E. 1996. Effects of N-free fertilization on ectomyccorrhiza community structurew in Norway spruce stands in southern Sweden. *Pl. & Soil* 181: 295–305.

Lange, M. 1978. Fungus flora in August. Ten years observations in a Danish beech wood district. *Bot. Tidsskr.* 73: 21–54.

Mehus, H. 1986. Fruit body production of macrofungi in some North Norwegian forest types. *Nordic J. Bot.* 6: 679–702.

Ohenoja, E. & Koistinen, R. 1984. Fruit body production of larger fungi in Finland. 2. Edible fungi in northern Finland 1976–1978. *Ann. Bot. Fenn.* 21: 357–366.

Ohenoja, E. 1993. Effect of weather conditions on the larger fungi at different forest sites in nothern Finnland in 1976–1988. Dissertation. *Acta Univ. Oulu. A* 243, 69 pp.

Ohenoja, E., Tuokkola, P. & Pohjola, L. 1993. Dry weight percentages and mean dry weights of fungal fruit bodies. *Oulun yliop.kasvitiet. lait. monisteita* 51: 10–21.

Richardson, M. 1970. Studies on *Russula emetica* and other agarics in a Scots pine plantation. *Trans. Brit. Mycol. Soc.* 55 (2): 217–229.

Salo, K. 1993. The composition and structure of macrofungus communities in boreal upland type forests and peatlands in North Karelia, Finland. *Karstenia* 33: 61–99.

Salonen, V. & Saari, V. 1990. Generic composition of macrofungus communities on virgin mire site types in Central Finland. *Ann. Bot. Fenn.* 27: 33–37.

Urbonas, V., Kalamees, K. & Lukin, V. 1986. *Conspectus Florum Agaricalium Fungorum (Agaricales s.l.) Lithuaniae, Latviae et Estoniae*. Mokslas, Vilnius. 133 pp.

Visser, S. 1995. Ectomycorrhizal fungal successions in jack pine stands following wildfire. *New Phytol.* 129: 389–401.

Väre, H., Ohenoja, E. & Ohtonen, R. 1996. Macrofungi of oligotrophic Scots pine forests in northern Finland. *Karstenia* 36: 1–18.

Winterhoff, W. 1984. Analyse der Pilze in Pflanzengesellschaften, insbesondere der Makromyzeten. In *Sampling methods and taxon analysis in vegetation science* (ed. Knapp, R.), pp. 227–248. Dr. W. Junk Publishers, The Hague, Boston, Lancaster.

Wästerlund, I. & Ingelög, T. 1981. Fruit body production of larger fungi in some young Swedish forests with special reference to logging waste. *Forest Ecol. Managem.* 3: 296–294.

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Phellinus gilbertsonii sp. nov. from western North America causing heart-rot of coastal Douglas-fir

Michael J. Larsen

Abstract: *Phellinus gilbertsonii* is proposed as a new species causing internal defect of live *Pseudotsuga menziesii* var. *menziesii*. An earlier name, *Daedalea vorax*, was used for this species, but the name was never validly published. Photomacrographs of the holotype are provided.

Kokkuvõte: M. J. Larsen. *Phellinus gilbertsonii*, Loode-Ameerikas harilikul ebatsuugal südamemädanikku põhjustav uus liik.

Esitatakse uue liigi, *Phellinus gilbertsonii* kirjeldus ja selle holotüübi fotod. Seen põhjustab hariliku ebatsuuga elustüvede südamemädanikku. Teda on varem kirjeldatud nimetuse all *Daedalea vorax,* kuid too nimi on nomenklatuurikoodeksi kohaselt kehtetu.

INTRODUCTION

This is the third paper in a series that attempts to stabilize the nomenclature and species concepts of fungi that were formerly referred to as *Phellinus pini* (Brot.: Fr.) A. Ames, a name that has been applied to what appears to be a highly variable species, one that causes internal defect in all conifer species in North America. In two previous communications, Larsen & Melo (1996) and Larsen & Stenlid (1999) neotypified *P. pini* from Portugal and *P. chrysoloma* (Fr.) Donk from Sweden. In this communication, I take up the name *Daedalea vorax* Harkn.

Owens (1936) suspected that there may be subspecific taxa in the existing species concept of *P. pini*, but concluded that his data were inconclusive on this point. Fischer (1994, 1996) concluded that in western North America there were seven biological species, some of which appeared to be host specific. Dreisbach & Hansen (5th Int. Mycol. Congr., Vancouver, Canada, 1994), using DNA analysis, tentatively concluded, as did Fisher (1994, 1996), that *P. pini*, originally described from Portugal, was not detected in western North America. They also concluded that *P. cancriformans*, causing internal defect and cankers on *Abies* sp. in the west, was a distinct species. Larsen & Cobb-Poulle (1990) summarized the nomenclatural status of the world taxa of *Phellinus* based on existing data and proposed synonymy in the literature; only *P. pini*, *P. chrysoloma*, and *P. cancriformans* (of the *P. pini* complex) were recognized.

Harkness (1879) proposed the new name *Daedalea vorax* for a fungus that causes internal defect in live incense cedar (*Libocedrus decurrens* Torr.) and coastal Douglas-fir [*Pseudotsuga menziesii* (Mirb.) Franco var. *menziesii*]. The report of the occurrence on incense cedar was apparently incorrect because the host proved to be Douglas-fir, and confirmed by me after examining Harkness' material. Harkness & Moore (1880) again reported *D. vorax* on incense cedar in the Blue Cañon area (presumably near San Rafael, California). Saccardo (1898, p. 658) listed *D. vorax* on *L. decurrens* but did not provide a Latin diagnosis. Haddow (1939) states, "von Schrenck relates that Harkness assured him in a letter concerning the disease of *Libocedrus*, that the record in the Catalogue of Pacific Fungi was erroneous, and that the host should have been reported as *Abies Douglasii*." It remains, however, that *D. vorax* was not validly published because Harkness (1879) provided no substantive descriptive data of his fungus. Thus, a *nomen nudum* was created. Niemelä's annotation of the Harkness specimens notes also that *D. vorax* was not validly published.

Cerný´ (1985) states that North American specimens should be called *Phellinus vorax* (Harkn.) Cerný´. Paine et al. (1964) concluded that isolates of *P. pini* from *P. menziesii* were distinct from isolates from adjacent white fir [*Abies concolor* (Gordon & Glend.) Lindl.] in northern California. Their observations on the growth habit and basidiocarp development on *A. concolor* agree with Owens' (1936a, b) for those from *A. grandis* (Douglas & D. Don) Lindl. The fungus on *A. grandis* was later named *P. cancriformans* (M.J. Larsen et al.) M.J. Larsen & Lombard (Larsen et al., 1979; Larsen & Cobb-Poulle, 1990; also see Boyce, 1961, p. 256).

Recently Fischer's (1994, 1996) studies of compatibility patterns of 13 and 25 stocks, respectively, of *P. pini*, suggested that in western North America there were numerous insterility groups, with each group being somewhat host specific. In addition, all North American groups were incompatible with European isolates.

In the western United States, we are aware of four distinct taxa, e.g., *P. cancriformans, P. vorax* (*nom. nud.*), one undescribed occurring on Sitka spruce [*Picea sitchensis* (Bong.) Carr.] and *P. gilbertsonii* described here. To date, we are not aware of any data that would confirm the occurrence of *P. pini* in this region. My purpose here is to propose a new species name to embody the original concept of Harkness (1879).

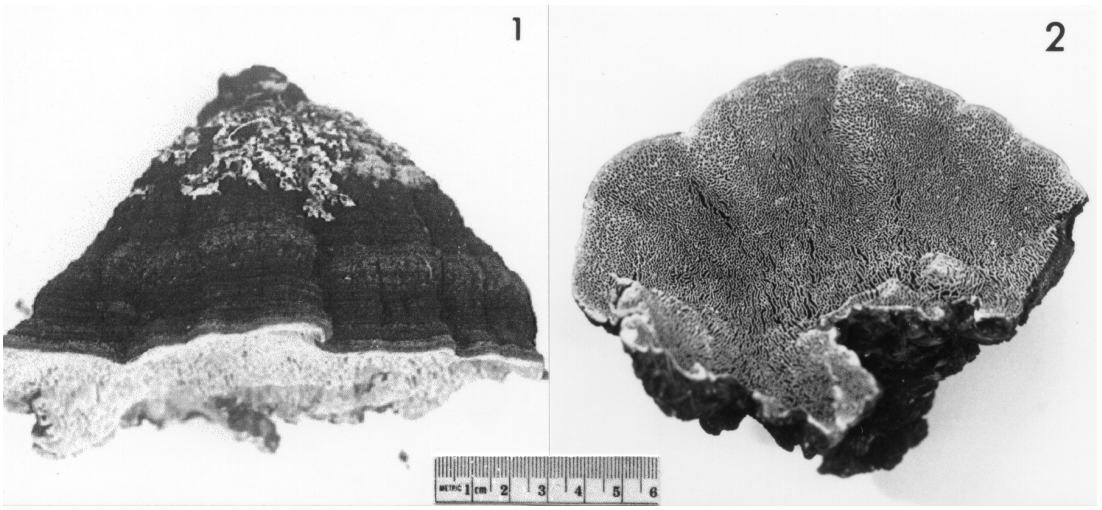
Data on microscopic characteristics were obtained from free hand sections of basidioma mounted in Melzer's reagent (Melzer, 1924), lactophenol Cotton blue (Johnson, 1940), 5% KOH, or diluted water. Capital letters used to designate herbaria are those of Holmgren et al. (1990).

Phellinus gilbertsonii M.J. Larsen sp. nov. Figs 1–3

(*Daedalea vorax* Harkn., Pacific Rural Press 17: 49. 1879 *(nomen nudum*).

Etymology – Named in honor of Dr. Robert L. Gilbertson for his past and continuing contributions to our knowledge of polypore fungi.

Basidiomatibus perennibus, solitaris ad imbricatis, paginis superis rimosis et nigris, sulcatis radiatis et longitudinali, zonatis; poris 2–3(–4) per mm, aliquot 1–2 mm ad diametrum; setibus absens in contextis et tramam; setibus hymeniis 30–40(–50)×7–9 µm, lanceolatis; basidiis 10×5 µm, urniformibus; basidiosporis 5.5×5.0 µm, globosis vel subglobosis, hyalinis; ad lignam vivo *Pseudotsugae menziesii* var. *menziesii*.



Figs 1–2. Fig. 1, lateral view of a basidioma of *Phellinus gilbertsonii* illustrating undulating margin and grooved sulcate pilear surface. Fig. 2, ventral view of the basidioma in Fig. 1, illustrating poroid to daedaloid configuration of the hymenophore (holotype FP135947).

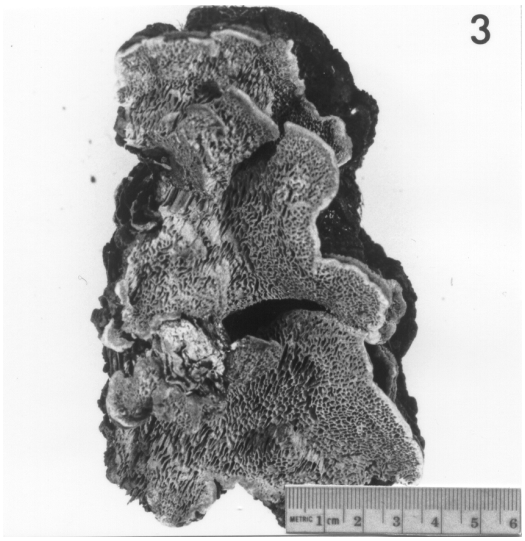


Fig. 3. Effused-reflexed basidioma of *P. gilbertsonii* illustrating a coarsely poroid to daedaloid hymenophore (from FP135944).

Holotype – California, Humboldt Co., Bush Mt., approximately 10 mi east of Eureka, Six Rivers National Forest, on P. menziesii var. menziesii, 28 IX 1997, M.J. Larsen 135947 (BPI; isotype CFMR). Basidiomata tissue (T) and single spore (SS1-4) isolates from 135947 are deposited in culture collections of CFMR and ATCC.

Basidiomata up to 10×7×7 cm, solitary but occasionally imbricate, ungulate to somewhat applanate, often sessile and reflexed, usually centrally attached and growing appressed over bark around point of attachment, associated with branch stubs. Pilear surface at first coarsely hirsute, becoming rimose and blackened, with radial grooves, sulcate, zonate. Margin somewhat acute at first, yellow to dark ferruginous brown, undulating, occasionally down-curved. Context ferruginous brown, 1–2 mm thick and overlain by a thin black crust (old tomentum) 0.5 mm thick, with a distinct pattern of radial growth, black lines of tissue not associated with the context. Pore surface pale yellow to pale tan, plane to somewhat concave. Pores 2–3(–4) per mm., at first round but eventually becoming radially oriented to coarsely daedaloid and then individual pores 1–2 mm across, occasionally decurrent on substrate, tubes indistinctly stratified, older tubes dull ferruginous brown stuffed with brown hyphae, current tube surfaces pale colored.

Hyphal system dimitic. Contextual skeletal hyphae with a parallel arrangement of growth, 2.0–5.0 µm diam, dull brown in IKI, aseptate but with some adventitious septa, unbranched. Contextual generative hyphae 2.5–3.5 µm diam, pale tan in IKI, septate, thin-walled. Tramal skeletal hyphae 2.5–3 µm diam, aseptate. Tramal generative hyphae 1.5–3.0 µm diam, pale tan to hyaline. Hymenial setae 30–40(–50)×7–9 µm, lanceolate. Basidia 10 × 4 µm, urniform, arising from generative hyphae, 1–1.5 µm diam. Basidiospores 5.0–5.5×5.0 µm, globose to subglobose, attenuated somewhat toward the apiculum with some wall thickening, IKI-, hyaline in IKI, water and KOH.

Additional specimens examined – California, Humboldt Co., approximately 10 mi east of Eureka, Six Rivers National Forest, on *P. menziesii* var. *menziesii*, 28 IX 1997, M.J. Larsen nos 135936–135948, 135950 (CFMR), and 135949 (DAV); California, east of Mt. Shasta, Mcleod Ranger District, Trinity-Shasta National Forest, on *P. menziesii* var. *menziesii*, VI 1993, M.J. Larsen 135837 (CFMR). Tissue (T) and single spore (SS) cultures on file at CFMR and ATCC; 135936-T; 135942-T, SS1-10; 135943-T, SS1-11; 135944-T, SS1-4; 135945-T, SS1-15; 135946-T, SS1-16; 135947-T, SS1-10; 135948 SS1-10; 135949 SS1-10; 135950 SS1-11.

Type of rot – A diffuse white pocket rot.

Sexuality – Heterothallic bipolar based on Fischer's (1994) Group III.

DISCUSSION

Fischer's (1994, 1996) analysis of RFLP data provided convincing evidence for separation of taxa within the *P. pini* complex. However, as I interpret his findings, I disagree with his opinion concerning *D. vorax*. Harkness' collections were from Douglas-fir in California. Thus, Fischer's conclusion that *D. vorax* does not occur in North America is not appropriate. In addition, there is no evidence that suggests Fischer (1994, 1996) examined Harkness' material. In all probability, Fischer's (1994, 1996) Group III is what is called *P. gilbertsonii* here. However, I have not had the opportunity to examine Fischer's cultures or specimens from western North America.

Phellinus gilbertsonii may be recognized by its restriction to *Pseudotsuga menziesii* var. *menziesii*, absence of tramal and contextual setae, urniform basidia, perennial basidiomata with a sulcate pilear surface with radially oriented grooves, and pores that become coarsely daedaloid. For comparative data on other closely related species, eg, *P. chrysoloma*, *P. piceinus*, and *P. pini*, see Larsen & Stenlid (1999).

REFERENCES

Boyce, J.S. 1961. *Forest Pathology*. McGraw-Hill Book Co. New York. 572 pp.

Cerný´, A. 1985. Taxonomic Study in the *Phellinus pini* complex. *Ceská Mykol.* 39: 71–84.

Fischer, M. 1994. Pairing tests in the *Phellinus pini* group. *Mycologia* 86: 524–539.

Fischer, M. 1996. Molecular and microscopical studies in the *Phellinus pini* group. *Mycologia* 88: 230–238.

Haddow, W.R. 1939. On the classification, nomenclature, hosts and geographical range of *Trametes pini* (Thore) Fries. *Trans. Brit. Mycol. Soc.* 22: 182–193.

Harkness, H.W. 1879. *A foe to the lumberman*. Pacific Rur. Press 17: 49.

Harkness, H.W. & Moore, J.P. 1880. *Catalogue of Pacific Coast Fungi.* Cal. Acad. Sci. San Francisco (Published by the authors). 46 pp.

Holmgren, P.K., Holmgren, N.H. & Barnett, L.C. 1990. Index herbariorum. Part I. The herbaria of the world, ed. 8. *Regnum Veg.* 120. 693 pp.

Johansen, D.A. 1940. *Plant microtechnique*. McGraw-Hill Book Co., New York. 523 pp.

Larsen, M.J., & Cobb-Poulle, L. A. 1990. *Phellinus* (Hymenochaetaceae). A survey of the world taxa. *Syn. Fung.* (Oslo) 3. 206 pp.

Larsen, M.J., Lombard, F.F. & Aho, P.E. 1979. A new variety of *Phellinus pini* associated with cankers and decay in white firs in southwestern Oregon and northern California. *Canad. J. Forest Res.* 9: 31–38.

Larsen, M.J. & Melo, I. 1996. Neotypification of *Phellinus pini*. *Mycologia* 88: 839–843.

Larsen, M.J. & Stenlid, J. 1999. Neotypification of *Phellinus chrysoloma*. *Folia Cryptog. Estonica* 34: 9–13.

Melzer, V. 1924. L'ornamentation des species des *Russules*. *Bull. Soc. Mycol. France* 40: 78–81.

Owens, C.E. 1936a. Studies on the wood-rotting fungus *Fomes pini.* I. Variations in morphology and growth habit. *Amer. J. Bot.* 23: 144–149.

Owens, C.E. 1936b. Studies on the wood-rotting fungus *Fomes pini.* II. Cultural characteristics. *Amer. J. Bot.* 23: 235–254.

Paine, L.A., Schwantzbart, G. & O'Regan, W.G. 1964. Estimation of growth-time temperature characteristics for isolates of *Fomes pini*, a heart-rot fungus. *Canad. J. Bot.* 42: 1635–1652.

Saccardo, P.A. 1898. *Sylloge fungorum (Index nominum hospitum specierumque omnium fungorum* [prepared by P. Sydow-MR] XIII. 1340 pp.

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New taxa and new combinations in hymenochaetoid fungi (Hymenomycetes)

Erast Parmasto
Institute of Zoology & Botany of the Estonian Agricultural University, 181 Riia St., 51014 Tartu, Estonia.
E-mail: e.parmasto@zbi.ee

Abstract: A new family, Asterodontaceae Parmasto (Hymenochaetales), a new genus, *Dichochaete* Parmasto (Clavariachaetaceae) and seven new species, *Hymenochaete allantospora* Parmasto, *H. americana* Greslebin & Parmasto, *H. australis* Parmasto & Greslebin, *H. burdsallii* Parmasto, *H. jobii* Parmasto *(H. corticolor* s. auct.), *H. reticulata* Parmasto and *H. ryvardenii* Parmasto are described. Three new combinations, *Dichochaete ceratophora* (Job) Parmasto, *D. setosa* (Sw.: Fr.) Parmasto and *Hymenochaete cinnamomea* ssp. *spreta* (Peck) Parmasto are published.

Kokkuvõte: E. Parmasto. *Hymenochaete*-laadsete eoslavaseente uued liigid ja uued kombinatsioonid.

Kirjeldatakse uus sugukond Asterodontaceae (Hymenochaetales), uus perekond *Dichochaete* (Clavariachaetaceae), uued liigid *Hymenochaete allantospora, H. americana, H. australis, H. burdsallii, H. jobii (H. corticolor* s. auct.), *H. reticulata* ja *H. ryvardenii*. Moodustatakse uued taksonoomilised kombinatsioonid *Dichochaete ceratophora, D. setosa* ja *Hymenochaete cinnamomea* ssp. *spreta*.

METHODS

Colour terminology used below is as in the Rayner (1970) colour chart; colour notations are given using the Munsell Book of Color (1942). Spore measurements were made 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., Marlboro, MA, USA) software. For statistical analysis, 25 spores were measured in each specimen. Herbarium acronyms are after Holmgren et al. (1990).

DESCRIPTIONS

Asterodontaceae Parmasto, fam. nova (Hymenochaetales)

Basidiomata annua, effusa, molle gossypina; hymenophorum verrucosum, deinde hydnoideum, brunneo-aurantiacum vel cinnamomeo-umbrinum. Systema hypharum asterotrimiticum; hyphae generatoriae sine fibulis; hyphae sceletales adsunt; in contextu asterosetae numerosae 3–7-radiatis. Setae hymeniales simplices vel cum 2–4 radiis laterales basales; basidia clavata, 4-sterigmatis; sporae ellipsoideae, tenuiter vel incrassate tunicatae, hyalinae, inamyloideae.

Typus: *Asterodon* Pat., Bull. Soc. Mycol. France 10: 130 (1894).

Basidiomata annual, resupinate, cottony soft; hymenophore at first warted, then composed of densely arranged teeth, brownish orange to cinnamon brown. Hyphal system asterotrimitic, composed of septate generative hyphae without clamps, skeletal hyphae, and numerous stellate asterosetae with 3–7 unbranched rays. Hymenial setae simple or with 2–4 side branches at base; basidia clavate, with 4 thin sterigmata; basidiospores ellipsoid, with thin or thickened hyaline inamyloid walls.

Genera included: *Asterodon* Pat.

Remarks: The genus *Asterodon* was included in the family Hymenochaetaceae by Jülich (1982), Fiasson & Niemelä (1984), Knudsen (1995) and other modern taxonomists. However, it has significant differences from the other genera of Hymenochaetales: presence of true skeletal hyphae, stellate asterosetae as the main component of context, and absence of styrylpyrones characteristic for most species of all other genera of Hymenochaetales (Fiasson, 1982). Thus, its placement in a separate family is warranted.

Dichochaete Parmasto, gen. nov. (Clavariachaetaceae)

Basidiomata annua, effusa vel effuso-reflexa; si pileata tum superficies pilei radiatim fibrillosa vel strigosa; hymenophorum laeve, granulosum, colliculosum, tuberculosum vel hydnoideum. Tomentum atque cortex desunt vel indistincte adsunt, strata hypharum et setarum adsunt. Systema hypharum dimiticum; hyphae setales adsunt vel desunt; dichohyphae divaricate vel sympodialiter ramosae, apices ramorum in hymenio dendrohyphidia numerosa formantes. Setae subulatae vel subfusoideae, ad 110 µm longae; basidia subclavata, 4-sterigmatis; sporae ellipsoideae, minutae (ad 6 µm longae), tenuiter tunicatae, hyalinae.

Typus: *Thelephora setosa* Sw.: Fr., Fl. Ind. Occid. 3: 1929 (1806); Fries, Syst. Mycol., Index 189 (1832).

Etymology: dica, asunder; caith, hair. Gender: *f*.

Basidiome resupinate or effuse-reflexed; when pileus present, surface radiately fibrillose or strigose; hymenophore smooth, granulose, colliculose, warted or hydnoid. Tomentum and cortex absent or indistinct, hyphal layer and (later) thickening setal layer present. Hyphal system dimitic with generative and dichohyphae; setal hyphae absent or present; dichohyphae numerous, strongly dichotomously branched (divaricately) or sympodially branched, their tips forming numerous dendrohyphidia in the hymenium. Setae subulate or subfusoid, not bifurcate at base, up to 110 µm long; basidia subclavate, with 4 sterigmata; basidiospores ellipsoid, small (up to 6 µm long), hyaline, thin-walled, inamyloid.

Remarks: There are two species in the genus *Hymenochaete*, *H. ceratophora* Job and *H. aspera* Berk. & M.A. Curtis *(= Hydnochaete setosa)* deviating from the others by presence of dichohyphae similar to those in the genus *Clavariachaete* (Clavariachaetaceae); these are here combined in the new genus *Dichochaete*. The basidiomata of *Clavariachaete* spp. are negatively geotropic and branched (clavarioid); the pileate basidiomata of *D. setosa* have usually at base long branched vertical outgrowths (branched hairs) simulating clavarioid basidiomata of *Clavariochaete*.

Dichochaete ceratophora (Job) Parmasto, comb. nova

Basionym: *Hymenochaete ceratophora* Job, Rev. Invest. Agrop. INTA 20 (1): 146 (1985). Synonym: *H. alabastrina* Escobar ex Léger, Cryptogamie, Mycol. 11 (4): 294, f. 3 (1990); Léger, Hymenochaete 51 (1998).

Basidiome effused, tightly adnate, waxy when dry, thin or thickened (70-180 µm); hymenium smooth or granulose to colliculose, not cracked, when sterile Fulvous Cinnamon or yellowish brown (M: 7.5 YR 6/9), when fertile, with basidia and spores, then athelioid (pellicular), Rosy Buff or gray with a rose tint (M: 5 YR 7.5/2–3); margin indeterminate or abrupt, concolorous, thin.

Tomentum and cortex indistinct or absent; context composed of hyphal layer and a setal layer 55–140 µm thick; dark line above the hymenium indistinct or absent.

Context hyphae loosely interwoven; hyphal system dimitic, with generative and dichohyphae; setal hyphae absent. Generative hyphae hyaline, subhyaline, or yellowish, thin-walled, septate, branched, 2.5–4 µm diam; dichohyphae numerous, pale brown, with thickened or thick walls, dichotomously or sympodially branched, 2–3.5(–4) µm diam, with numerous short sidebranches. In context, setal stratum and hymenium crystalline masses or scattered crystals usually present.

Setae rare to numerous, subulate, (50)60–110 × 6–10 µm, projecting up to 60 µm above the hymenium, straight, acute, naked or enclosed in hyphal sheath.

Hyphidia and cystidia absent; dendrohyphidia present as numerous tips of branched dichohyphae, with thickened walls; basidioles thin-walled or absent; basidia subclavate, 10–15 × 4–5.5 µm, with four sterigmata 4–5 µm long; basidiospores elongated-ellipsoid, 4.5–7 × 2-2.5(–2.8) µm.

Distribution. Mesoamerica (Costa Rica), South America (Argentina, Brazil).

Specimens examined. South America: Argentina, Buenos Aires, Punta Lara, Feb 1976 Gómez, det. D.J. Job (BAFC 30334); Brazil, Paraná, General Carneiro, Fazenda São Pedro, 4 Oct 1989 A.A.R. de Meijer 1385, det. M. Rajchenberg (TAA 171370).

Remarks: The characteristic alabaster (marble white) colour of basidiomata is present only in specimens with well developed basidia and

basidiospores; in that case, the hymenium is somewhat athelioid (pellicular). Mean size of the basidiospores and basidiospore length/width quotient *Q* of the specimen de Meijer 1385: 6.46 × 2.15 µm; 3.00.

DICHOCHAETE SETOSA (Sw.: Fr.) Parmasto, comb. nova

Basionym: *Thelephora setosa* Sw.: Fr., Fl. Ind. Occid. 3: 1929 (1806); Fries, Syst. Mycol. 3, Index 189 (1832). Synonyms: *Hydnochaete setosa* (Sw.: Fr.) Lloyd, Mycol. Writ. 4: 559 (1916). - *Hydnum resupinatum* Sw., Nova gen. spec. plant. 149 (1788). - *Hydnochaete resupinata* (Sw.) Ryvarden, Mycotaxon 15: 437 (1982). - *Hymenochaete aspera* Berk. & M.A. Curtis, J. Linn. Soc. Bot. 10: 334 (1868); Léger, Hymenochaete 57 (1998).

The species is well described by Ryvarden (1982), Corner (1991) and Léger (1998); some features mainly characteristic for clavariachaetoid fungi are described in detail below.

Pileal surface radiately strigose, rough with coarse fibers, or densely covered with entangled forked or corniculately branched hairs up to 3(–5) mm long, with concentrical zones, at base sometimes with long branched outgrowths; margin thin, entire to lacerate, sometimes long-fimbriate or eroded at the edge, plicate. Hymenium granulose, colliculose when young, then warted or irregularly hydnoid; aculei pointed to rounded, scattered or in groups, up to 2 mm long; margin of the resupinate part usually fibrillose; short mycelial strands usually present at the resupinate margin.

Tomentum and cortex absent; context composed of hyphal layers; hyphal threads sometimes present, 50–100 µm in diam.

Hyphal layer 100–1000 µm thick; context hyphae tightly interwoven but more loosely arranged towards the adaxial surface, structure often fibrillose with elongated cavities and hyphal threads 20–45 µm or up to 90 µm in diam, these longitudinally arranged or descending, curved outward on the upper surface of the pileus.

Hyphal system dimitic with generative and dichohyphae; setal hyphae present in context and in pileal surface, up to 250 µm long, 4–10 µm in diam; generative hyphae 2–5 mm in diam, pale yellow to pale brown, thin-walled to thick-walled, septate, in the subhymenium hyaline and thin-walled; dichohyphae rare or abundantly present in the teeth, less common in the context but numerous at margin of the pileus, repeatedly dichotomously branched, with short sidebranches, yellow to hyaline

Cystidia absent; dendrohyphidia present (see above, dichohyphae); basidioles present, without incrustation; basidia clavate or subclavate, 8–15 × 3–5 µm; sterigmata 4; basidiospores broadly ellipsoid, 2.5–3.5 × 2–2.5 µm.

Types studied. *Thelephora setosa:* Jamaica, Swartz (K). *Hydnum resupinatum:* Jamaica, Swartz (K, lectotype selected by Ryvarden, 1982; S, isolectotype). *Hymenochaete aspera:* Cuba, Wright 211 (K, lectotype; BPI 277592, FH, K, NY, S, isolectotypes; K, paratypes).

Distribution. North America: Mexico (Veracruz); Mesoamerica: Costa Rica; Caribbean: Cuba, Dominica, Jamaica, Trinidad; South America: Argentina (Tierra del Fuego), Brazil, Chile, Colombia, Ecuador, Venezuela; Asia-Tropical: India (N. India and Bengal), Nepal.

Remarks: The structure of the basidiome is *hericioid*, i. e., composed of branching, loosely anastomosed fibrils as in *Hericium erinaceum* (cf. Corner, 1991: 165). Pileal surface is densely covered with corniculately branched hairs, at base the pileus sometimes possesses long branched vertical outgrowths. Such a structure is obviously homologous with the structure of negatively geotropic branched basidiomata of *Clavariachaete* spp.

The species epithet *aspera* has been used by most authors who dealt with this taxon as a species of *Hymenochaete*; based on the International Code of Botanical Nomenclature (Sydney Code, 1981), Ryvarden (1982) used the pre-Friesian name *resupinata* in his monograph of the genus *Hydnochaete*. However, the Swartz's species *Thelephora setosa* was not described by Fries in his papers but nevertheless sanctioned in the Index of his "Systema mycologicum" (Fries, 1832: 189), where he mentioned under *Thelephora*: "setosa *Sw.* (denuo observ.)", i. e., as a species *observed once again*. Accordingly, *setosa* is the correct epithet for this species (cf. ICBN Art. 13.1 (d), Greuter *et al.*, 2000).

Hymenochaete allantospora Parmasto, sp. nova

Fig. 1, *1*

Basidiomata effuso-reflexa, pilei angusti; hymenium laeve, fulvum vel atro-avellaneum. Tomentum, cortex, stratum hypharum atque stratum setosum adsunt. Systema hypharum monomiticum; setae subulatae vel fusoideae, 80–150 × (9–)10–15(–16) µm, acutae, fragile fractae, parte superiore vel ad apicem cum crystallis polyhedricis incrustatae; basidia cylindrice clavata; sporae cylindricae, allantoideae, 8.5–11(–23) × 2.2–2.7 µm.

Holotypus: Mexico, Veracruz, Rancho Santa Inés, km 1 of the Xalapa-Coatepec road, alt. 1330 m, 29 Mar 1990 V.M. Bandala (TAA 171364; isotypus: XAL).

Etymology: *allantospora*, with allantoid spores.

Basidiomata effuso-reflexed with small pilei 0.5–1 cm long, 250–500(–700) mm thick, resupinate part 1–3 cm in diam, then confluent; upper surface of pilei coarsely hirsute, indistinctly zonate, dark Umber (M: 7.5 YR 3–4/4), margin slightly lobed or lacerate. Hymenium sometimes concentrically sulcate, not cracked, fulvous Umber or dark Hazel (M: 7.5 YR 5/5, later 5 YR 6/4).

Tomentum and cortex present; context composed of hyphal layer and (in old specimens) of setal layer.

Tomentum 200–400(–600) µm thick, hyphae in ascending bundles, pale brown, with thickened walls, 3.5–5 µm in diam; cortex 20–35(–45) µm thick, hyphae densely parallel, agglutinated, brown; hyphal layer up to 300 µm thick, hyphae densely longitudinally arranged but not agglutinated.

Hyphal system monomimitic; hyphae pale brown, with thickened walls, septate, rarely branching, 2.5–4 µm in diam; some hyphae thin-walled and subhyaline; in hymenium crystals or granules of resinous brown matter locally present.

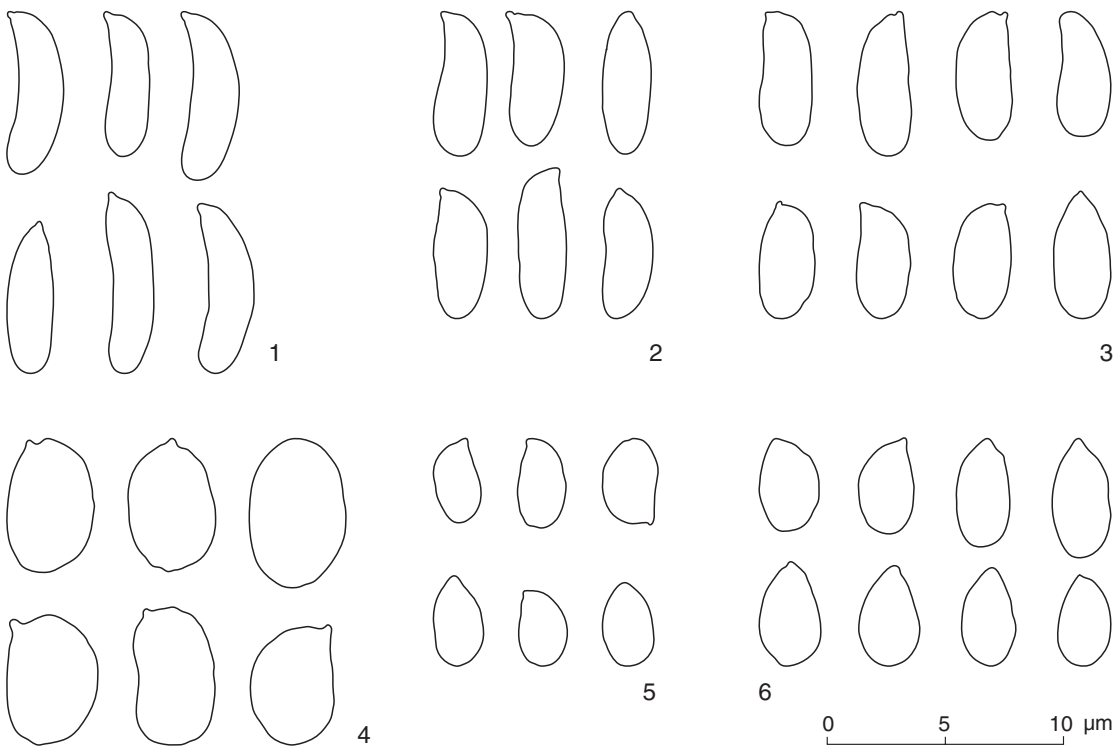

Fig. 1. Spores of *Hymenochaete* species: 1 – *H. allantospora*, 2 – *H. americana*, 3 – *H. australis*, 4 – *H. burdsallii*, 5 – *H. jobii*, 6 – *H. reticulata*.

Setae rare or infrequent, 80–150 × (9–)10–15–(16) µm, projecting up to 120 µm, subulate to fusiform, easily broken, with acute tip, straight, enmeshed in thin or thick hyphal sheaths, in upper part or at tip encrusted with granules of polyhedric crystals.

Hyphidia numerous, cylindrical, thin-walled and hyaline, then pale brown, with thickened walls usually encrusted with resinous granules or crystals, 2–3.5 µm in diam; basidioles not numerous, some with slightly thickened encrusted walls; basidia clavate-cylindrical, 20–25 × 5–6 µm; sterigmata 4, 3–4 µm long; basidiospores cylindrical, curved (allantoid), 8.5–11(–13) × 2.2–2.7 µm.

Fig. 2. *Hymenochaete americana:* setae, basidia and spores (A. Greslebin).

Distribution. Northern America: Mexico, Veracruz, near Xalapa (holotype); near Xalapa, alt. 1330 m, 10 Dec 1990 D.M. Murrieta 359 (XAL); near Xalapa, 1750 m, 7 Jul 1994 A. García-Velázquez 394 (XAL and TAA 171365).

Remarks: *H. allantospora* is externally similar to *H. tabacina* (Sowerby: Fr.) Lév. which has setae up to 90 µm long, basidiospores 4.5–7 × 1.2–2.2 µm and setal hyphae in context. Another similar species, *H. australis* Parmasto & Greslebin differs in more broadly cylindrical basidiospores 7–9 × 2.4–3.2 µm and unencrusted slender setae 65–90 × 9–11 µm. *H. allantospora* may be closely related to the New Zealand endemic species *H. gladiola* G. Cunn. which differs in slightly smaller basidiospores 7–9(–10) µm long and numerous never encrusted setae 100–200 µm long; its substrate is *Weinmannia* spp. (Saxifragales). Hyphidia are absent in the type of *H. gladiola* (K and BPI 278206, isotypes studied by me) but are numerous, brown, with thickened walls, 2–3(–3.5) µm in diam in a paratype (PDD 7638; isoparatype BPI 278206 studied by me). Possibly the two sibling species have Gondwana origin. The only known substrate of *H. gladiola,* species of the genus *Weinmannia* are distributed in South America, too, but they have not been found north of southern Mexico.

Mean basidiospore size and *Q* value of the specimens of *H. allantospora:*

9.36 × 2.33	4.02	(paratype, XAL 394)
9.96 × 2.51	3.96	(holotype, XAL 1866)

HYMENOCHAETE AMERICANA Greslebin & Parmasto, sp. nova

Figs. 1, *2;* 2

Basidiomata resupinata, crustosa, ad 600 µm crassa. Tomentum, cortex, stratum hypharum atque textus setarum posterior indistincte 2–3-stratosus adsunt. Systema hypharum subdimiticum; hyphae skeletoideae crasse tunicatae, brunneae, 3–4.5 µm in diam.; hyphidia et cystidia desunt; setae subulatae vel fusoideae, (60–)70–100 × 8–12 µm, in parte superiore crystallis polyedricis vel cum capitulo conico crystallino obtextae. Basidia clavato-

cylindracei, 15–22 × 5–6 µm, 4-sterigmatibus; basidiosporae cylindraceae, leviter curvatae, quidam subsigmoideae, (7.0–)7.5–9.2(–9.5) × 2.5–3(–3.2) µm.

Holotypus: Argentina, Tierra del Fuego, Estancia Moat, 12 Nov 1999 A. Greslebin (CFMR 2181; isotypus: TAA 171369).

Etymology: *americana,* growing in America.

Basidiomata resupinate, crustose, 100–600 µm thick, 1–3 cm in diam, then confluent; hymenium smooth or with scattered rounded collicles, slightly cracked, dark Vinaceous Buff to dark Fawn or chocolate brown (M: 5 YR 5/3 or 3–4/3–4), without olive or lilac tint. Margin broad (up to 2 mm), distinct, yellow-ochre or Sienna (M: 7.5 YR 5/8), later not distinguishable from the hymenium.

Tomentum present but sometimes indistinct; cortex present; context composed of a thin hyphal layer and later a stratose setal layer; dark line above the hymenium absent.

Tomentum 25–40 µm thick, hyphae loosely interwoven, pale brown, with thickened walls, 4–5 µm in diam; tomentum in old specimens disappearing; cortex 20–60 µm thick, hyphae parallel, densely agglutinated, pale brown; hyphal layer thin, hyphae more or less loosely longitudinally arranged.

Hyphal system subdimitic; setal hyphae absent; generative hyphae 2–3.5 µm in diam, pale yellow, with thickened walls; skeletoids thick-walled, pale brown, 3–4.5 µm in diam; in context and hymenium crystalline matter locally present.

Setal layer 50–400 µm thick, indistinctly 1–3-stratose; setae unnumerous or numerous, (60–)70–100 × 8–12 µm, projecting up to 70 µm, subulate to fusiform, with acute tip, straight, naked or rarely enmeshed in hyphal sheaths, always encrusted with small groups of polyhedric crystals, sometimes crystals forming a narrowly conical cap.

Cystidia and hyphidia absent. Basidioles numerous, with slightly thickened walls; basidia clavate-cylindrical, 15–22 × 5–6 µm; sterigmata 4, 4.4–5 µm long; basidiospores cylindrical, slightly curved, sometimes some almost sigmoid, (7.0–)7.5–9.2(–9.5) × 2.5–3(–3.2) µm.

Distribution. South America: Argentina, Tierra del Fuego (holotype); North America: USA: Arizona, Pima Co., Coronado Nat. Forest, Sycamore Canyon, 24 Sep 1970 and 21 Jan 1971 E.R. Canfield 56 and RLG 7122 (ARIZ). Found on *Quercus arizonica* and on unknown angiospermic trees.

Remarks: This species appears to be closely related *H. vaginata* G. Cunn., which differs in sometimes possessing effused-reflexed basidiomata, presence of numerous hyaline, yellow or pale brown hyphidia, encrusted with small crystals or unencrusted large setae 90–160 × 9–14 µm and somewhat smaller basidiospores; it has been found once in New Zealand on *Phyllocladus alpinus* (Pinopsida, Podocarpales), and (a young specimen) in Hawaii. An isotype of that species (K) is almost sterile, with only few, partly collapsed basidiospores; these are (6–)6.8–8 × 2.4–3.2 µm (mean of 12 spores: 7.24 × 2.79 µm; *Q* = 2.59). If the two taxa are allopatric species, their origin and distibution is possibly of Gondwana origin.

Mean basidiospore size and *Q* value of *H. americana:*

7.85 × 2.78	2.83	(Tierra del Fuego, Greslebin 2181, CFMR)
8.02 × 2.78	2.88	(Arizona, Canfield 56, ARIZ)
8.27 × 2.63	3.15	(Tierra del Fuego, Greslebin 1893, CFMR)
8.83 × 2.97	2.97	(Arizona, Canfield 7122, ARIZ)

HYMENOCHAETE AUSTRALIS Parmasto & Greslebin, sp. nova

Fig. 1, *3*

Basidiomata effuso-umbonata marginibus non adnatis vel pilei dimidiati formantes, molle coriacea sed in statu sicco fragiles, 5–15 mm in diam., deinde confluentes, 200–400(–500) µm crassa pilei angusti; hymenium laeve, Sienna color, vetustus radialiter crevisae. Tomentum deest vel indistinctus; cortex, stratum hypharum atque stratum setosum adsunt. Systema hypharum subdimiticum; hyphae ramosae, 2.5–5 µm in diam. Setae rare, fusoideae, (60–)65–90(–120) × (7–)9–11 µm, subacutae, sine incrustatione; cystidia et hyphidia desunt; basidia clavata, 4-sterigmatis; sporae cylindricae, 7–9 × 2.4–3.2 µm.

Holotypus: Argentina, Tierra del Fuego, aprovechamiento Fregosini, *Nothofagus pumilio,* 3 Dec 1995 A. Greslebin 145 (TAA 171362; isotypus: BAFC 50398).

Etymology: *australis*, of southern distribution.

Basidiome resupinate with free margins (umbonate), rarely effuse-reflexed and imbricate, adnate with central point, soft coriaceous but brittle when dry, paper-like when old; 200–400(–500) µm thick, 5–15 mm in diam, then confluent; pilei (when present) dimidiate, 2–3 mm long, 3–5 mm broad; pileal surface strigose, with some indistinct concentrical zones, Sienna or light Umber to Umber (M: 5–7.5 YR 4–5/6 or 5.5/8); hymenium smooth, later sometimes uneven and indistinctly concentrically sulcate, when old radially cracked, Sienna or dark Sienna, sometimes with orange tint (M: 5 YR 5–6/5–6), without a lilac tint; margin of the resupinate part entire or slightly laciniate, lighter coloured, when young luteous-ochreous.

Tomentum absent or indistinctly present; cortex present; context composed of hyphal layer and one setal layer, sometimes with few rows of setae; thin dark line above the hymenium usually absent.

Tomentum (when present) 20–40 µm thick, hyphae thick-walled, brown and agglutinated; cortex 25–40 µm thick, hyphae tighly interwoven, thick-walled; hyphal layer 50–300 µm thick, lighter coloured than other layers, hyphae longitudinally loosely arranged.

Hyphal system indistinctly dimitic; setal hyphae in hyphal layer absent; generative hyphae 3–5 µm in diam, hyaline or yellow, thin-walled or with thickened walls, septate, branched usually under right angle; thick-walled brownish skeletoids 2.5–4 µm in diam, with rare septa.

Setae rare or infrequent, (60–)65–90(–120) × (7–)9–11 µm, projecting to 50 µm, fusiform, with bluntly acute tip, straight, naked or enveloped in hyphal sheats, without incrustation.

Hyphidia and cystidia absent; basidioles numerous, yellowish, with thickened walls, 20–25 × 4–5 µm, without incrustation; basidia clavate or subclavate; sterigmata 4, up to 4(–5) µm long; basidiospores cylindrical, one side slightly concave, 7–9 × 2.4–3.2 µm.

Causes white rot of wood.

Distribution. Southern South America; common in Tierra del Fuego.

Paratypes studied. Argentina: Neuquén, Dpto. Maipú, Lote 42 y 43 ca. Laguna Rosada, on *Nothofagus pumilio*, 3 Oct 1997 A. Greslebin 1308 (CIEFAP, TAA); Río Negro, Puerto Blest, road to Los Cantaras, on *Nothofagus dombergii*, 16 Mar 1987 M. Rajchenberg 3878 (BAFC 31427, TAA); Tierra del Fuego: Lapataia Nat. Park, 15 km W of Ushuaia, on *Nothofagus* sp.,19-20 Feb 1982 L. Ryvarden 19224, 19293, 19301 (O, TAA), Est. Harberton, on *Nothofagus*, 18 Feb 1982 L. Ryvarden 19174 (O, TAA), Ensanada 15 km W of Ushuaia, on *Nothofagus*, 22 Feb 1982 L. Ryvarden 19405 (O, TAA), Monte Olivia, on *Nothofagus*, 23 Feb 1982 L. Ryvarden 19497 (O, TAA), Dpto. Ushuaia, Ea. El Valdez, on *Nothofagus pumilio*, 4-5 Mar 1996 A. Greslebin 406 (CIEFAP, TAA).

Remarks: Superficially, *H. australis* is very similar to *H. tabacina*, which differs in presence of (sometimes rare) setal hyphae in context, smaller basidiospores 4.2–6.8 × 1.3–2.2 µm and presence of usually well developed effuse-reflexed pilei. *H. allantospora*, equally similar and possibly closely related, differs in narrowly cylindrical (allantoid) basidiospores 8.5–11 × 2.2–2.7 µm, large setae 80–150 × (9–)10–15–(16) µm, encrusted in upper part or at tip with granules of polyhedric crystals.

Mean basidiospore size and *Q* value in *H. australis*:

7.02 × 2.59	2.71	(Greslebin 145)
7.54 × 2.80	2.70	(Greslebin 1308)
7.64 × 2.63	2.91	(Ryvarden 19293)
7.92 × 2.81	3.05	(Greslebin 406)
8.57 × 2.81	3.05	(Ryvarden 19497)
8.61 × 2.88	2.99	(Ryvarden 19405)

HYMENOCHAETE BURDSALLII Parmasto, sp. nova

Fig. 1, *4*

Basidiomata effusa, adnata, in statu sicco coriacea, 0.5–2.5 cm in diam., 40–150 µm crassa; hymenium laeve, non crevisum, atro-ochraceum; margo farinaceo-fibrillosus, luteolus, deinde vanescens. Tomentum et cortex desunt, stratum hypharum indistinctum vel ad 30 µm crassum hyphis dense intertextis compositum; stratum setorum adest. Systema hypharum monomiticum; setae subulatae, acutae, (50–)60–90(–95) × 5–9(–10) µm; cystidia et hyphidia desunt; basidioli numerosi, 15–25 × 5–7(–8) µm; basidia urniformia, 15–20(–25) × 6–7.5 µm; sporae late ellipsoideae, (6.5–)7–8(–8.5) × 4.5–5.2(–5.5) µm.

Holotypus: USA, Michigan, Marquette Co, Big Bay, SE slope of Breakfast Roll, *Ostrya virginiana*, 10 Aug 1974 H.H. Burdsall 8272 (CFMR; isotype: TAA).

Etymology: *Harold H. Burdsall, Jr.*, eminent American mycologist, collector of a large collection of hymenochaetoid fungi.

Basidiomata effused, closely adnated, coriaceous when dry, as rounded patches 0.5–2.5 cm in diam, 40–150 mm thick; hymenium smooth but in some places uneven (with very low tubercles), azonate, somewhat farinose, not cracked, dark Ochreous (M: 10 YR 6/8), without olive or lilac tint; margin farinose-fibrillose, thin, when young about 1 mm wide, Luteous (M: 10 YR 7.5/10), later disappearing and margin distinctly delimited.

Tomentum and cortex absent, hyphal layer absent or indistinct, then 20–30 µm thick, hyphae densely interwoven but not agglutinated; setal layer with numerous hyphae; dark line above the hymenium absent; in hymenium conglomerates of brownish resinous matter or crystals up to 10 µm in diam.

Hyphal system monomitic; setal hyphae absent; generative hyphae brown, with thin or thickened walls, (1.5–)2–3.2(–4) µm in diam. Setae numerous but not crowded, subulate, with acute tip, straight, (50–)60–90(–95) × 5–9(–10) µm, projecting 30–50 µm above the hymenium, usually covered with a thin hyphal sheath; cystidia and hyphidia absent, basidioles numerous, hyaline, thin-walled, with rounded tip, 15–25 × 5–7(–8) µm; basidia urniform, thin-walled, hyaline, 15–20(–25) × 6–7.5 µm, with 4 broad when young, then thin sterigmata about 4 µm long; basidiospores broadly ellipsoid, thin-walled, hyaline, some with one side slightly flattened, (6.5–)7–8(–8.5) × 4.5–5.2(–5.5) µm.

Distribution. North America: USA, Michigan, Marquette Co.; found twice. Paratype: Michigan, Marquette Co., Big Bay, Lumbermanna cove, 9 Aug 1974 H.H. Burdsall 8252 (CFMR). - On bark of (fallen branches?) *Ostrya virginiana*.

Remarks: The new species is superficially very similar to young *H. cinnamomea*, but has quite different microstructure (hyphal layer absent) and broad basidiospores.

Mean basidiospore size and Q value in *H. burdsallii*:

7.36 × 4.65	1.58	(Burdsall 8252)
7.57 × 4.86	1.56	(Burdsall 8272)

Hymenochaete cinnamomea (Pers.: Fr.) Bres. subsp. **spreta** (Peck) Parmasto, comb. nova

Basionym: *Hymenochaete spreta* Peck, Rep. New York St. Mus. 30: 47 (1879).

Setal layers of the context of basidiomata without an alternating layer of loosely interwoven hyphae, or this layer thin, up to 30(–60) µm thick, hyphae almost densely interwoven. Hymenium of the perennial specimens densely cracked (sometimes like *H. corrugata*). Basidioles short-celled, with thickened brown walls sometimes encrusted with granules of resinous matter.

Distribution. Northern America: Canada, USA (common but more rare in South-East), Mexico (only one locality in Oaxaca State).

Types studied: USA, New York, Haldberbury Mts., on wood of Acer, Oct 1875 C.H. Peck (NYS, holotype; BPI, isotype).

Remarks: Structure of the basidiome is the only morphological difference between ssp. *cinnamomea* and ssp. *spreta*. Mean basidiospore size and mean spore form (length/width ratio *Q*) vary in the same range in both subspecies. There also are no significant differences between the basidiospore size and form in specimens collected from Estonia and Italy (Europe), Kopet-Dagh Mts. (Asia), Russian Far East (Asia), Argentine (S. America), New Zealand, and the specimens of ssp. *spreta* collected from various parts of the USA.

Hymenochaete jobii Parmasto, sp. nova

H. corticolor sensu Burt (1918), Reeves & Welden (1967) and Job (1990) **non** Berk. & Ravenel (1873) = *H. cervina* Berk. & M.A. Curtis.

Figs. 1, *5*; 3

Basidiomata perennia, effusa, adnata, crustosa vel lignea, ad 1000(–3000) µm crassa. Hymenium laeve, humiliter tuberculatum, griseo-brunneum vel badium. Tomentum, cortex et stratum hypharum desunt vel cortex tenuis indistinctus adest; stratum setarum incrassatum bene evolutum. Systema hypharum subdimiticum; hyphae sceletoideae tunicis incrassatis, brunneae, 3–4.5 µm in diam.; setae subulatae, (50–)60–110(–120) × 7–12(–15) µm. Hyphidia hyalina vel flaventia 2–3 µm in diam; basidia subclavati, 15–25 ×

3.5–5 µm, 4-sterigmatibus; sporae tenuiter ellipsoideae, uno latere depressae, 4.5–6 × 2.2–3.2(–3.5) µm.

Haec species sub nomine *H. corticolor* s. auct. (typus exclusus) pernota est.

Holotypus: USA, New York State, Schuyler Co., Van Etten, Arnot Forest, *Betula*, 19 Sep 1970 H.H. Burdsall, Jr. 4932 (TAA 171182; isotypi: BPI, CFMR, K).

Etymology: *Daniel J. Job*, eminent mycologist, author of excellent papers on tropical and subtropical *Hymenochaete* species.

Basidiomata effused, closely adnate, hard when dry, up to 1.5 cm in diam, then confluent, (150–)500–1000(–3000) µm thick. Hymenium smooth but usually with low rounded tubercles, not cracked or with a few irregular cracks, greyish Umber to dark chocolate brown (M: 5 YR 5/4 to 7.5 YR 4/4–7); margin fibrillose when young, soon disappearing.

Tomentum, cortex and hyphal layer absent or cortex indistinctly present as a thin layer of agglutinated thick-walled hyphae 10–20 µm thick; setal layer well developed, thickening, setae in overlapping or distinct rows.

Hyphal system subdimitic with indistinct differentiation of generative hyphae and skeletoids; generative hyphae 2–4.5 µm in diam, pale brown, with thickened walls; setal hyphae absent. Setae numerous, (50–)60–110(–120) × 7–13(–15) µm, subulate, sometimes encrusted with small crystals at tip; cystidia absent, hyphidia hyaline or yellowish, 2–3 µm in diam, mainly thin-walled, sometimes with slightly thickened and granulose walls. Basidia subclavate, 15-25 × 3.5–5 µm, with 4 thin sterigmata; basidiospores narrowly ellipsoid, with one side flattened, 4.5–6 × 2.2–3.2 (–3.5) µm.

Distribution. North America: Canada, USA; Caribbean: Cuba, Jamaica; South America: Brazil, Equador. On several angiospermic trees (*Acer*, *Alnus*, *Betula*, *Castanea*, *Fagus*, *Juglans*, *Populus*), but mainly on *Quercus* spp.

Remarks: *H. cervina* and *H. corticolor* have been distinguished as two species by several authors until Léger studied the (lecto)type of *H. corticolor* (NY) and found it to be identical with *H. cervina*. I have studied the isotype of *H. corticolor* in BPI and agree with him: the spores of the type are 7.5–8 × 4.5 µm, i. e., similar to those of *H. cervina* which has usually basidiospores 5-7.5 × 3.5–4.3 mm. Nevertheless, the species described by American authors as *H. corticolor* is a good species with dif-

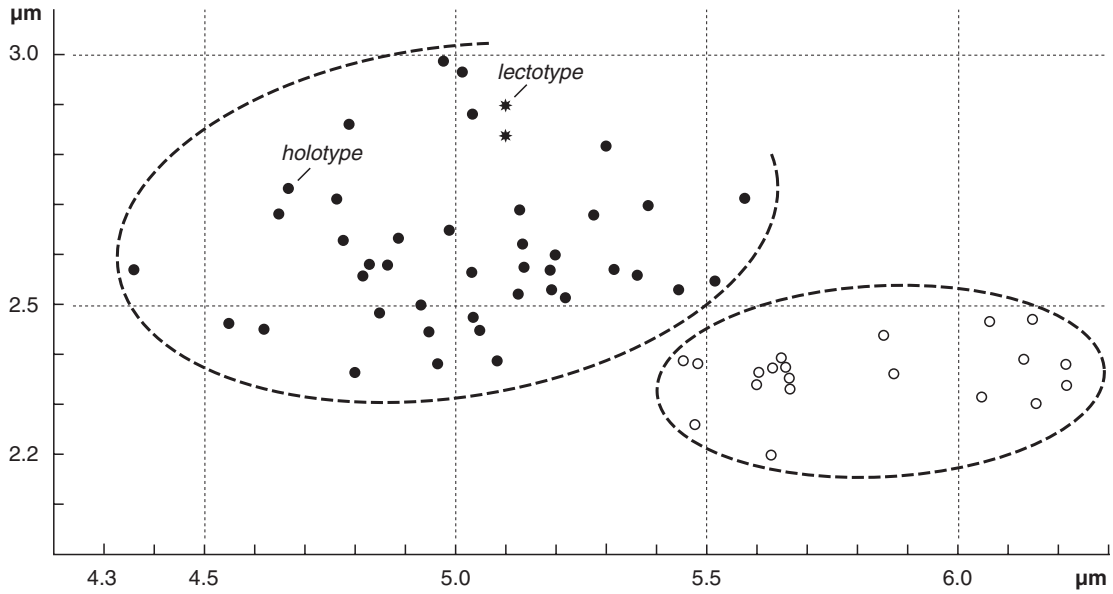

Fig. 3. Mean spore size of *Hymenochaete jobii* (●), *H. subfuliginosa* (✷) and *H. fuliginosa* (○).

ferent basidiospore size. A very good description of it was published by Job (1990).

H. fuliginosa (Pers.) Lév. is closely related to *H. jobii;* it differs in cylindrical slightly curved basidiospores 5-6.5(–7) × 1.8–2.6(–2.8) µm (Fig. 3), smooth hymenium without tubercles, and occurrence on coniferous wood. Published or herbarium data on *H. fuliginosa* growing on angiospermic trees in North America are mostly a result of misidentifications.

Hymenochaete subfuliginosa, an European species, is morphologically similar to *H. jobii*. It is lectotypified here. *H. subfuliginosa* Bourdot & Galzin (Bull. Soc. Mycol. France 38 (4): 184, 1922; lectotype here designated: France, Aveyron, Vignoles, *Quercus*, 12 Jun 1914 Galzin 15666; PC, Herb. Bourdot 15372) It differs in spores 4.5–5.5 × 2.7–3.2 µm, i. e., somewhat broader than usual in *H. jobii* (Fig. 3), more slender setae 50–100 × 5–8(–10) µm and presence of locally well developed cortex 20–50 µm thick. *H. jobii* might be considered a subspecies of *H. subfuliginosa,* but that European taxon is said to have an ITS region rDNA sequence fully homologous with the European *H. fuliginosa* (Mugnier *in* Léger & Lanquetin, 1996: 111). The problem of the taxonomy of this group of species is in need of further studies.

Hymenochaete reticulata Parmasto, sp. nova

Fig. 1, *6*

Basidiomata effusa, adnata, in statu sicco coriacea vel crustosa, ad 20 cm longa, 150–350 µm crassa. Hymenophorum reticulatim poratum, fulvum vel cinnamomeum; pori angulati, 0.5–1(–1.5) mm diametro (1.5–2(–2.5) per mm), disseptimentis tenuibus 0.1–0.2 mm altis. Tomentum et cortex desunt, stratum hypharum bene evoluta. Systema hypharum subdimiticum; hyphae sceletoideae numerosae tunicis incrassatis, brunneae, 2.5–3.5(–4) µm in diam. Setae numerosae, conico-subulatae, 50–80 × 7–11(–13) µm; hyphidia desunt; basidia subcylindricae, 15–20 × 5–7 µm, 4-sterigmatibus; sporae ellipsoideae, uno latere depressae, 5.5–6.5(–7) × 3–3.5(–3.7) µm.

Holotypus: Costa Rica, Turrialba, 28 Jul 1964 B. Lowy (LSU; isotypi: BPI, TAA).

Etymology: *reticulata*, reticulate, netted.

Basidiomata widely effused, closely adnate, coriaceous or crustose when dry, up to 20 cm or more long, 150–350 µm thick; hymenium reticulately poroid, pores angular, 0.5–1(–1.5) mm in diam, 1.5–2(–2.5) per mm, 0.1–0.2 mm deep; not cracked, Fulvous to Cinnamon (M: 5–7.5 YR 6/5), without olive or lilac tint; marginal part without pores (even); margin thin, indistinct or somewhat floccose, concolorous with hymenium; context cottony, light brown.

Tomentum and cortex absent, hyphal layer 100–300 µm thick, hyphae densely interwoven but not agglutinated; hymenial (setal) layer not thickening; dark line above the hymenium absent; in hymenium numerous aggregates of crystals 6–15 µm in diam.

Hyphal system indistinctly subdimitic; setal hyphae absent; generative hyphae few, subhyaline, thin-walled, rarely branched and with few septa, 2.5–3(–3.5) µm diam; skeletoids numerous, with thickened walls, brown, with rare septa, 2.5–3.5(–4) µm in diam; some brown hyphae long and straight, similar to skeletoids. Setae numerous, subulate-conical, bluntly acute, straight, 50–80 × 7–11(–13) µm, projecting 30–50 µm above the hymenium, usually covered with a thin hyphal sheath. Cystidia and hyphidia absent; basidioles present, subcylindrical, hyaline, thin-walled; basidia nearly cylindrical, 15–20 × 5–7 µm; basidiospores ellipsoid, with one side flattened, 5.5–6.5(–7) × 3–3.5(–3.7) µm (mean of 30 basidiospores: 5.97 × 3.22 µm, Q = 1.85), thin-walled, some with small guttules, non-amyloid and non-dextrinoid.

Causes white rot of wood.

Distribution. Mesoamerica: Costa Rica (found only in type locality).

Remarks: The type specimen is well developed, but hymenium is collapsed and many basidiospores damaged. There are no other species of *Hymenochaete* with distinctly poroid or reticulate hymenophore; formally the new species may be included into *Phellinus*. However, there are no similar species in that genus except *Ph. palmicola* (Berk. & M.A. Curtis) Ryvarden which differs in well developed tube layer up to 2 mm thick, more narrow subulate setae 50–70 × 5–7 µm and cylindrical-ellipsoid basidiospores 4–5 × 2–2.5 µm (Gilbertson & Ryvarden, 1987: 590-591). Another specimen of that fungus has been described by Lowe (1966: 152–153) as having basidiospores 6–7 × 3–5 µm. The new species has some similarity with *Ph. ferruginosus* (Schrad.: Fr.) Bourdot

& Galzin which differs in tough to soft-spongy basidiomata, well developed tube layer up to 10(–20) mm thick, small pores (usually 4–9 per mm), presence of setal hyphae, smaller setae 25–60(–65) × 5–8 µm, and more broadly ellipsoid shorter basidiospores with thickened walls (except when immature) and a large guttule. Very young shallow pores of that species have thick tomentose dissepiments, while in *H. reticulata* dissepiments are thin and not tomentose. In the genus *Hymenochaete*, the new species belongs to the section *Fultochaete* Escobar ex Léger and may be related to *H. rhabarbarina* (Berk.) Cooke.

HYMENOCHAETE RYVARDENII Parmasto, sp. nova

Fig. 4

A *H. spathulata* Léger setis cylindraceis apice tenuitunicatis (cystidiis *Tubulicrinis* spp. similes), sporis ellipsoideis vel subnavicularis 6.5–8(–8.5) × (2.8–)3–3.6(–4.2) µm nec non basidiomatis ad 800 µm crassis differt.

Holotypus: Thailand, Chanwat Chiang Doo, Doi Chiang Doo Nat. Park, 22 Feb 1979 L. Ryvarden 17844 (O; isotypus in TAA conservandur).

Etymology: *Leif Ryvarden*, eminent Norwegian mycologist, collector of the holotype.

Basidioma effused, closely adnated, woody-coriaceous when dry, 5 cm or more in diam; up to 800 µm thick; hymenium smooth, partly deeply irregularly cracked, dark Hazel (M: 7.5 YR 6/4), without olive or lilac tint; margin thin, to 0.5 mm broad, fimbriate, yellowish white; context (setal layer) woody, indistinctly stratified; at base of the basidiome in some places thin dark brown line.

Tomentum and hyphal layer absent; cortex indistinct, 20–30 µm thick, hyphae densely agglutinated; setal layer thickening; dark line above the hymenium absent.

Hyphal system subdimitic; setal hyphae absent; generative hyphae subhyaline, thin-walled, rarely branched and with few septa, 2.5–3.5 µm in diam; skeletoids numerous, thick-walled, brown, 2.5–3.5(–4) µm in diam, densely vertically interwoven. Setae infrequent, cylindrical, with very thick walls; capillary lumen narrow, abruptly or almost gradually expanded like in *Tubulicrinis* spp. (Corticiaceae); tip rounded and sometimes incrusted; 60–110 × 8–10 µm, mostly embedded, some projecting 10–25 µm above the hymenium. Cystidia absent; hyphidia not well differentiated, 2–3 µm in diam, cylindrical, hyaline, then some with thickened walls; basidioles numerous, hyaline, thin-walled, 20–30 × 3–5 µm; basidia almost cylindrical, 15–20 × 4–4.5 µm, with 4 thin sterigmata about 3 µm long; basidiospores ellipsoid, one side slightly flattened, some subnavicular, 6.5–8(–8.5) × (2.8–)3–3.6(–4.2) µm (mean of 30 basidiospores: 7.27 × 3.25 µm, Q = 2.24).

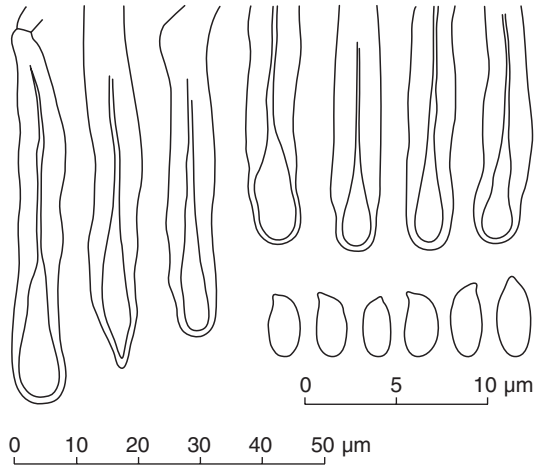

Fig. 4. *Hymenochaete ryvardenii:* setae and spores.

Distribution. Asia Tropical: Thailand (found only in type locality).

Remarks: *H. ryvardenii* is closely related to the West-Central African *H. spathulata* Léger; that species differs in producing thin basidiomata up to 220 µm thick, spathulate setae with somewhat different structure of tip, and cylindric basidiospores 6.4–7.4(–8.5) × (1.6–)1.9–2.1 µm, with one side concave (see Léger, 1998: 250–261, f. 99–100). It is possible that the two taxa may be considered to be allopatric subspecies after additional collections will be made in Asia and Africa.

ACKNOWLEDGEMENTS

I am much indebted to my colleagues for the interesting and rare specimens of hymenochaetoid fungi sent me by Drs. H.H. Burdsall, Jr., A.L. Greslebin, G. Guzmán, D.J. Job, A.A.R. de Meijer, M. Rajchenberg and L.

Ryvarden. Curators of the following herbaria kindly made it possible to study types and other specimens: K, BAFC, CFMR, FH, K, LSU, NY, NYS, O, S and XAL. I am grateful to Dr. H.H. Burdsall, Jr. for revising the English of the manuscript and for helpful remarks. This work has been financially supported by the Estonian Science Foundation (Grant no 2145).

LITERATURE

Corner, E.J.H. 1991. Ad Polyporaceas VII. The xanthochroic polypores. *Beih. Nova Hedwigia* 101: 1-177.

Fiasson, J.-L. 1982. Distribution of styrylpyrones in the basidiocarps of various Hymenochaetaceae. *Biochem. System. Ecol.* 10 (4): 289-296.

Fiasson, J.-L. & Niemelä, T. 1984. The Hymenochaetales: a revision of the European poroid taxa. *Karstenia* 24: 14-28.

Fries, E. 1832. *Index alphabeticus generum, specierum et synonymorum in Eliae Fries Systemate Mycologico ejusque supplemento "Elencho Fungorum" enumeratarum*. Greifswald. 206 pp.

Gilbertson, R.L. & Ryvarden, L. 1987. *North American polypores*. Vol. 2. Fungiflora, Oslo, pp. [8]+438-885.

Greuter, W., McNeill, J., Barrie, R. *et al.* 2000. *International Code of Botanical Nomenclature (Saint Louis Code).* Regnum Vegetabile 138. Koeltz Scientific Books, Königstein. 474 pp.

Holmgren, P. K., Holmgren, N. H. & Barnett, L. C. 1990. *Index Herbariorum. Part I: The herbaria of the world*. 8th ed. New Yotk Botanical Garden, New York. 693 pp.

Job, D.J. 1990. Le genre Hymenochaete dans les zones tempérées de l'hémisphère sud. *Mycol. Helvet.* 4 (1): 1-51.

Jülich, W. 1982 ("1981"). Higher taxa of Basidiomycetes. *Biblioth. Mycol.* 85: 1-485.

Knudsen, H. 1995. Taxonomy of the basidiomycetes in Nordic Macromycetes. *Symb. Bot. Ups.* 30 (3): 169-208.

Léger, J.-C. 1998. Le genre Hymenochaete Léveillé. *Biblioth. Mycol.* 171: 1-319.

Léger, J.C. & Lanquetin, P.L. 1996. Contribution a l'etude des caracters culturaux chez les Hymenochaetaceae (Basidiomycotina). *Cryptogamie, Mycol.* 17 (2): 105-121.

Lowe, J.L. 1966. Polyporaceae of North America. The genus Poria. *Tech. Bull. St. Univ. Coll. Forestry at Syracuse Univ.* 90: 1-183.

Munsell Color Co., Inc. 1942. *Munsell Book of Color*. Baltimore.

Rayner, R.W. 1970. *A mycological Colour Chart.* Commonwealth Mycological Institute and British Mycological Society, Kew.

Ryvarden, L. 1982. The genus Hydnochaete (Hymenochaetaceae). *Mycotaxon* 15: 425-447.

Folia Cryptog. Estonica, Fasc. 37: 67–78 (2000)

The genus *Melanoporia* (polypores, Hymenomycetes)

Erast Parmasto & Anu Kollom
Institute of Zoology & Botany of the Estonian Agricultural University 181 Riia St., EE 51014 Tartu, Estonia.
E-mail: e.parmasto@zbi.ee, anu@zbi.ee

Abstract: The morphology, cultural characters and distribution of the two known species of *Melanoporia* are described. The two morphologically similar and partially compatible taxa may be interpreted as semispecies, taxonomically – as allopatric sibling species.

Kokkuvõte: E. Parmasto ja A. Kollom. Perekond *Melanoporia* (polüpoorid, Hymenomycetes).

Kirjeldatakse perekonna *Melanoporia* kahe senituntud liigi morfoloogilisi ja kultuuritunnuseid ning levikut. Neid morfoloogiliselt sarnaseid ja osaliselt ristuvaid taksone võib pidada poolliikideks, süstemaatika seisukohalt võttes aga allopatrilisteks teisikliikideks.

INTRODUCTION

Melanoporia Murrill is a genus of polypores recognized as an independent one by only a few mycologists. During the years 1960–1990, the senior author has made numerous collections of *M. castanea* in the Russian Far East, and observed some basidiomata growing on the same trees during up to 14 years. Comparison with the North American *M. nigra* aroused the question on their conspecificity.

MATERIAL AND METHODS

The basidiomata of the species were described in field and laboratory; in both cases colour notations were made in accordance with Munsell's Book of Color (1942). Specimens were examined microscopically as hand sections or as squash mounts in 2% KOH solution at magnifications x 700 and x 1000.

The methods for studying the cultures follow Nobles (1965) and Stalpers (1978). The culture descriptions were derived from two weeks and six weeks old cultures grown in the 90 mm Petri plates on the 1.25% malt extract agar (MEA) at 25°C in the dark. All isolates of *M. castanea* are of polysporous origin made from spore prints. Colour notations follow Kornerup and Wanscher (1978). Hyphae are described as *staining* when they colour in phloxine and erythrosine water solutions. The tests for extracellular oxidases are performed using drop test method (Marr, 1979); the following reagents were used: syringaldazine (Syr), gum-guaiac (G-G), a-naphthol (a-N), guaiacol (Gua), p-cresol (p-Cre), and L-tyrosine (L-Tyr). Species codes follow that of Nobles (1965) modified by Nakasone (1990) and Stalpers (1978).

The incompatibility system was determined by the occurrence of clamp connections resulting from pairing of twelve monokaryotic isolates of the collection TFC 86-67 in all possible combinations. The first intracollection pairings have been conducted several years ago, and the only monokaryon representing the A_2B_1 mating type (no. 10) is no longer extant. To find the monokaryotic isolate representing the missing A_2B_1 mating type, all remaining monokaryotic isolates not used in the first intracollection pairings were confronted against three monokaryotic tester strains. One to three monokaryotic isolates each representing the four mating types of the isolate TFC 86-67 were used in di-mono matings. In di-mono matings the Petri plates of 9 cm in diam. were used and the method described by Boidin (1980) was followed. After six to ten weeks of the growth the mycelium about 2–3 cm behind the line of the monokaryotic tester strain inoculum blocks was checked microscopically for clamp connections. In most cases, dikaryotization was not evident within the area of monokaryotic tester strain and it was necessary to subculture the di-mono pairs inoculating small pieces of mycelium taken about 2–3 cm behind the line of the monokaryotic testers to the fresh malt agar in Petri plates. After sufficient growth the new colonies were

studied microscopically for clamp connections. Those di-mono pairs which refused to mate were incubated at least 17–18 weeks and subcultured several times during that time.

All cultures are deposited in the culture collection of the Institute of Zoology and Botany of the Estonian Agricultural University (TFC).

TAXONOMY

Melanoporia Murrill
N. Am. Flora 9 (1): 14 (1907); Donk, Persoonia 1 (2): 239 (1960); Murrill, Keys fleshy Basid. Florida 32, 46 (1972); Gilb. & Ryvarden, N. Am. Polyp. 2: 440 (1987); Ryvarden, Gen. Polyp. 182 (1991); Bondartseva, Def. fung. Rossiae. Aphyll. 2: 248 (1998).

Basidiomata pileate or resupinate, perennial, dark brown or purplish black. Tube trama continuous with the context; tubes distinctly stratified; pores angular or rounded, small (5–8 per mm).

Hyphal system dimitic; generative hyphae with clamps, subhyaline; skeletal hyphae numerous, brown, in tube trama more or less parallel. Cystidia absent; basidia broadly clavate, with 4 short and thin sterigmata; spores ellipsoid, thin-walled, hyaline, inamyloid, small (up to 5 mm long). Heterothallic, tetrapolar (one species studied). Causes a brown rot of angiospermic wood.

Type: *Polyporus niger* Berk. (=*M. nigra* (Berk.) Murrill).

Two closely related (allopatric) species in East Asia and North America.

Melanoporia has been synonymized with *Nigroporus* Murrill by Ryvarden (1977: 223) and Corner (1987: 126); afterwards Ryvarden changed his opinion and treated them separately (Gilbertson & Ryvarden, 1987). *Nigroporus* differs from *Melanoporia* in presence of thick-walled generative hyphae simulating binding hyphae; it causes a white rot of wood. The other two genera with blackish basidiomata *Nigrofomes* Murrill and *Melanoporella* Murrill differ with simple-septated generative hyphae and white rot of wood. *Nigrofomes* has monomitic hyphal system, pileate basidiomata with concentrically zoned context and umber brown cystidia, *Melanoporella* has dimitic hyphal system, resupinate basidiomata and lacks cystidia (Corner, 1987; Gilbertson & Ryvarden, 1987; Ryvarden, 1991; Ryvarden & Johansen, 1980).

According to the preliminary classification proposed by Parmasto & Parmasto (1992), *Melanoporia* belongs to the family Fomitopsidaceae Jülich s.l.

Key to species

1. Basidiomata effuse-reflexed, triquetrous (rarely resupinate); tubes in 3–15(–28) layers. Skeletal hyphae 4–6(–7) µm in diam., not swelling in KOH. East Asian species ..... *M. castanea*
– Basidiomata resupinate; tubes not stratified or in up to 3 layers. Skeletal hyphae swelling in KOH, 4–9(–10) µm in diam. North American species ..... *M. nigra*

Melanoporia castanea (Imazeki) T. Hattori & Ryvarden
Mycotaxon 50: 29, f. 1 (1994); Dai & Niemelä, Ann. Bot. Fenn. 32: 216 (1995); Bondartseva, Def. fung. Rossiae. Aphyll. 2: 248 (1998). – *Fomitopsis castanea* Imazeki, Bull. Gov. Forest Exp. Sta. Tokyo 42: 1 (1949). – *Phellinus quercinus* Bondartsev & Ljub., Novosti Sist. Nizsh. Rast. 1965: 141 (1965). – *Melanoporia quercina* (Bondartsev & Ljub.) Parmasto, XIV Pacific Sci. Congr. Abstracts H: 34 (1979; not validly published).

Basidiomata perennial, triquetrous, effused-reflexed (very rarely resupinate), 5–12(–15) cm broad and 2–6(–12) cm long, thick (up to 20 cm). Pileal surface sepia or brown violaceous (Munsell: 5 YR 4/4), then blackish gray, finely tomentose or velvety, old specimens with broad zones (sulcate) and covered with indistinct black crust; margin rounded, thick, velvety when young, fawn umber (2.5 YR 4/4), receding in some years. Context 0.5–3 cm thick, hard, woody, slightly fibrous, broadly concentrically zonate, brown violaceous or blackish chestnut (2.5–5 YR 3/4–4/5). Tubes distinctly stratified, multilayered (3–15, rarely up to 28 layers each 3–6 mm thick); young layer dark violaceous gray, with a thin grayish coating in tubes; older strata purplish brown or dark brick (2.5–5 YR 2.5–4/2–4); pore surface dark fawn to violaceous black (7.5 YR 3/3–10 R 4/2); pores rounded-angular, 0.1–0.15 mm in diam., (4–)5–6(–7) per mm. No smell or a faint “fungal” smell.

Hyphal system dimitic. Velvety pileal surface composed of mainly thick-walled interwined skeletal hyphae with rare secondary septa; hyphal tips rounded, thin-walled. Context hyphae densely interwined; generative hyphae few, thin-walled, sparsely branched, with clamps, yellowish or subhyaline, (2–)2.5–4.5 µm; skeletal hyphae very numerous, with thick or very thick walls, strict, dark brown, 4–6(–7) µm in diam. No cystidia; hyphidia sometimes present, narrowly conical, up to 25(–30) x 3–4 µm. Basidia shortly clavate, 14–20 x 5–6.5(–7) µm, with 4 thin sterigmata 3–4 µm long; spores ellipsoid, with one side flattened, hyaline, nonamyloid, 3.5–4.5(–5) x 2–2.5 µm (Table 1). Spore print white.

Causes brown cubical heart rot of living trunks and fallen logs.

Distribution and hosts. Russian Far East: Primorsk Terr. and Sakhalin Is.; China, Jilin Prov.; Japan, Nagano; Taiwan, Tapei (Chen, 1976: 126 as *Poria nigra*). On living trunks, rarely on fallen trunks of *Quercus mongolica* Fisch. ex Ledeb., exceptionally also of *Maackia amurensis* Rupr. & Maxim.; found on *Acer* and *Fraxinus* in NE China by Ryvarden (1986: 22).

Specimens studied: RUSSIA (30 collections; on *Quercus mongolica*, and collected and identified by E. Parmasto, if not mentioned otherwise). PRIMORSK TERR.: *Distr. Nadezhdinsk*, on *Quercus mongolica*, 14 May 1950 Ljubarski (LE 22516, **holotype** of *Phellinus quercinus*); *Distr. Ternei*, Sikhote-Alin Nature Reserve, Maisa, 11 Sep 1976 (TAA 52766), on the same tree 11 Sep 1990 (TAA 151171), Maisa 11 Sep 1990 (TAA 150932), 13 Sep 1990 leg. & det. U. Kõljalg (TAA 150999), Blagodatnoye, 23 Sep 1990 (TAA 151392), Sukhoi Klyuch near Blagodatnoye, 25–26 Sep 1990 (TAA 151442, 151457, 151461); *Distr. Kavalerovo*, Fabrichnyi, 6 Oct 1977 (TAA 101180), same locality, leg. P. Gordienko (TAA 101869); Kavalerovo, 5 Oct 1977, leg. P. Gordienko (TAA 101869); Khrustalnyi, 7 Oct 1977 (TAA 101875, 101877), 7 Oct 1979 leg. P. Gordienko (TAA 101876); same locality, on *Maackia amurensis* 7 Oct 1977 (TAA 101878); *Distr. Lazo*, Lazo Nature Reserve, Amerika, 9 and 12 Aug 1986 (TAA 107506, 107615); *Distr. Ussuriisk*, Kamenushka, 2 Jun 1976 (TAA 100088–100090, 174979); same locality, 2 Aug 1979 leg. M. Saar (TAA 118496), Ussuri Nature Reserve, Komarovo-Zapovednoye, 3 Jun 1976 (TAA 174980); *Distr. Slavyanka*, Kedrovaya Pad Nature Reserve, 16 Sep 1961 (TAA 14414) and 20 Sep 1961 (TAA 16304). KHABAROVSK TERR.: *Distr. Lazo*, Mukhen, 29 Sep 1961 (TAA 14764); *Distr. Pivan*, Kabansopka, 17 Aug 1961 (TAA 15670). SAKHALIN PROV.: *Distr. Nevelsk*, Kuznetsovo, 11 Sep 1979 L. Järva (TAA 93123), 14 Sep 1979 (TAA 102460).

Most of the collections of *M. castanea* were made from living trees; the basidiomata were observed near the tree base, but in some cases up to 6 m high. The type of rot is not white as mentioned by Ryvarden (1986: 228); this was checked cutting a model tree in Kavalerovo; brown (cubical) heart rot connected with a basidiome (TAA 101875) was clearly observable.

The largest basidiome found (TAA 101877) was 15 x 40 x 20 cm in size and had 28 tube layers.

Statistical data on spore size of specimens studied are given in the Table 1.

Table 1. Mean spore size (µm) and length/width quotient in *Melanoporia castanea* (30 spores measured in each specimen)

Specimen TAA	L	W	Q
100090	3.44	1.71	2.01
100089	3.53	1.93	1.85
174979	3.55	1.81	1.96
100088	3.57	2.06	1.73
174980/1	3.63	1.81	2.03
174980/2	3.65	1.88	1.95
151171	3.89	2.19	1.77

Cultural characters

Cultures examined: TFC 76-17 (herbarium specimen: TAA 100090), TFC 76-20 (TAA 52766) TFC 86-67 (TAA 107506), and TFC 90-19 (TAA 151171). The isolates TFC 76-20 and TFC 90-19 are derived from the collections made from the same tree in 1976 and 1990 respectively.

Growth characteristics: Growth on MEA moderately rapid to medium, plates covered in three weeks (51–62 mm in 14 days). Margin even, hyaline or sparsely cottony, marginal hyphae appressed to raised, distant; mat at two weeks white, cottony, thin, even, translucent; at six weeks mat thin, mostly even, translucent, white or turning entirely or at least in some areas yellowish white, creme (Kornerup & Wanscher: 3A2 or 4A2) or butter yellow (4A4–5), appressed cottony or cottony-woolly to felty, in some isolates with scattered cottony or cot-

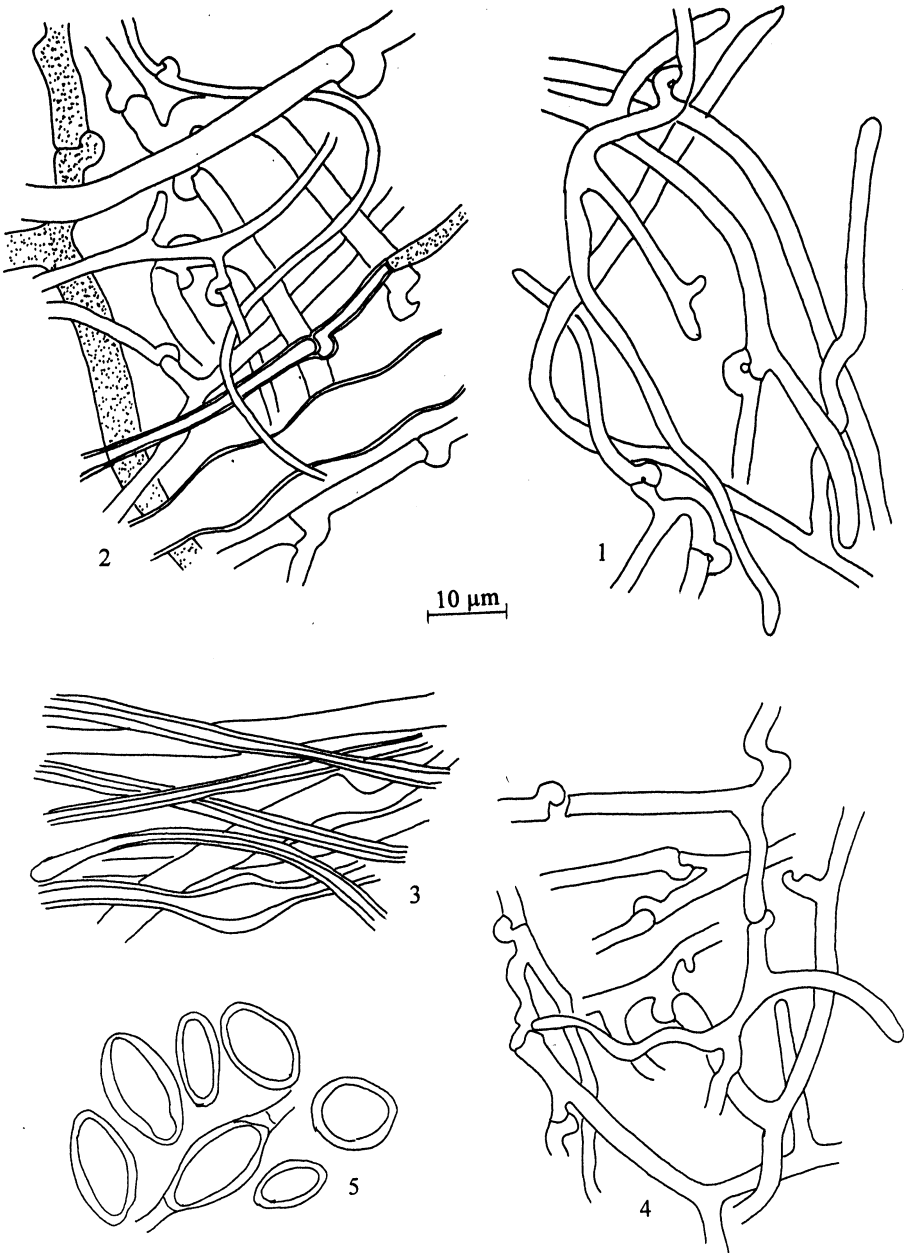

Fig. 1. *Melanoporia castanea,* microscopic structures from culture (TFC 86-67): 1 – generative hyphae from advancing zone; 2 – generative hyphae from aerial mycelium; 3 – skeletal hyphae; 4 – generative hyphae from submerged mycelium; 5 – chlamydospores.

tony-woolly mounds or floccose tufts all over the plate, with white and then sparsely cottony (or rarely felty) but mostly with brownish- to greyish-orange or light to oak brown (5C5–6, 5C5–6 to 5D6) felty mycelium growing up the edges of the plates. Reverse slightly bleached or unchanged but under brown coloured areas darkened. Odour pleasant, aromatic, strong but in the end may turn unpleasant, in some isolates fading.

Hyphal characteristics. *Marginal hyphae* (Fig. 1.*1*) hyaline, with clamp connections, thin-walled, (1.5–)2–4(–5) µm, rarely up to 7 µm in diam., rarely to moderately branched, branches sometimes short. *Aerial mycelium*. Generative hyphae (Fig. 1.*2*) hyaline, staining, with clamp connections, clamps often sprouting, at first mostly thin-walled, later thin- to thick-walled, (1–)1.5–5(–9) µm in diam., moderately to ordinarily branched, branches sometimes at right angles; later some broader hyphae (5–9 µm in diam.) thick-walled, usually rarely branched and empty, with conspicuous clamps, poorly staining or not staining, some with simple septae, some swollen. In some preparations generative hyphae with long (about 50–100 µm to several hundred mm) aseptate thick-walled branches (young skeletals?); their content and especially the clublike apical part are deeply staining. Pigmented hyphae yellow to yellowish brown, branched, with clamps, sometimes swollen, (1.5–)2–5(–6.5) µm in diam., absent in some isolates (TFC 70-17), but in some others isolates present after two weeks (TFC 86-67, 90-19). Skeletal hyphae (Fig. 1.*3*) yellow to yellowish brown, thick-walled to solid, (1.5–)2–5 µm, rarely up to 6 µm in diam., usually not branched or with very rare branches at the base of some skeletals, not staining but the lumen and especially the club-like rounded tips of the thick-walled skeletals often staining; in poroid areas sometimes swelled. Chlamydospores (Fig. 1.*5*) intercalary, mostly staining, thick-walled, ellipsoid to almost round, 7–18 x 6–12 µm; crystals variably present. *Submerged mycelium*. Generative hyphae (Fig. 1.4) as in the aerial mycelium (1–)1.5–5(–7) µm in diam., slightly more branched than aerial hyphae; branches sometimes narrower, mostly thin-walled, later some broader hyphae (up to 7 µm in diam.) with thickened walls, some thick-walled and rarely branching, simple septate or swelled; yellow pigmented hyphae found in the submerged mycelium of some isolates. Chlamydospores as in aerial mycelium but more numerous; crystals variably present.

Probasidia and some mature *basidia* bearing four sterigmata were found on brown poroid fruiting areas of the isolate TFC 86-67 in 1987, but the macroscopic appearance of that isolate is rather variable. In the descriptions compiled in 1995 the mycelial mat of this isolate remained white and no fruiting areas was formed then.

Oxidase reactions.

	Syr.	Syr+H_2O_2	G-G	a-N	Gua	p-Cre	L-Tyr
TFC 76-17	–	–	–	(+)	–	–	–
TFC 76-20	–	–	–	(+)	–	(+)	–
TFC 86-67	–	–	–	–	–	(+)	–
TFC 90-19	–	–	–	–	–	+	(+)

+, weak; (+), very weak; – , no reaction

All weak or very weak reactions appeared after 30 minutes. Very weak colour reactions with gum-guaiac were also observed in all isolates studied but only after an hour.

Species codes.
Nobles (1965): (2b). 3.8. (26). 34. 36. 37. (38). (39). (40). 43. (50). (53). 54. 60;
Stalpers (1978): (2), 7,(12), 13, 14, 19, 21, 22, 25, 30, 31, 34, (35), 36, (37), (38), 39, 42, 44, 45,46, (50), 51, 52, 53, (54), (55), 67,(80), (82), (83), 85, 89, 94.

MELANOPORIA NIGRA (Berk.) Murrill
N. Am. Fl. 9 (1): 15 (1907);

Gilb. & Ryvarden, N. Am. Polyp. 2: 440, f. 212 (1987). – *Polyporus niger* Berk., London J. Bot. 4: 304 (1845). – *Poria nigra* (Berk.) Cooke, Grevillea 14 (72): 111 (1886); Baxter, Pap. Michigan Acad. Sci., Arts, Lett. 25: 167, t. 12–19 (1940); Overh., Penns. Agric. Exp. Sta. Tech. Bull. 418: 59 (1942); Davidson, Campb. & Vaughn, Fungi causing decay living oaks 44, t. 3 F, f. 6 B (1942). – Lowe, Polyp. N. Y. St. Poria: 78 (1946); Lowe & Gilb., J. Elisha Mitchell Sci. Soc. 77 (1): 59 (1961); Lowe, Mycologia 55 (4): 473 (1963); Polyp. N. Am. Poria 169, f. 158 (1966). – *Nigroporus niger* (Berk.) Ryvarden, Norweg. J. Bot. 24: 213–230 (1977).

Basidiomata perennial, resupinate (sometimes with slightly elevated upper margin), adnate, 2.5–20 cm broad, 0.2–2(–2.5) cm thick; margin narrow, dark brown but paler than pore surface, receding each year. Context corky or woody, up to 2 mm thick, soft-fibrous, dark purplish brown or purplish black, sometimes with a black hard layer next to the substrate. Tubes not stratified or in up to 3 layers; pore surface dark chocolate brown, dark umber to dark blackish brown; pores rounded or slightly angular, 0.1–0.15 mm in diam., 5–7(–8) per mm.

Hyphal system dimitic. Generative hyphae few, thin-walled, sparsely branched, with clamps, hyaline or yellowish, (1–)2–5(–7) µm in diam.; skeletal hyphae very numerous, densely interwined (in tube trama more or less parallel), thick-walled or solid, dark brown, dextrinoid, 4–9(–10) µm in diam., swelling in KOH. No cystidia; hyphidia sometimes present, narrowly conical, up to 25(–30) x 3–4 µm. Basidia broadly clavate, 12–15 x 4–6 µm, with 4 thin sterigmata; spores ellipsoid to oval, with one side flattened, hyaline, nonamyloid, 3–4.5 x 2–3 µm.

Causes brown cubical rot of wood, sometimes heart rot of living oaks.

Distribution and hosts. North America (eastern part of the USA: Alabama, Arkansas, Florida, Illinois, Indiana, Iowa, Kansas, Kentucky, Missouri, N. Carolina, Ohio, Pennsylvania, S. Carolina, Tennessee, W. Virginia, Wisconsin). On logs and living trunks of hardwoods (*Quercus, Castanea*). Mentioned from Taiwan (Chen, 1976: 127) but that locality may belong to *M. castanea*.

Specimens studied: USA, Ohio, March, T.G. Lea 112 (K, holotype; UPS, isotype); Arkansas, Crossett, on *Quercus rubra*, 20 Aug 1951 J.L. Lowe 5043 (BPI, K); N. Carolina, Chapel Hill, on *Quercus*, 13 Oct 1945 J.L. Lowe 2843 (K); S. Carolina, on *Quercus*, Herb. Berk. 1879 (K and Fungi Carolini exs. 1: 20 – BPI, NY, S).

Misidentified specimens seen from Guyana (19 Apr P.J. Edwards 1382, K = *Porogramme albocincta* (Cooke & Massee) Lowe), Ceylon (Herb. C.E. Broome 261, K = *Grammothele fuligo* (Berk. & Broome) Ryvarden), and Dominica (Aug 1892 M.R. Elliote, K = *Porogramme albocincta).*

The spore data given by Murrill, 1907: 14 (spores black, thick-walled, 7 x 4.5 µm) and Davidson, Campbell & Vaughn, 1942 (spores in culture dark smoky brown, 6–7 x 4–5 µm) are erroneous.

Cultural characters.

Culture examined: CBS 341.63 (isolated by R.W. Davidson and H. Wester, District of Columbia, USA).

Growth characteristics: Growth rate on MEA rather variable being moderately rapid in 1987 when it was described first time, plates covered in two-three weeks (77–81 mm in 14 days), medium to slow in 1995, the plates covered in four weeks (40–47 mm in 14 days). Margin mostly even, but may sometimes be slightly indistinct, white or very thin and hyaline, marginal hyphae mostly raised, some appressed, distant. Mat at two weeks thin, even, translucent, white, cottony, opposite to the inoculum appressed cottony, around inoculum sometimes with light to pale brownish spots in cottony mycelium, white sparsely cottony mycelium growing up the edges of the plate and on the lid; later colony white, whitish or sometimes yellowish white (4A2), appressed, translucent, thin cottony, cottony-woolly to thin felty mostly in the areas opposite to the inoculum; the mycelium around the inoculum and sometimes locally all over the plate uneven and slightly raised, pale to light orange (5B3–4) or brownish orange (5C3–5), floccose and with tomentose-felty mounds often surrounded by clearly delimited white margins, especially at the margins of the plate and behind the inoculum slightly with low tubercules and sometimes with shallow pores, the mycelium growing up the edges of the plate mostly pale, light to brownish orange (5B3–4 to 5C3–5), felty or white, sparsely cottony; usually white sparsely cottony mycelium growing on the lid. Reverse unchanged or bleached and under brown areas darkened. Odour quite strong, aromatic or slightly acidulous.

Hyphal characteristics: Marginal hyphae (Fig. 2.*1*) hyaline, thin-walled, with clamp connexions, staining, rarely branching; branches sometimes short, (1.5–)2–3(–4.5) µm in diam. *Aerial mycelium*. Generative hyphae (Fig. 2.*2*) at first mostly thin-walled, later thin- to thick-walled, (1.0–)1.5–2.5(–5.5) µm in diam., moderately to ordinarily branched, sometimes swelled, mostly hyaline and stain-

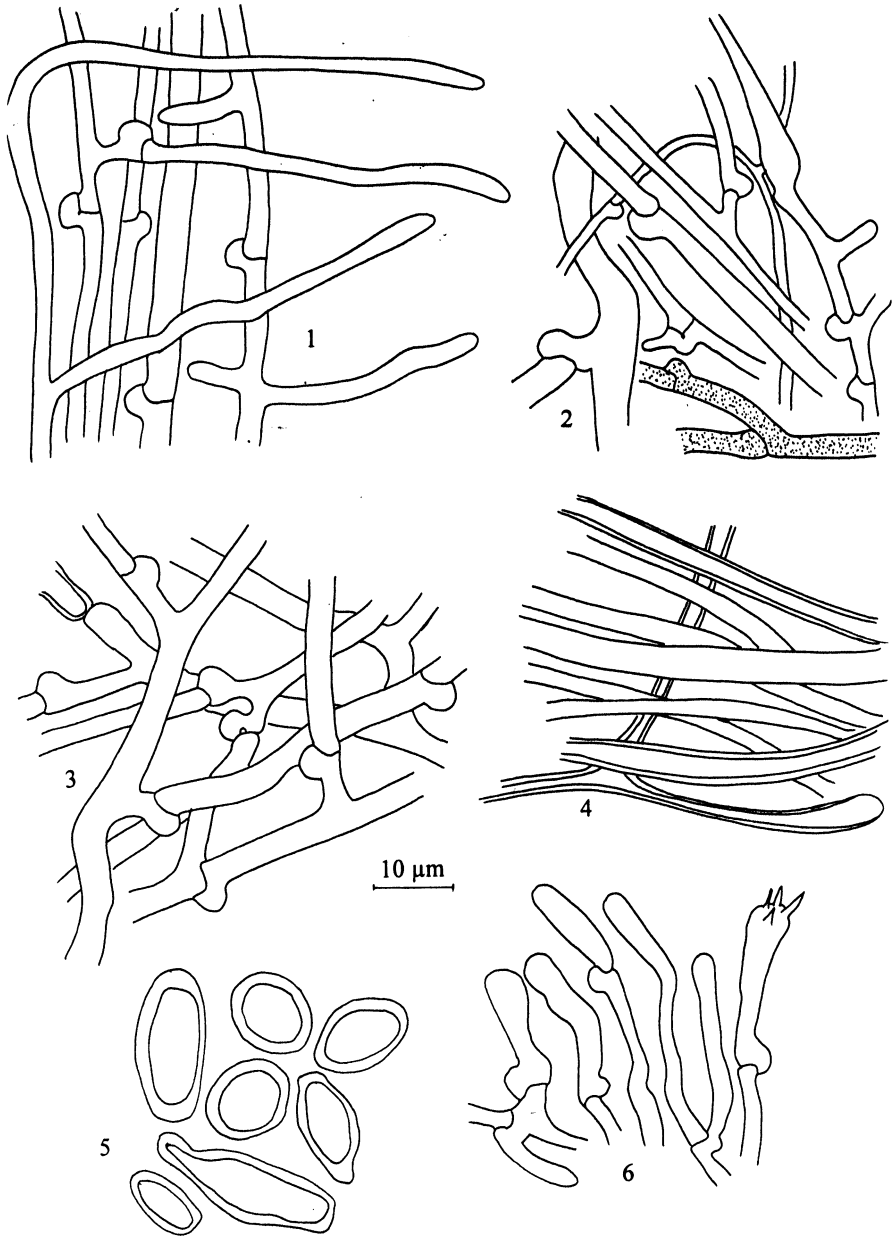

Fig. 2. *Melanoporia nigra*, microscopic structures from culture (CBS 341.63): 1 – generative hyphae from advancing zone; 2 – generative hyphae from aerial mycelium; 3 – generative hyphae from submerged mycelium; 4 – skeletal hyphae; 5 – chlamydospores; 6 – probasidia and a basidium.

ing but later some yellow or yellowish brown branching clamped hyphae present mainly in preparations made from the coloured areas of the mat; some hyphae broader, 6–8 µm, rarely up to 12 µm in diam., mostly thick-walled, staining, often swelled, rarely branched and with conspicuous clamps or not branched and with simple, often constricted septae; some generative hyphae have rather long aseptate, thick-walled branches (young skeletals), mostly at right angles and usually with a clamp connection at the base, with content and especially the thick-walled rounded tips intensively staining, numerous in some areas of the mat. Skeletal hyphae (Fig. 2.*4*) thick-walled or solid, (1.5–)2–4.0(–5.5) µm in diam., usually not branched but very rare branchings of some skeletals were observed, at first yellow, later yellow to brown, not staining but the lumen of the thick-walled skeletal hyphae and especially the thin-walled rounded tips often staining; on poroid areas rarely swollen; numerous, later dominating in brownish poroid felty areas, later present in small amounts also in white cottony areas. Chlamydospores (Fig. 2.*5*) thick-walled, intercalary, 9–24 x 7–10.8 µm, ellipsoid, broadly ellipsoid to almost round, but later of very various shape. Crystals, probasidia and rarely some mature basidia (Fig. 2.*6*) were found in preparations made from brown poroid areas. *Submerged mycelium*. Generative hyphae (Fig. 2.*3*) hyaline, thin-walled and staining, (1.3–)1.6–4.5 µm in diam., more branched than aerial hyphae, later some broader hyphae (up to 6–8 µm in diam.) thick-walled and sometimes swollen. Chlamydospores (Fig. 2.*5*) and crystals present as in aerial mycelium, but more numerous.

Oxidase reactions. All reactions negative, but after an hour very weak reaction with gum guaiac and weak with L-tyrosine.

Species codes.
Nobles (1965): 1. 3. 8. 26. 34. 36. 37. (38). (39). (40). 43. 44. (45). 48. (50). (53). 54;
Stalpers (1978): (6), (7), (8), (12), (13), 14, 19, 21, 22, 25, 30, (31), 34, (35), 36, (37), (38), 39, 42, 44, 45, 46, 50, 51, 52, 53, (54), (55), 67, (80), 85, 88, 89.

The culture description obtained by us is similar to these compiled by Davidson et al. (1942) and J. Stalpers (1978), who possibly used the same strain.

RESULTS OF MATING STUDIES

Incompatibility system. A bifactorial incompatibility system (tetrapolarity) was ascertained for the isolate *M. castanea* TFC 86-67 (Fig. 3). The isolates mating type assignment is as fol-

		A_1B_1			A_2B_2		A_1B_2						A_2B_1
		2	5	12	6	8	3	4	7	9	11	13	10
A_1B_1	2		-	-	+	+	-	-	-	-	-	-	F
	5	-		-	+	+	-	-	-	-	-	-	-
	12	-	-		+	+	-	-	-	-	-	-	F
A_2B_2	6	+	+	+		-	F	F	F	F	-	F	-
	8	+	+	+	-		-	F	-	-	-	-	-
A_1B_2	3	-	-	-	F	-		-	-	-	-	-	+
	4	-	-	-	F	F	-		-	-	-	-	+
	7	-	-	-	F	-	-	-		-	-	-	+
	9	-	-	-	F	-	-	-	-		-	-	+
	11	-	-	-		-	-	-	-	-		-	+
	13	-	-	-	F	-	-	-	-	-	-		+
A_2B_1	10	F	-	F	-	-	+	+	+	+	+	+	

Fig. 3. *Melanoporia castanea* (TFC 86-67). Results of pairings of 12 monokaryotic isolates. Symbols: + compatible mating with abundant clamp connections, – incompatible mating, **F** false clamps formed indicating the presence of common-B factor.

lows (the monokaryons tested additionally are given in the parentheses):

A_1B_1: 2*, 5*, 12*, (23)
A_2B_2: 6*, 8
A_1B_2: 3*, 4*, 7, 9, 11, 13 (17, 28)
A_2B_1: 10*,(22*)

The monokaryotic isolates marked with an asterisk * were used in di-mono mating experiments.

Di-mono matings. Monokaryotic tester strains representing four mating types of the isolate TFC 86-67 were paired with four polysporous isolates of *Melanoporia castanea* including the polysporous isolate of the same specimen (TFC 86-67), and with the dikaryotic isolate of *M. nigra* CBS 341.63. The results of all di-mono pairings between five polyspore isolates and monokaryotic tester strains are given in Fig. 4. The mating data revealed a various degree of partial compatibility between isolates studied. The dikaryotization of monokaryons occurred rather slowly and even in the case of the relatively better dikaryotized monokaryons clamp connections were detected after five to seven weeks of the contact. This slow dikaryotization could not be connected with the age of testers strains. Recently isolated monokaryotic tester strains (nos 2, 3, 6, 10) of *M. castanea* and dikaryotic isolate of *M. nigra* were first mated in 1987 and the clamp connections in subcultures of monokaryon no. 10 were not found before eight weeks of the contact. The behavior of monokaryons was various in different di-mono pairs and the representatives of the same mating type did not behave in the same way. Of the monokaryons nos 3 and 4 (A_1B_2 mating type), only monokaryon no. 4 was readily dikaryotized by all polysporous isolates in six to seven weeks (clamp connections were found in di-mono mats), whereas the monokaryon no. 3 was dikaryotized only by the polysporous isolate TFC 90-19, and even then the clamp connections were found in subcultures only after 17–18 weeks of contact (no clamps after nine weeks of contact). Of the three representatives of the A_1B_1 mating type (nos 2, 5, 12), only monokaryon no. 5 was dikaryotized within six weeks by all dikaryotic isolates studied. Monokaryon no. 2 revealed few clamps in pairs with TFC 76-17, 76-20 and 86-67 after six to eight weeks, whereas after 17–18 weeks abundant clamp connections were found. No clamps in pairs with TFC 90-19 were detected. Monokaryon no. 12 was dikaryotized by dikaryons TFC 76-17 or 76-20 in five to six weeks, but no clamps was detected in pairs with TFC 90-19 or 86-67 after 15–18 months

TAA 86-67		*Melanoporia castanea*				*M.nigra*
Mating type	No. of tester strain	76-17 PSP	76-20 PSP	86-67 PSP	90-19 PSP	CBS 341.63
A_1B_1	2	+	+	+	-	-/-
	5	+	+	+	+	+/n.d.
	12	+	+	-	-	-/n.d.
A_2B_2	6	+	+	+	+	-/F
A_1B_2	3	-	-	-	+	-/-
	4	+	+	+	+	+/n.d.
A_2B_1	10	n.d.	n.d.	n.d.	n.d.	n.d./+
	22	+	+	-	+	-/n.d.

Fig. 4. Results of di-mono matings between monokaryotic tester strains of *Melanoporia castanea* TFC 76-17 and polysporous isolates of *M. castanea* TFC 76-17, 76-20, 86-67, 90-19 and dikaryotic isolate of *M. nigra* CBS 341.63. Symbols: **+** compatible mating, **–** incompatible mating, **F** false clamps, **n.d.** not determined. The mating results on the left side of a slash are derived in 1995, on the right side of a slash in 1987.

of contact. The monokaryon no. 22 was dikaryotized after seven to eight weeks in matings with polysporous isolates of *M. castanea* TFC 76-20 and 90-19, but with the collection of TFC 76-17 only after 18 weeks of the contact the hyphae with clamp connections were found.

Most di-mono matings between monokaryotic tester strains of *M. castanea* and dikaryotic isolate of *M. nigra* were subcultured and checked for clamp connections during 18 weeks (ten weeks in the case of monokaryon no 2); positive results with monosporous tester strains nos 4 and 5 were recorded after five to six weeks of contact.

DISCUSSION

Possibly the negative results of mating tests would not have been changed if the observations would have lasted for a longer period. However, Stenlid & Rayner (1991) detected clamp connections in subcultures of some clampless heterokaryons of *Heterobasidion annosum* after two years. The partial incompatibility between di-mono pairs within isolate TFC 86-67 may be the case of illegitimate noncompatible dikaryon-homokaryon mating where the dikaryotization of the homokaryon may occur, but tardily and sporadically (Raper, 1966), and may therefore be remained undetected. As demonstrated, for example, by Kope (1992) in the case of the ectomycorrhizal fungus *Pisolithus arhizus*, illegitimate heterokaryon-homokaryon pairings may fail to become heterokaryotic at all.

Buller phenomenon has been used by many researchers in incompatibility studies as the only possibility to perform mating experiments. In many cases di-mono matings have given good results, but sometimes the results are confusing: the dikaryotization of monokaryons by dikaryons depends upon several factors. Hallenberg (1988) found in intraspecific matings of *Bulbillomyces farinosa* and *Peniophora limitata* that different single-spore cultures of a specimen representing the same mating type behaved differently in matings with certain other cultures. He concluded that an additional mating barrier exists. Wilson (1991) studied somatic incompatibility in *Echinodontium tinctorium*; he found clamp connections in the mats of monokaryotic component in 54% of di-mono pairings and explained it by the slow growth and somatic incompatibility interactions of the fungus. Stenlid & Rayner (1991) studied heterokaryosis and nuclear migration in *Heterobasidium annosum* and found stable heterokaryons without clamp connections. Their subcultures were found to have clamps two years later, and they concluded that the absence of clamp connections does not necessarily imply absence of gene flow. Vilgalys et al. (1993) used di-mono matings in intercollection matings of *Pleurotus ostreatus* complex and found that six dikaryons were not able to cross with any tester used. They assumed that this is due to several factors, including the presence of additional intersterility groups in *Pleurotus*, or inhibition of di-mono mating. They also noticed that the age of the cultures did not appear to affect their ability to mate. Eger (1978), when using di-mono matings in *Pleurotus ostreatus*, observed restraint of nuclear migration in many compatible and hemicompatible pairings and concluded that the Buller phenomenon has to be used critically and without genetic studies the di-mono matings only provide an estimate of the breeding potential. To obtain useful results, a great number of samples from various regions has to be used. However, this is not always realistic, as recently pointed out by Hallenberg (1998).

Only one dikaryotic isolate of *M. nigra* and monokaryotic tester strains from only one collection of *M. castanea* were available for our mating experiments. The results of di-mono matings do not encourage us in the interpretations of the results since both possibilities are equal. Clamp connections found in some di-mono pairs indicate that some compatibility between the two populations exists. Explanations to the negative results where the dikaryotization of the monokaryons failed is hard to find in such a limited sample.

The partial compatibility has been a subject of many discussions for many investigators. Boidin (1986) and Petersen & Hyghes (1998) have introduced the expression of partial compatibility as a *percent compatibility* to measure the extent of speciation. The 32.5% compatibility in di-mono matings between *M. nigra* and *M. castanea* would support the idea

of considering them as two separate species. The populations of *M. nigra* in North America and *M. castanea* in East Asia have been separated for a long time, but due to the absence of direct contact the genetic barriers are not formed. Abnormal mating behavior in crosses among isolates from different geographical regions may be indicative of incipient speciation (Vilgalys, 1991) and, as pointed out by Petersen (1995), *in vitro* compatibility does not necessarily reflect *in vivo* events. Mating ability on a global scale can at least be said to indicate a close relationship, but does not necessarily imply a proof for conspecificity (Hallenberg, 1998).

The culture characters of *M. nigra* and *M. castanea* are rather similar and no separating characters could be found except that the isolate CBS 341.63 of *M. nigra* always produced fruiting areas with probasidia and mature basidia but the isolates of *M. castanea* studied did not except isolate TFC 86-67 which sometimes produced probasidia and some mature basidia.

The morphological differences between *M. castanea* and *M. nigra* are small. Dai & Niemelä (1995: 217) said that basidiocarps of the first mentioned species are distinctly pileate but always resupinate in *M. nigra*. However, in the original description of *M. nigra*, the basidioma was described as "entirely resupinate, except the very edge, where it is slightly raised" (Berkeley, 1845: 304). On plate XII of the Baxter's paper (1940) there is "a specimen which actually has an ungulate form and so resembles a species of Fomes..." Except this one, no well developed pilei have been found in *M. nigra*. On the other hand, some young specimens of *M. castanea* collected on fallen trunks in Russian Far East have resupinate basidiomata with hardly elevated upper margin. Difference in spore size and form is small; the spores of *M. nigra* are more broadly ellipsoid. The main morphological difference is in skeletal hyphae: according to Dai & Niemelä (1995: 217), these are unchanged in KOH in *M. castanea* but swollen in *M. nigra*: 4–5(–6) µm in diam. in Cotton Blue and 6–9(–10) µm in KOH. In the specimens of *M. nigra* studied by us, this characteristics is not always distinct.

Morphological similarity and partial compatibility between *M. castanea* and *M. nigra* may be interpreted taxonomically in different ways. The taxa may be called subspecies of *M. nigra*, or treated as semispecies, or as sibling species. Semispecies is the most suitable term in this case, but it is not in use in formal taxonomy ruled by the International Code of Botanical Nomenclature. The areas of the two taxa are geographically isolated; they are not fully compatible, and that is why these are considered to be allopatric sibling species by us.

East Asian – East American distribution of plants usually called arctotertiary disjunction of closely related (sibling) species is a well known phenomenon in phytogeography but much less common in mycogeography of wood-rotting fungi. The disjunction of the two *Melanoporia* taxa both specialized to oak wood is probably very old; the Bering Land Bridge between Asia and N. America was covered with broad-leaved forests in the Oligocene or (at the latest) in the Early Miocene (cf. Parmasto, 1979).

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REFERENCES

Baxter, D.V. 1939. Some resupinate Polypores from the region of the Great Lakes. XI. *Pap. Michigan Acad. Sci.* 25: 145–170.

Berkeley, M.J. 1845. Decades of Fungi. Dec. VIII–X. Australian and North American Fungi. *London J. Bot.* 4: 298–315.

Boidin, J. 1980. La notion d'espèce. III Le critère d'interfertilité ou intercompatibilité: résultats et problèmes. *Bull. Soc. Mycol. France* 26: 43–57.

Boidin, J. 1986. Intercompatibility and the species concept in the saprobic Basidiomycotina. *Mycotaxon* 26: 319–336.

Chen, Z.C. 1976. Notes on new Formosan forest fungi. IV. Research on the wood-destroying *Poria* from Taiwan. *Taiwania* 21 (2): 123–127.

Corner, E.J.H. 1987. Ad Polyporaceas IV. *Beih. Nova Hedwigia* 86. 265 pp., 11 pl.

Dai, Y.-C. & Niemelä, T. 1995. Changbai wood-rotting fungi 4. Some species described by A.S. Bondartsev and L.V. Lyubarsky from the Russian Far East. *Ann. Bot. Fenn.* 32: 211–226.

Davidson, R.W., Campbell, W.A. & Vaughn, D.B. 1942. Fungi causing decay of living oaks in the eastern United States and their cultural identification. *Techn. Bull. U.S.D.A.* 785. 65 pp.

Eger, G. 1978. Biology and breeding of *Pleurotus*. In *The biology and cultivation of edible mushrooms*. (eds Chang, S.T. & Hayes, W.A.), pp. 497–519. Academic Press, New York.

Gilbertson, R.L & Ryvarden, L. 1987. *North American Polypores*. Vol. 2. Fungiflora, pp. 435–885. Oslo.

Hallenberg, N. 1988. Species delimitation in Corticiaceae (Basidiomycetes). *Mycotaxon* 31 (1): 445–465.

Hallenberg, N. 1998. Evolutionary processes on species level in wood-inhabiting Basidiomycetes. *Folia Cryptog. Estonica* 33:35–40.

Hattori, T. & Ryvarden, L. 1994. Type studies of Polyporaceae 25. Species described from Japan by R. Imazeki and A. Yasuda. *Mycotaxon* 50: 27–46.

Kope, H.H. 1992. Interactions of heterokaryotic and homokaryotic mycelium of sibling isolates of the ectomycorrhizal fungus *Psilolithus arhizus*. *Mycologia* 85 (5): 659–667.

Kornerup, A. and J.H. Wancher. 1978. *Methuen Handbook of Colour.* 3rd ed. London.

Marr, C.D. 1978. Laccase and tyrosinase oxydation of spot test reagents. *Mycotaxon* 9 (1): 244–276.

Munsell Color Co., Inc. 1942. *Munsell Book of Color.* Baltimore.

Murrill, W.A. 1907. *North American flora.* Vol. 9 (1) (Polyporaceae): 1–72.

Nakasone, K.K. 1990. Cultural studies and identification of wood-inhabiting Corticiaceae and selected Hymenomycetes from North America. *Mycol. Mem.* 15: 1–412.

Nobles, M.K. 1965. Identification of cultures of wood-inhabiting Hymenomycetes. *Canad. J. Bot.* 43: 1097–1139.

Parmasto, E. 1979. Genesis of the flora of wood-rotting Aphyllophorales fungi in the Far East of the Soviet Union. In *XIV Pacific Science Congress. Abstract of papers. H.* pp. 33–34. Moscow.

Parmasto, E. & Parmasto, I. 1992. Size and shape of basidiospores in the Hymenomycetes. *Mycol. Helv.* 5: 47–78.

Petersen, R.H. 1995. There's more to a mushroom than meets the eye: Mating studies in the Agaricales. *Mycologia* 7 (1): 1–17.

Petersen, R.H. & Hughes, K.W. 1998. Mating systems in *Omphalotus* (Paxillaceae, Agaricales). *Pl. Syst. Evol.* 211: 217–229.

Raper, J.R. 1966. *Genetics of sexuality in higher fungi.* Ronald Press, NY. 283 pp.

Ryvarden, L. 1977. Type studies in the Polyporaceae 10. Species described by J.M. Berkeley, either alone or with other authors from 1844 to 1855. *Norweg. J. Bot.* 24: 213–230.

Ryvarden, L. 1986. A note of the Polyporaceae in the Chang Bai Shan Forest Reserve in northeastern China. *Acta Mycol. Sin.* 5 (4): 226–234.

Ryvarden, L. 1991. *Genera of polypores. Nomenclature and taxonomy*. Synopsis Fungorum 5. Fungiflora, Oslo. 363 pp.

Ryvarden, L. & Johansen, I. 1980. *A preliminary polypore flora of East Africa*. Fungiflora, Oslo. 636 pp.

Stalpers, J.A. 1978. Identification of wood-inhabiting fungi in pure culture. *Stud. Mycol.* 16, 248 pp.

Stenlid, J. & Rayner, A.D. 1991. Patterns of nuclear migration and heterokaryosis in pairings between sibling homokaryons of *Heterobasidion annosum*. *Mycol. Res.* 95 (11): 1275–1283.

Vilgalys, R. 1991. Speciation and species concepts in the *Collybia dryophila* complex. *Mycologia* 83 (6): 758–773.

Vilgalys, R., Smith, A., Sun, B.L. & Miller, O.K. *Jr.* 1993. Intersterility groups in the *Pleurotus ostreatus* complex from the continental United States and adjacent Canada. *Canad. J. Bot.* 71: 113–128.

Wilson, A.D. 1991. Somatic incompatibility in dikaryotic-monokaryotic and dikaryotic pairings of *Echinodontium tinctorium*. *Canad. J. Bot.* 69: 2716–2723.

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Lichens in the reserves and other important woods of eastern Latvia

Alfons Piterans & Anna Zeiviniece
Department of Botany and Ecology, University of Latvia, 4 Kronvalda bulv., LV 1586, Riga, Latvia.
E-mail: apiteran@lanet.lv

Abstract: Of the 112 recorded lichen species growing in the botanical reserves of eastern Latvia, ten species (*Cetrelia cetrarioides, Evernia divaricata, Hypogymnia vittata, Lobaria pulmonaria, L. scrobiculata, Menegazzia terebrata, Pertusaria flavida, P. hemisphaerica,Ramalina thrausta* and *Thelotrema lapadinum*) are included in the Red Data Book, and three others are rare (*Flavoparmelia caperata, Leptogium cyanescens* and *Rinodina pyrina*).

Kokkuvõte: A. Piterans ja A. Zeivinice. Samblikud Ida-Läti kaitsealadel ja muudes olulistes metsades.

Ida-Läti botaanilistelt kaitsealadelt on leitud 112 samblikuliiki. Neist kümme (*Cetrelia cetrarioides, Evernia divaricata, Hypogymnia vittata, Lobaria pulmonaria, L. scrobiculata, Menegazzia terebrata, Pertusaria flavida, P. hemisphaerica,Ramalina thrausta* ja *Thelotrema lapadinum*) on kantud Punasesse raamatusse, kolm muud liiki on haruldased.

INTRODUCTION

Forests, an intrinsic part of the natural heritage of Latvia, once covered nearly the entire territory. Over the last few thousands of years, the structure and biological diversity of natural forests have been modified due to changes in ecological factors and anthropogenic impact. The distributions of sensitive lichen species have narrowed or they have become extinct. Monitoring of lichen populations is important in assessment of environmental changes, particularly with respect to the natural, relatively untouched forests that contribute most to biological diversity. Reserves, which are rather well protected from human impact, have been well studied in their vascular plant flora but their lichen floras are less known. The aim of this paper is to describe the lichen flora of reserves and other natural forest habitats in eastern Latvia.

MATERIAL AND METHODS

Reserves represent one type of protected territories in Latvia. Our study was focused on the reserves of eastern Latvia, as well as on a few natural forest habitats. Studies were made in the following sites (Fig. 1):

1. Barkava – Barkava Oak Woods, Barkavas Pagasts, Madonas District;
2. Kuprava – Kuprava Linden Woods, Liepnas Pagasts, Aluksnes District;
3. Marsi – Oak Woods in Valkas Pagasts by the Gauja bridge, Valkas District;
4. Pededze – oak woods in Stradu Pagasts, Gulbenes District;
5. Piedruja – Piedrujas Oak Woods, Piedrujas Pagasts, Kraslavas District;
6. Pilori – Pahatnieka and Pilora Oak Woods along the Lake Ezezera shore, Andzeiu Pagasts, Kraslavas District;
7. Sloboda – oak woods by the Sloboda on the right bank of the Daugave River, Kalnieshu Pagasts, Kraslavas District;
8. Ziles – planned Pirtsliea-Lika Tributary Nature Reserve (Zile Forestry Management Area, oak woods in Forest Management Units 105 and 110 along the banks of the Gauja River) Valkas Pagasts, Valkas District.

The lichen flora of the reserves was assessed in relation to species composition, particularly of rare species, and recommendations for protection were made. Material (about 400 herbarium specimens) was collected during May and August, 1998 and deposited in Herbarium RIG. The abbreviations of authors names are given after Kirk & Ansell (1992).

RESULTS

The Kuprava Linden Woods Botanical Reserve is characterized by a mixed-age linden canopy, combined with ash, maple, elm and spruce. The unique microclimate of the forest stands

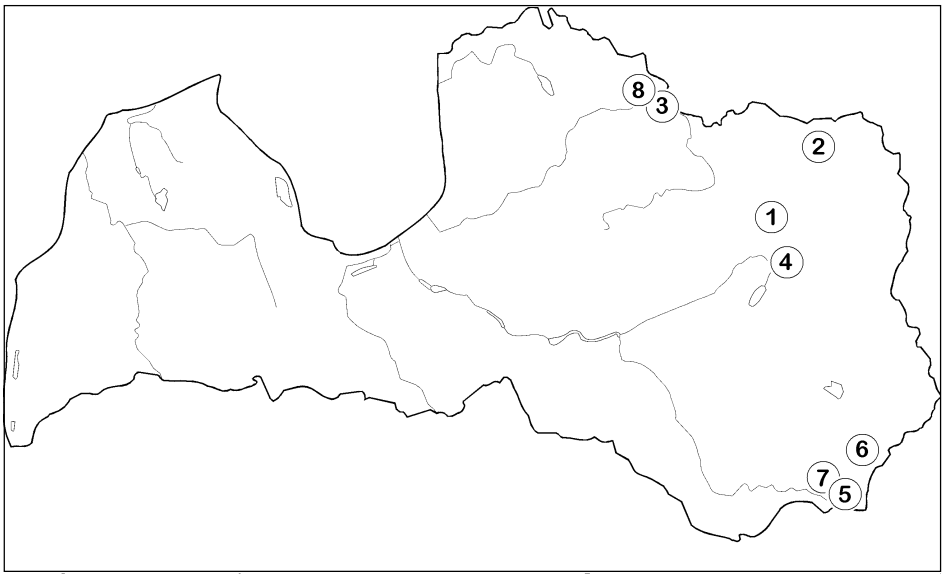

Fig. 1. Location of study sites in botanical reserves and other important woods of eastern Latvia. 1. Barkava, 2. Kuprava, 3. Marsi, 4. Pededze, 5. Piedruja, 6. Pilori, 7. Sloboda, 8. Ziles.

supports the survival and growth of many rare lichen species. *Cetrelia cetrarioides* grows on old shaded linden trunks, the only location in eastern Latvia. Another rarity is the moisture-loving crustose lichen *Thelotrema lepadinum*, which is largely restricted to wet coastal areas of Latvia. *Menegazzia terebrata* was also found on shaded broad-leaf tree trunks. *Hypogymnia vittata*, a rare species found growing on a fallen linden tree covered with moss, has been previously recorded only in the Gauja National Park on moss-covered sandstone cliffs. *Evernia divaricata* mainly is growing in the eastern Latvia. Large foliose *Lobaria pulmonaria* isnt rare for other parts of Latvia. In total we have more then 100 localities in Latvia. Of the studied areas, the Kupravas linden tree stand was the richest in rare lichen species, and also in more common lichens (Table 1).

The Pededze Oak Woods Botanical Reserve is unique in its old oak trees abundantly overgrown with lichens. *Lobaria pulmonaria*, one of rare species, grows mainly on old oak and ash trunks. Other rare species include *Cetrelia cetrarioides*, characteristic in eastern Latvia, *Menegazzia terebrata*, and *Ramalina thrausta* which grows mainly on coniferous trees.

The planned Pirtslica-Likas Tributary Nature Reserve in the Zile Forest Management Area (Valka District) hosts old oak stands mixed with linden tree, ash and other broad-leaf trees. The woods host many rare lichen species: *Lobaria scrobiculata*, *Cetrelia cetrarioides*, *Leptogium cyanescens*, *Umbilicaria deusta*, the crustose lichens *Pertusaria hemisphaerica* and *P. flavida*, as well as many common lichen species.

The Barkava Oak Woods Botanical Reserve is dominated by oak, mixed with ash, European bird cherry, alder, buckthorn and other trees. Of the 31 recorded lichen species, rare species include *Menegazzia terebrata* on oak, *Flavoparmelia caperata* (one of two locations in Latvia), and *Cetrelia cetrarioides* which forms large thalli on old oak follen logs.

A total of 70 lichen species were recorded on the islands of Lake Ezezers. Under the dominant broad-leaf tree canopies, many shade-tolerant and moisture-loving lichens are found. The lichen species are mostly epiphytic, and there are a few lichens growing on soil, mostly in open areas. The lichen flora is composed mainly of common species (*Hypogymnia physodes*, *Parmelia sulcata*, *Graphis scripta*, *Physcia tenella*, *Xanthoria parietina* etc.). The most diverse floras occur on the islands of Jershovka, Liela sala, and Liela Kalinas sala. Soil-inhabiting lichens are most common on

Jershovka Island, where habitat diversity is highest. *Peltigera polydactyla* occurs on shaded soil. The only *Usnea* species is *U. hirta*. *Melanelia elegantula* is a rare species found on broad-leaf trees of some of the islands (Piterans,1982; Piterans & Zeiviniece, 1996, 1999; Piterans et al., 1971).

The lovely Pahatnieku and Piloru Oak Woods along the shores of Lake Ezezera in Kraslava District are formed by many old oak, ash and other broad-leaved trees. The trees support many common species. Rare species were not found, but the habitats are suitable for *Cetrelia cetrarioides*, *Lobaria pulmonaria* and other rare species.

In the Piedruja Oak Woods and the Indrica Valley, crustose lichens (*Graphis scripta*, *Arthonia radiata*, and *Arthothelium ruanum*) grow mostly on smooth bark of broad-leaved trees. The most common foliose lichens are *Hypogymnia physodes*, *Parmelia sulcata*, *Physconia distorta*, *Anaptychia ciliaris*, *Physconia grisea*, and *Platismatia glauca*. Abundant crustose lichens include *Lecanora carpinea*, *Graphis scripta* and *Phlyctis argena*.

The Daugava Valley by the shore of the Sloboda are rich in oak, linden tree, and in places also ash, habitats which are suitable for common and rare lichen species. *Flavoparmelia caperata* which grows on old oak stumps, is associated mainly with broad-leaved trees. The rare *Rinodina pyrina* was found, but *Bacidia hegetschweileri* which was recorded here 100 years ago by A. Bruttan (Bruttan, 1870; Piterans, 1996) has not been subsequently found.

Some rare lichen species grow also in relatively untouched forests. For example, the rare *Cetrelia cetrarioides*, *Menegazzia terebrata*, and *Evernia divaricata* were found in the Numernes Forest Management Area, Ludza District. Also, rare species such as *Pleurosticta acetabulum* can occur in parks, roadsides or on separate trees.

Table 1. List of recorded lichen species in reserves and other important woods of eastern Latvia. Red data species are marked with an asterisk *.

Species	Barkava	Kuprava	Marsi	Pededze	Piedruja	Pilori	Sloboda	Zile
	1	2	3	4	5	6	7	8
Amandinea punctata (Hoffm) Coppins & Scheid.							+	
Anaptychia ciliaris (L.) Körb.	+	+	+	+	+	+	+	+
Bryoria capillaris (Ach.) Brodo & D. Hawksw.								+
Bryoria fuscescens (Gyeln.) Brodo & D. Hawksw.		+	+			+		+
Buellia griseovirens (Turner & Borrer) Almb.		+		+	+		+	+
Calicium viride Pers.								+
Caloplaca cerina (Ehrh. ex Hedw.) Th. Fr.								+
Caloplaca flavorubescens (Huds.) J. R. Laundon		+						+
Caloplaca holocarpa (Hoffm. ex Ach.) A. E. Wade			+			+		
Candelaria concolor (Dickson) Stein					+		+	
Candelariella xanthostigma (Ach.) Lettau			+	+				
Cetraria chlorophylla (Willd.) Vain.		+						+
Cetraria islandica (L.) Ach.				+				
**Cetrelia cetrarioides* (Delise ex Duby) W. L. Culb. & C. F. Culb.	+	+		+				
Chaenotheca chrysocephala (Turner ex Ach.) Th. Fr.				+				
Chaenotheca furfuracea (L.) Tibell		+						
Chrysothrix candelaris (L.) J. R. Laundon	+			+				+
Cladina rangiferina (L.) Nyl.		+					+	
Cladina stellaris (Opiz) Brodo								+
Cladonia cenotea (Ach.) Schaer.		+	+					

	1	2	3	4	5	6	7	8
Cladonia chlorophaea (Flörke ex Sommerf.) Spreng.			+	+				
Cladonia coniocraea (Flörke) Spreng.	+	+				+		+
Cladonia cornuta (L.) Hoffm.		+						
Cladonia crispata (Ach.) Flot.		+						
Cladonia deformis (L.) Hoffm.		+	+					
Cladonia digitata (L.) Hoffm.		+	+					
Cladonia fimbriata (L.) Fr.				+		+		
Cladonia floerkeana (Fr.) Sommerf.		+						
Cladonia furcata (Huds.) Schrad.		+		+				
Cladonia glauca Flörke		+						
Cladonia gracilis (L.) Willd.		+						
Cladonia macilenta Hoffm.						+		
Cladonia phyllophora Hoff.		+						
Cladonia verticillata (Hoffm.) Schaer.		+						
**Evernia divaricata* (L.) Ach.		+						
Evernia prunastri(L.) Ach.	+	+	+	+	+	+	+	+
Flavoparmelia caperata (L.) Hale	+						+	
Graphis scripta(L.) Ach.	+			+	+	+		+
Hypocenomyce scalaris(Ach.) M. Choisy		+		+		+		+
Hypogymnia physodes (L.) Nyl.	+	+	+	+	+	+	+	+
Hypogymnia tubulosa (Schaer.) Hav.	+			+				
**Hypogymnia vittata* (Ach.) Parrique		+						
Imshaugia aleurites (Ach.) S. L. F. Meyer								+
Lecanora albella (Pers.) Ach.				+				+
Lecanora allophana Nyl.						+		+
Lecanora argentata (Ach.) Malme				+		+	+	
Lecanora carpinea (L.) Vain.	+	+			+	+	+	+
Lecanora leptyrodes (Nyl.) Degel.					+			
Lecanora populicola (DC.) Duby	+			+		+		+
Lecanora pulicaris (Pers.) Ach.						+		
Lecanora symmicta (Ach.) Ach.					+			
Lecidella elaeochroma (Ach.) M. Choisy	+	+	+				+	
Lecidella euphorea (Flörke) Hertel	+	+					+	+
Lepraria incana (L.) Ach.	+	+	+	+	+	+	+	+
Leptogium cyanescens (Rabenh.) Körb.								+
**Lobaria pulmonaria* (L.) Hoffm.		+	+	+				+
**Lobaria scrobiculata* (Scop.)DC.								+
Melanelia exasperata (De Not.) Essl.					+			
Melanelia exasperatula (Nyl.) Essl.	+	+		+	+	+	+	+
Melanelia glabratula (Lamy) Essl.	+	+	+	+	+	+	+	+
Melanelia olivacea (L.) Essl.	+			+				+
Melanelia subaurifera (Nyl.) Essl.								+
**Menegazzia terebrata* (Hoffm.) A. Massal.	+	+		+				
Opegrapha vulgata Ach.		+						
Parmelia sulcata Taylor	+	+	+	+	+	+	+	+
Parmeliopsis ambigua (Wulfen) Nyl.		+						

	1	2	3	4	5	6	7	8
Peltigera aphthosa (L.) Willd.								+
Peltigera canina (L.) Willd.				+		+		+
Peltigera degenii Gyeln.								+
Peltigera didactyla (With.) J. R. Laundon		+		+	+			
Peltigera horizontalis (Huds.) Baumg.	+							
Peltigera hymenina (Ach.) Delise			+					
Peltigera neckeri Hepp ex Müll. Arg.	+							
Peltigera polydactyla (Neck.) Hoffm.		+		+				
Peltigera praetextata (Flörke ex Sommerf.) Zopf	+	+	+	+		+		+
Peltigera rufescens (Weiss) Humb.			+	+				
Pertusaria albescens (Huds.) M. Choisy	+	+				+		+
Pertusaria amara (Ach.) Nyl.	+	+	+	+	+	+	+	+
Pertusaria coccodes (Ach.) Nyl.								+
**Pertusaria flavida* (DC.) J. R. Laund.				+				+
**Pertusaria hemisphaerica* Flörke) Erichsen								+
Pertusaria leioplaca DC.		+						+
Phaeophyscia ciliata (Hoffm.) Moberg						+		
Phaeophyscia orbicularis (Neck.) Moberg		+				+		
Phlyctis argena (Spreng.) Flot.	+	+		+	+	+	+	+
Physcia adscendens (Fr.) H. Oliver					+	+		
Physcia aipolia (Ehrh. ex Humb.) Fürnr.		+	+		+	+	+	+
Physcia stellaris (L.) Nyl.				+	+	+		
Physcia tenella(Scop.) DC.		+		+	+	+	+	
Physconia distorta (With.) J. R. Laundon		+	+		+	+	+	+
Physconia enteroxantha (Nyl.) Poelt		+						
Physconia grisea (Lam.) Poelt		+			+	+	+	
Platismatia glauca (L.) W. L. Culb. & C. F. Culb.	+	+	+	+	+	+	+	+
Pseudevernia furfuracea (L.) Zopf	+			+		+	+	+
Ramalina farinacea (L.) Ach.	+	+	+	+	+	+	+	+
Ramalina fastigiata (Pers.) Ach.					+			
Ramalina fraxinea (L.) Ach.	+	+	+	+	+	+	+	+
Ramalina obtusata (Arnold) Bitter		+		+				
Ramalina pollinaria (Wesr.) Ach.				+		+	+	+
Ramalina roesleri (Hochst. ex Scher.) Hue		+					+	+
Ramalina sinensis Jatta					+			
**Ramalina thrausta* (Ach.) Nyl.				+				
Rinodina pyrina (Ach.) Arnold					+		+	
**Thelotrema lepadinum* (Ach.) Ach.		+						
Umbilicaria deusta (L.) Baumg.								+
Usnea filipendula Stirt.		+		+				+
Usnea hirta (L.) F. H. Wigg.				+				
*Usnea subfloridana*Stirt.	+	+						
Vulpicida pinastri (Sop.) J.-E. Mattsson & M. J. Lai		+						
Xanthoparmelia somloensis (Gyeln.) Hale		+						
Xanthoria parietina (L.) Th. Fr.	+		+	+		+		+
Xanthoria polycarpa (Hoffm.) Th. Fr. ex Rieber				+	+			

DISCUSSION

Lichens, as any other organisms, are an intrinsic component of the biosphere. They are characterized by large diversity in form, and play an important role in natural processes. Lichen species distributions have been declining due to environmental pollution and alterations in habitats. Many species have become rare, and populations of other common species are decreasing. Population decline is most apparent for species which require a natural, untouched habitat. Therefore, to protect the genetic diversity of lichens, it is necessary to protect the habitats which are most suitable for their survival and growth, bearing in mind the specific conditions to which each species is adapted. In this respect, protection of the diversity of habitats and substrates for lichens is important.

Of the 500 lichen species in Latvia, 34 are included in the Latvian Red Data Book (Piterans & Vimba, 1996). A part of the Red Data Book listed lichens grow in protected territories but some are outside of protection regimes. Human impact has caused rapid changes in natural vegetation by forest harvest and pollution, which strongly also affect lichen survival and growth. Populations of these lichen species have declined, and tolerant species have adapted to the altered environment. More attention should be paid to the lichen species which are included in the Latvian Red Data Book. The protection of such rare species is possible by conservation of their natural habitats. It is important to study the biology and ecology of rare species to develop their protection plans, to ensure their survival for subsequent generations.

A total of 112 lichen species were found in botanical reserves and other natural forests of eastern Latvia, of which ten are included in the Red Data Book (*Cetrelia cetrarioides, Evernia divaricata, Hypogymnia vittata, Lobaria pulmonaria, L. scrobiculata, Menegazzia terebrata, Pertusaria flavida, P. hemisphaerica, Ramalina thrausta* and *Thelotrema lepadinum*) and three are rare (*Flavoparmelia caperata, Leptogium cyanescens* and *Rinodina pyrina*). There were six red listed species found in the Kuprava linden tree woods, three in the Barkava oak woods, and six in the Pededzes oak woods. Red listed lichens were not found in the Pahatnieki and Pilori oak woods, even in suitable habitats for these species. This may be due to higher anthropogenic impact. Similarly, rare lichen species were absent from the Piedruja oak woods. The oak woods of the Ziles Forest Management Area in Valka District, along the Pirtsliea- Lika tributary (Forest Management Units 105 and 110) supported six protected lichen species, which is likely a result of a low impact level and unaltered habitats. Therefore, these woods should be protected for biological diversity. The study results should help to facilitate forest management for conservation of biological diversity, and are important also for regional nature protection and environmental education.

ACKNOWLEDGEMENTS

We wish to thank Roger Andersson (Swedish Threatened Species Unit SLU) and prof. Stellan Sundhede (Göteborg University) for financial assistance in organizing expedition in Latvia and for useful scentific discussions. We also thank prof. Guntis Brumelis (University of Latvia) for the English translation of the text.

REFERENCES

Bruttan, A. 1870 *Lichenen Est-, Liv- und Kurlands. Arch. Naturk. Liv-, Ehst- und Kurland.* Zweiter Serie 7: 163–326.

Kirk, P. M. & Ansell A. E. 1992. *Authors of fungal names.* C. A. B. International. Wallingford. 95 pp.

Piterans, A. 1982. *Lichens of Latvia* (in Russian). Zinatne, Riga. 352 pp.

Piterans, A. 1996. Lichens of the Daugava Valley (in Latvian). *Daba un muzejs* 6: 74–76.

Piterans, A. & Zeiviniece A. 1996. Review of the Eastern Latvia lichen flora (in Latvian). *Daba un muzejs*. 6 : 77–80.

Piterans, A. & Zeiviniece A. 1999. The lichen of the Latgale district (in Latvian). *Acta Latgalica* 10: 312–324.

Piterans, A. & Vimba, E. 1996. *Latvian Red Data Book. Fungi and Lichens* (in Latvian and English). LU Biologijas instituts, Riga, 202 pp.

Piterans, A., Pokule, A & Trifonova, Z. 1971. Short description of the lichens flora of islands of Lake Ezezers (in Russian). In *Materials of the VI Symposium of the Baltic republics on mycology and lichenology I.* Riga, pp. 45 - 47.

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New species and new records of Ascomycetes from Estonia

Ain Raitviir[1] & Kadri Leenurm [1,2]

[1]Institute of Zoology and Botany, Estonian Agricultural University, Riia Street 181, EE51014 Tartu, Estonia. E-mail: ain@zbi.ee

[2] Institute of Botany and Ecology, University of Tartu, Lai 40, EE51003 Tartu, Estonia. E-mail: kadleen@ut.ee

Abstract: Three new species of Helotiales, *Phaeohelotium hylocomnii* Raitv. & Leenurm (Helotiaceae), *Lachnum pendulae* Raitv. and *Proprioscypha echinulata* Raitv. & Leenurm (Hyaloscyphaceae), are described and 25 species of Ascomycetes belonging to 4 orders and 10 families are reported for the first time from Estonia. Two new combinations, *Belonidium sulphurellum* (Peck) Raitv. & Leenurm and *Belonidium virtembergense* (Matheis) Raitv. & Leenurm, are proposed.

Kokkuvõte: A. Raitviir ja K. Leenurm. Kottseente uued liigid ja esmasleiud Eestist.

Kirjeldatakse kolm uut tiksikulaadsete seltsi (Helotiales) kuuluvat liiki *Phaeohelotium hylocomnii* Raitv. & Leenurm (Helotiaceae), *Lachnum pendulae* Raitv ja *Proprioscypha echinulata* Raitv. & Leenurm (Hyaloscyphaceae) ja 25 esmakordselt Eestist leitud kottseent, neljast erinevast seeneseltsist ja kümnest sugukonnast. Pakutakse välja kaks uut kombinatsiooni: *Belonidium sulphurellum* (Peck) Raitv. & Leenurm ja *Belonidium virtembergense* (Matheis) Raitv. & Leenurm.

INTRODUCTION

Several new, rare or interesting species of Ascomycetes have been found in Estonia in recent years. The authors have collected or identified from collections by other mycologists three new species and twenty five first records for Estonia.

MATERIAL AND METHODS

Freshly collected living material was mounted in tap water, and dry herbarium material was soaked in a 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 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

ELAPHOMYCETALES

Elaphomycetaceae

ELAPHOMYCES ACULEATUS Vittad.

Tartumaa, Järvselja, Forestry block no. 274 (58°16'N 24°18'E), hypogeous in spruce forest, Aug 27 2000, coll. M. Vaasma, det. A. Raitviir (TAA 165687), Aug 28 2000, coll. M. Soon, det. A. Raitviir (TAA 165679). The first collection was parasitized by *Cordyceps canadensis* Ellis & Everh.

HYPOCREALES

Clavicipitaceae

CORDYCEPS CANADENSIS Ellis & Everh.

Tartumaa, Järvselja, Forestry block no. 274, (58°16'N 24°18'E), on fruitbodies of *Elaphomyces aculeatus* in spruce forest, Aug 27 2000, coll. M. Vaasma, det. A. Raitviir (TAA 165687).

Hypocreaceae

NECTRIA BEROLIENSIS (Sacc.) Cooke

Tartu, Mäe St. (58°23.7'N 26°43.5'E), on dead branches of *Ribes nigrum* in a garden, May 24 2000, coll. K. Jürgens, det. K. Leenurm (TAA 165642).

PODOSTROMA ALUTACEUM (Pers.: Fr.) G.F. Atk.

Valgamaa, Helme Comm., SW of Lagesoo, Taagepera Forestry, block no. 38, (58°2.5'N 25°44.4'E), on soil in a pine forest of *Vaccinium vitis-idaea* type, Jul 20 1998, coll. E. Parmasto, det. A. Raitviir (TAA 167717).

Tartumaa, Järvselja, Forestry block no. 274, (58°16'N 24°18'E), on the forest debris in spruce forest, Aug 28 2000, coll. M. Soon, det. A. Raitviir (TAA 165680).

HELOTIALES

Dermateaceae

PEZICULA RUBI (Lib.) Niessl

Pärnumaa, Nigula Nature Reserve, N-coast of the lake (58°01.0'N 24°43.0'E), on a dead cane of *Rubus idaeus*, Sep 24 1990, A. Raitviir (TAA 137932).

Geoglossaceae

MICROGLOSSUM FUSCORUBENS Boud.

Saaremaa, Kuressaare Comm., S. of Mullutu (58°15.8'N 22°24.0'E), on the ground under *Corylus avellana* in an oak forest, Sep 11 1998, coll. I. Parmasto, det A. Raitviir (TAA 169161).

MICROGLOSSUM VIRIDE (Fr.) Gillet

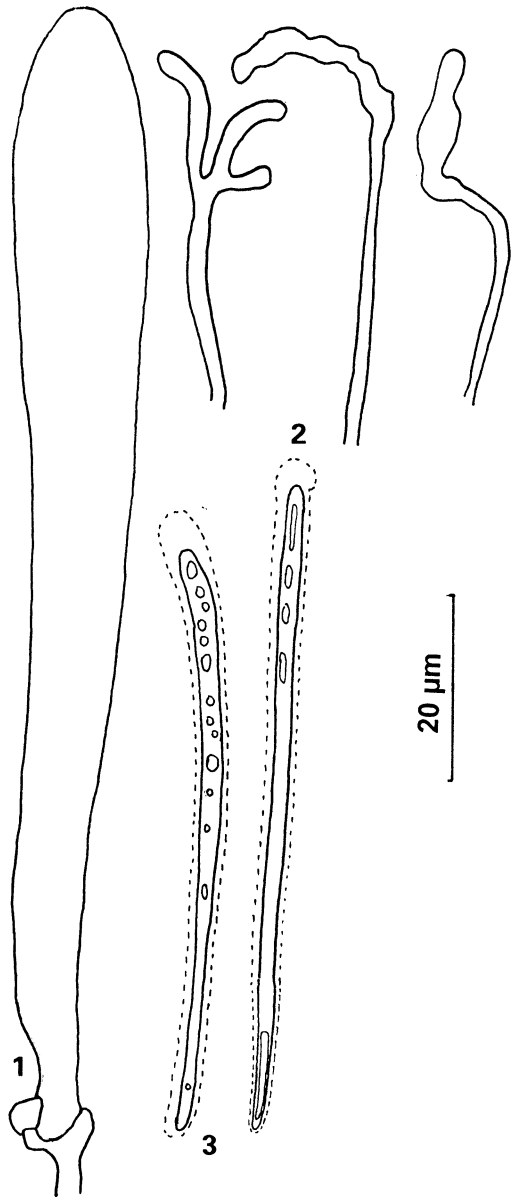
Saaremaa, Kuressaare Comm., S. of Mullutu (58°15.8'N 22°24.0'E), on the ground under *Tilia cordata* in an oak forest, Sep 11 1998, coll. I. Parmasto, det A. Raitviir (TAA 169161).

SPATHULARIA NEESII Bres.

Ascocarps scattered to solitary, 1.5–3 cm high. Clavula 4–7 mm broad, about 2 mm thick, pale ochraceous. Stipe 1–2 cm high, 1.5–3 mm thick, more or less cylindrical, flattened at the top, concolorous with the hymenium. Asci arising from croziers, clavate, 8-spored, 110–135 × 12–14 µm. Spores fasciculate, acicular, slightly widened in upper and narrowed at the lower end, straight to slightly flexuous, aseptate, containing numerous lipid globules, 60–75 × 2–2.4 µm, surrounded by a mucilaginous envelope about 0.8 µm thick and forming a conspicuous apical clavula up to 6 µm wide. Paraphyses filiform.

Tartumaa, Järvselja, Forestry block no. 286 (58°15.5'N 27°18.5'E), in larch forest, on dead fallen needles of *Larix* sp., Aug 29 2000, coll. K. Leenurm, det. A. Raitviir & K. Leenurm (TAA 165685).

This species, greatly neglected and only very briefly mentioned in the taxonomic studies on *Spathularia* (Mains, 1956; Maas Geesteranus, 1972; Ohenoja, 1975), is very probably a rare one confined to needle debris of *Larix* spp. Until now it has been reported only from the Alps, most recently by Rahm (1966) and Baral & Krieglsteiner (1985). The Estonian record is a distant outpost from the alpine distribution area of the species, and demonstrates how a saprobic fungal species is introduced to a new area together with its host species.



Figs 1–3. *Spathularia neesii*. – **1.** An ascus. – **2.** Paraphysis tips. – **3.** Two spores. (From TAA 165685).

The authors find *S. neesii* to be a good species different from *S. flavida* Pers: Fr. and *S. rufa* Cooke in small delicate ascocarps having clavula and stipe of the same colour. Microscopically it is distinct in its long straight spores having a thicker mucilaginous envelope

than in the other species characterized by shorter and usually curved spores.

Helotiaceae

ALLOPHYLARIA SUBLICOIDES (P. Karst.) Nannf.

Jõgevamaa, Alam-Pedja Nature Reserve, Umbusi-Epruraba Zone, Kursi Forestry, block no. 300 (58°28.5'N 26°9.0'E), on dead stems of *Filipendula ulmaria*, Aug 27 1997, coll. K. Leenurm, det. A. Raitviir (TAA 164067).

CYSTOPEZIZELLA CONORUM (Rehm) Svrcek.

Pärnumaa, Nigula Nature Reserve, Forestry block no.83 (58°01.0'N 24°43.0'E), on wood of a deciduous tree, Sep 17 1996, coll. K. Põldmaa, det A. Raitviir.

DISCINELLA MARGARITA W.D. Buckley

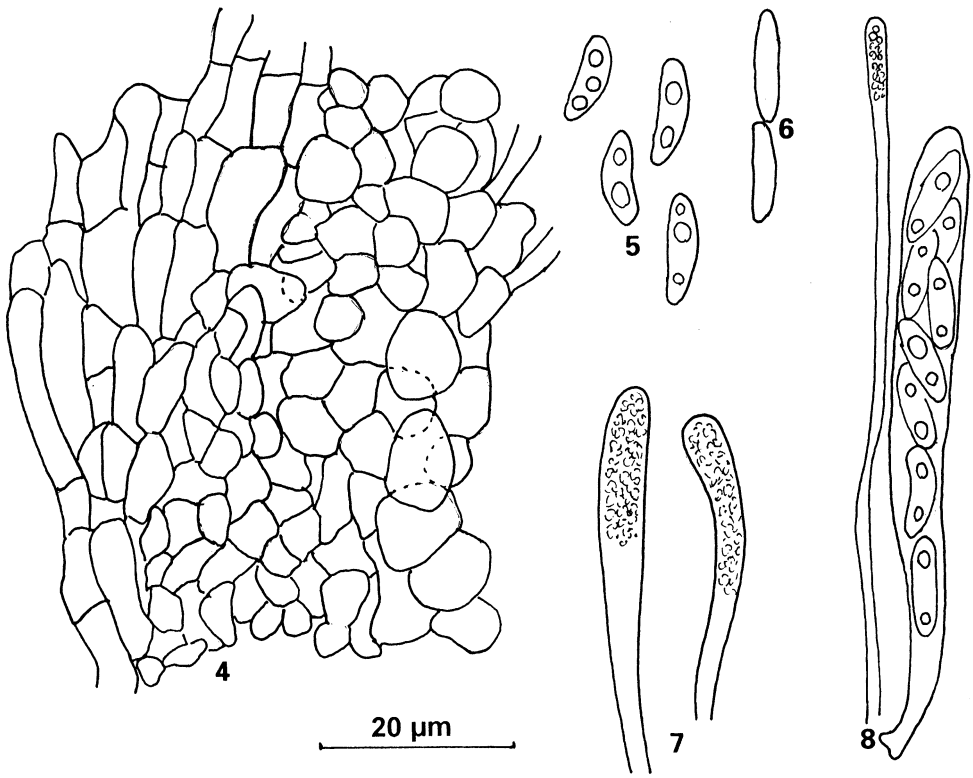
Tartumaa, Kambja Comm., Reola, Röövlimägi (58°16.5'N 26°44.5'E), on fallen needles of *Larix* sp., Oct 21 1997, coll. K. Leenurm & A. Raitviir, det. A. Raitviir (TAA 165321).

GORGONICEPS ARIDULA (P. Karst.) P. Karst.

Tartumaa, Järvselja, Forestry block no. 286, on a decaying fallen branch of *Larix* sp. in a larch forest, Aug 29 2000, coll. K. Leenurm, det. A. Raitviir & K. Leenurm (TAA 165678).

PHAEOHELOTIUM HYLOCOMNII Raitv. & Leenurm species nova

Apothecia 0.5–1 mm in diametro, superficilia, subsessilia vel breviter stipitata, patelliformia vel discoidea distincte marginata, extus griseo-albida, minute pubescentia, disco alutacea, margine albopubescentia. Stratum externum excipuli ex cellulis subglobosis dexdrinoideis compositur. Pili marginales cylindracei, 50–60 µm longi apicibus leniter dilatatis ad usque 3–4 µm, intus pallide luteis, iodo brunnescen-



Figs 4–8. *Phaeohelotium hylocomnii.* – **4.** Ectal excipulum. – **5.** Four spores living in water. – **6.** Two spores in MLZ. – **7.** Hairs. – **8.** An ascus and a paraphysis. (From TAA 165394).

tibus. Asci uncinati, cylindraceo-clavati, octospori, 50–60 × 6–6.5 µm, poro iodo caerulescentia. Sporae late ellipsoideae, inequilaterales, hyalinae, aseptatae, biguttulatae, 9–11 × 3.5–4 µm. Paraphyses cylindraceae, ascos minute superantes, apicibus leniter dilatatis ad usque 2.5 µm, intus pallide luteis, iodo brunnescentibus.
In caules Hylocomnii splendens crescit.

Holotypus: Estonia, Valgamaa, Puka Comm., pars forest. Aakre no. 183/10 (58°4'N 26°4.2'E), in caules Hylocomnii splendens, Aug 4 1998, leg. K. Leenurm (Holotype TAA 165394).

Apothecia superficial, scattered or in small groups, subsessile to shortly stipitate. Receptacle saucer-shaped to almost discoid, greyish-whitish when fresh and dry, externally minutely downy. Disc 0.5–1 mm in diameter, pale leather-coloured when fresh and dry, surrounded by a whitish marginal rim. Marginal hairs cylindric-clavate, thin-walled, smooth, 50–60 × 3–4 µm, with pale yellowish granular content turning brown in MLZ. Ectal excipulum duplex, composed of inner layer of hyaline prismatic, thin-walled cells and outer layer of more or less isodiametric rounded to almost globose cells with granular content turning deep brown in MLZ. Asci arising from croziers, cylindric-clavate, 8-spored, 50–60 × 6–6.5 µm, apical pore deep blue in MLZ. Ascospores biseriate, broadly ellipsoid, inequilateral, straight, hyaline, aseptate, containing two big lipid globules, 9–11 × 3.5–4 µm. Paraphyses cylindrical, gradually widening toward apex, scarcely exceeding the asci, 1.5–2.5 µm wide, with pale yellowish granular content turning brown in MLZ.

Specimen examined: Valgamaa, Puka Comm., Aakre forestry, block 183/10 (58°1'N 26°4.2'E), on stems of *Hylocomnium splendens*, Aug 4 1998, coll. K. Leenurm (Holotype TAA 165394).

This species is close to *Phaeohelotium trabinellum* (P. Karst.) Dennis, differing from it in bigger apothecia, shorter asci, wider spores and muscicolous habit. We place the new species into *Phaeohelotium* due to its similarity to *Ph. trabinellum*. It should be noted, however, that with these two species included the genus *Phaeohelotium* becomes a rather heterogeneous one. The marginal hair and paraphysis characters of *Ph. trabinellum* and *Ph. hylocomnii* are also suggestive for the genus *Calycellina* Höhn. but no *Calycellina* species has outer layer of the ectal excipulum composed of dextrinoid textura globulosa.

PHAEOHELOTIUM TERRESTRE (Velen.) Svrcek

Tartumaa, Järvselja forestry, block no. 275 (58°15.8'N 27°19.5'E), on decaying fallen needles of *Picea abies*, Aug 28 2000, coll. K. Leenurm, det. A. Raitviir & K. Leenurm (TAA 165694).

SARCOLEOTIA GLOBOSA (Sommerf.: Fr.) Korf.

Võrumaa, Haanja Comm., Uigumägi, on mossy ground (57°39.3'N 27°05.2'E), Oct 1 1997, coll. T. Ploompuu, det. A. Raitviir (TAA 157691).
This species, described in detail by Schumacher & Sivertsen (1987), has an oroarctic and northern boreal distribution with a few outposts in temperate lowland localities in Germany, Belgium and the Netherlands. The Estonian locality is an additions to those outposts in the distributional area of this species.

Hyaloscyphaceae

ALBOTRICHA AMMOPHILAE Dennis & Spooner

Saaremaa, Harilaid (58°29.5'N 21°61'E), on a dead culm of a grass in coastal dunes, Oct 4 1996, coll. H. Järv, det. A. Raitviir (TAA 137636).

BELONIDIUM SULPHURELLUM (Peck) Raitv. & Leenurm comb. nov.

Basionymum: *Peziza sulphurella* Peck, Annual Rep. New York State Mus. 30: 59, 1878.
=*Incrucipulum sulphurellum* (Peck) Baral, Beih. Z. Mykol. 6: 74, 1985.

Hiiumaa, Emmaste Comm., Prassi (58°42'N 22°38'E), on dead stems of *Myrica gale* on the ground, Sep 8 2000, coll. K. Leenurm, det. A. Raitviir & K. Leenurm (TAA 165711).

The authors have recently shown that *Belonidium* Mont. & Durieu is an earlier available name for the genus *Incrucipulum* Baral (Leenurm & Raitviir, 2000). So the corresponding new combinations are proposed for the two species new for Estonia.

BELONIDIUM VIRTEMBERGENSE (Matheis) Raitv. & Leenurm comb. nov.

Basionymum: *Dasyscyphus virtembergensis* Matheis, Sydowia 29: 240, 1977.
=*Incrucipulum virtembergense* (Matheis) Baral, Beih. Z. Mykol. 6: 75, 1985.

Tartumaa Luunja Comm., Laukasoo bog (58°26.0'N 27°01.0'E), on dead leaves of *Vaccinium uliginosum*, Jul 16 2000, K. Leenurm (TAA 165658).

DASYSCYPHELLA CASSANDRAE Tranzsch.

Tartumaa, Luunja Comm., Laukasoo bog (58°26.0'N 27°01.0'E), on stems of *Chamaedaphne calyculata*, Jun 5 1998, coll. & det. A. Raitviir & K. Leenurm (TAA 165357).

HYALOPEZIZA RARIPILA (Höhn.) Huhtinen

Tartumaa, Nõo Comm., Mosina, by river Elva (58°16.0'N 26°27.0'E), on rotting stems of *Angelica sylvestris*, Dec 18 1997, coll. K. Leenurm, det. A. Raitviir (TAA 165454).

LACHNUM PENDULAE Raitv. species nova

Apothecia superficilia, gregaria, stipitata, cupulata, 0.5–1 mm diametro, albida vel pallide cremea, albopilosa. Excipulum ectale ex textura prismatica compositur. Pili cylindracei, apicibus leniter dilatatis ad usque 5 µm, hyalini, tenuiter tunicati, verruculosi, 3–4-septati, 50–70 × 2.5–3 µm. Asci non uncinati, cylindraceo-clavati, octospori, poro amyloideo, 45–55 × 3–4 µm. Sporae anguste cylindraceo-fusoideae, aseptatae, aguttulatae, 12–16 × 1.2–1.6 µm. Paraphyses anguste lanceolatae, aseptatae, ascos 5–10 µm superantes, 2–2.5 µm diametro.

In ligno emortuo Betulae crescit.

Holotypus: Estonia, Valgamaa, Helme, Lagesoo, pars forest.Taagepera no. 38, (58°2.7'N 25°44.6'E), in ligno putrido Betulae pendulae in pineto-piceetum, Jul 20 1998, leg.. E. Parmasto (Holotype TAA 167727).

Apothecia superficial, gregarious, seated on a short, well-developed, cylindrical to obconical stipe. Receptacle at first almost globose, then cupulate to shallow-cupulate, whitish to pale yellowish when dry, externally densely covered with whitish hairs. Disc 0.5–1 mm in diameter, whitish or pale cream-coloured to pale buff when dry, after drying not concealed by hairs. Stipe up to 0.5 mm long, concolorous with the receptacle. Hairs cylindric-clavate, gradually widening toward apex, hyaline, 3–4-septate, thin-walled, finely warty, not bearing crystals, 50–70 × 2.5–3 µm, apically swollen up to 5 µm. Ectal excipulum hyaline, composed of textura prismatica, cells thin-walled of variable size and shape, more or less isodiametric and sometimes almost globose, 8-16 µm in diameter at the base of the cup, wide and prismatic, measuring 20–30 × 8–12 µm in the middle of flanks, becoming smaller at the margin. Asci arising from simple septa, cylindric-clavate, 8-spored, 45–55 × 3–4 µm, apical pore blue in MLZ. Ascospores biseriate, narrowly cylindric-fusoid, sometimes narrowly clavate-fusoid, straight to slightly curved, hyaline, aseptate, without inclusions when living, 12–16 × 1.2–1.6 µm. Paraphyses narrowly lanceolate, exceeding the asci by 5–10 µm, 2–2.5 µm wide.

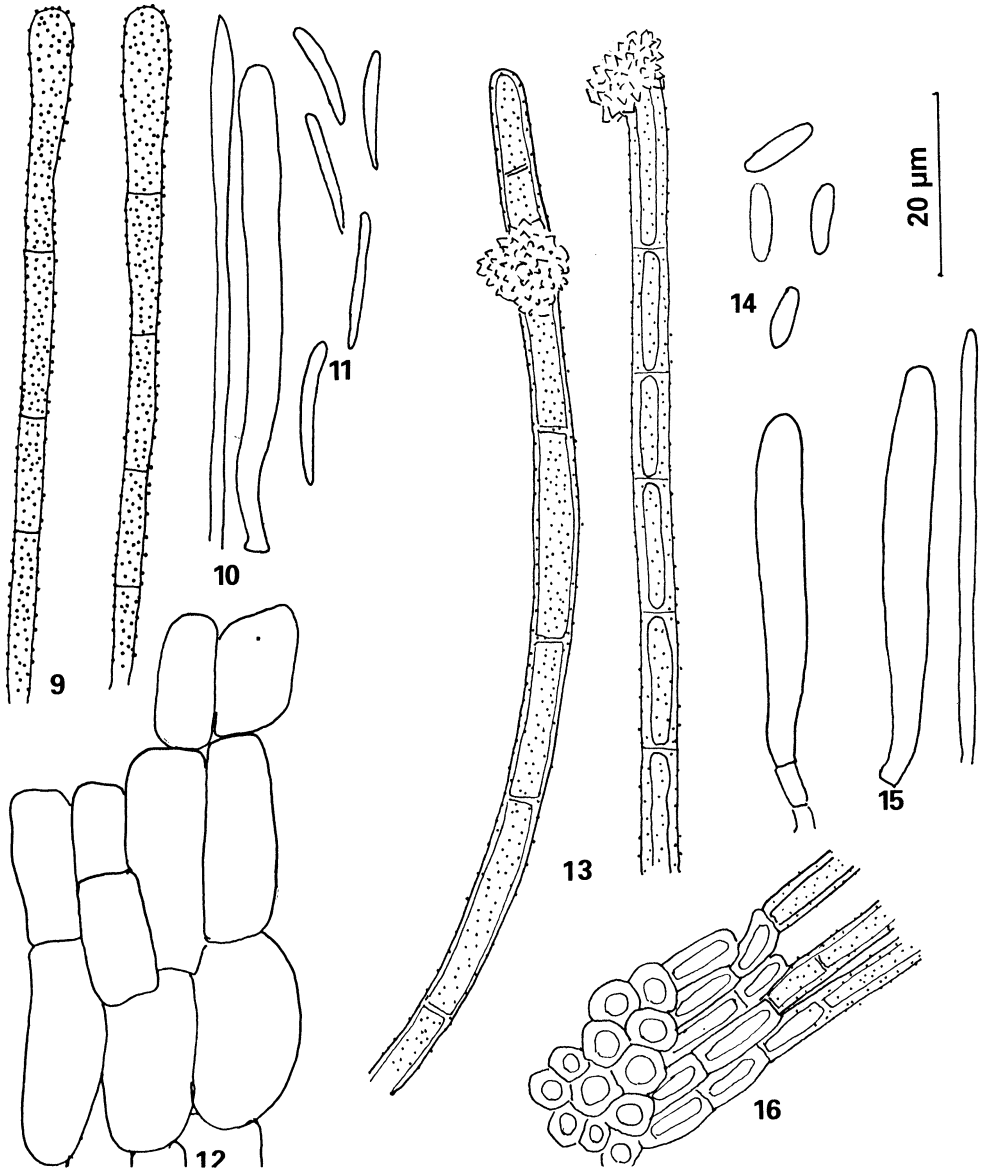
Specimen examined: Valgamaa, Helme Comm., SW of Lagesoo, Taagepera forestry, block no. 38, (58°2.7'N 25°44.6'E), on rotten wood of *Betula pendula* in a pine-spruce forest, Jul 20 1998, coll. E. Parmasto (Holotype TAA 167727).

PHIALINA FLAVEOLA (Cooke) Raitv.

Valgamaa, Aakre Forestry, block no. 95/7 (58°4'N 26°4.2'E), on a dead leaf of *Pteridium aquilinum* in a young oak-forest, Aug 6 1998, coll. & det. K. Leenurm (TAA 165390).

PROPRIOSCYPHA ECHINULATA Raitv. & Leenurm species nova

Apothecia superficilia, gregaria vel dispersa, sessilia vel subsessilia, 0.5–1 mm diametro, pallide lutea vel pallide aurantiaca, extus densiter longe albopilosa. Excipulum ectale duplex, strato intimo ex cellulis angularis vel subglobosis, strato extiomo ex cellulis prismaticis crassiter tunicatis sistente. Pili cylindracei, hyalini, crassiter tunicati, verruculosi, multiseptati, 200–300 × 4–5 µm, apicibus crystalliferis. Asci non uncinati, cylindraceo-clavati, octospori, poro amyloideo, 35–50 × 4.5–6 µm. Sporae ellipsoideo-fusoideae, aseptatae, aguttulatae, 6.5–10 × 2.4–3.2 µm. Paraphyses cylindraceae,



Figs 9–12. *Lachnum pendulae*. – **9.** Two hairs. – **10.** An ascus and a paraphysis. – **11.** Spores. – **12.** Excipular cells.
Figs 13–16. *Proprioscypha echinulata*. – **13.** Two hairs. – **14.** Spores. – **15.** Two asci and a paraphysis. – **16.** Ectal excipulum.

aseptatae, ascos minute superantes, 1.5–2 µm diametro.
Holotypus: Estonia, Virumaa occidentalis, Rakvere Comm., quercetum Tammiku prope Tõrna, in ramulo putrido quercinum, Sep 24 2000, leg. K. Leenurm (TAA 165717).

Apothecia superficial, scattered or in small groups, sessile to subsessile without clearly defined stipe. Receptacle almost globose, remaining more or less closed at maturity, exposing only a part of the disc through a small mouth, yellowish to pale orange-coloured when

fresh and dry, externally densely covered with long radiating glistering chalk-white hairs. Disc 0.5–1 mm in diameter, pale orange-coloured, completely obscured by hairs when dry. Hairs cylindrical, hyaline, multiseptate, thick-walled to very thick-walled, walls usually 1.5–1.8 µm thick, finely warty, apically bearing more or less spherical agglomerations of small crystals, 200–300 × 4–5 µm, apically rounded. Ectal excipulum duplex, composed of an inner layer of rounded, subhyaline, thick-walled cells and an outer layer of thick-walled, hyaline prismatic cells arranged at a low angle to the surface and giving rise to the hairs. Asci arising from simple septa, cylindric-clavate, 8-spored, 35–50 × 4.5–6 µm, apical pore blue in MLZ. Ascospores biseriate, ellipsoid-fusoid, sometimes slightly inequilateral, straight, hyaline, aseptate, without inclusions when living, 6.5–10 × 2.4–3.2 µm. Paraphyses cylindrical, pointed, scarcely exceeding the asci, 1.5–2 µm wide.

Specimen examined: Lääne-Virumaa, Rakvere Comm., Tammiku oak-forest in vincinity of Tõrna (59°19'N 26°16'E), on a decaying stick of *Quercus robur*, Sep 24 2000, coll. K. Leenurm (Holotype, TAA 165717).

The macroscopical and microscopical features of the apothecium leave *Proprioscypha* Spooner the only genus in which to place it. It differs from the only known species, *P. corticicola* Spooner, in shorter asci and spores and a bit more intense colouring of hymenium and excipulum. Spooner (1987) has compared the Australasian fungus with *Lachnellula* and *Hyalopeziza* but in our opinion the genus is more closely related to *Belonidium* Mont. & Durieu, differing from it in the structure of the excipulum.

Unguiculella hamulata (Feltgen) Höhn.

Hiiumaa, Emmaste Comm., Jausa, Laasi (58°47.0'N 22°42.5'E), on dead stems of *Filipendula ulmaria*, Nov 8 1997, coll. & det. K. Leenurm (TAA 165350, TAA-165351).

Rutstroemiaceae

Rutstroemia elatina (Alb.& Schwein.: Fr.) Rehm

Võrumaa, Rõuge Comm., Kurgjärve (57°42.5'N 27°2.5'E), on a cone scale of *Picea abies*, Oct 1 1997, coll. T. Ploompuu, det K. Leenurm & A. Raitviir (TAA 165446).

Vibrisseaceae

Vibrissea filisporia (Bonord.) Korf & A. Sánchez f. *fiscella* (P. Karst.) A. Sánchez.

Hiiumaa, Emmaste Comm., Jausa, Laasi (58°47.0'N 22°42.5'E), on dead canes of *Rubus idaeus*, Dec 14 1996, coll. K. Leenurm, det. A. Raitviir (TAA 165300).

TUBERALES

Tuberaceae

Tuber foetidum Vittad.

Tartumaa, Lääniste, Saarekivi Farm (58°16'N 27°08'E), hypogeous under cultivated *Corylus avellana*, Oct 5 2000, coll. P. Saarva, det. A. Raitviir (TAA 137931).

Tuber maculatum Vittad.

Põlvamaa, 1.5 km W of Maaritsa (58°09'N 26°41'E), in soil (depth 15 cm) in a garden, close to *Betula pendula*, Aug 23 1991, coll. A. Paal, det A. Raitviir (TAA 169408).

ACKNOWLEDGEMENTS

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REFERENCES

Baral, H. O. & Krieglsteiner, G. J. 1985. Bausteine zu einer Ascomyceten-flora der Bundesrepublik Deutschland: in Süddeutschland gefundene inoperculate Discomyceten - mit taxonomischen, ökologischen, chorologischen Hinweisen und eine Farbtafel. *Beih. Z. Mycol.* 6: 1–226.

Leenurm, K., Raitviir, A. 2000. The ultrastructure of *Belonidium aeruginosum* Mont. & Durieu (Hyaloscyphaceae, Helotiales). *Folia Cryptog. Estonica* 36: 57–63.

Maas Geesteranus, R. A. 1972. *Spathularia* and *Spathulariopsis*. *Proc. Kon. Ned. Akad. Wetensch. C.* 75: 243–255.

Mains, E.B. 1956. North American hyaline spored species of the Geoglossaceae. *Mycologia* 47: 846-877.

Ohenoja, E. 1975. *Leotia*, *Cudonia*, *Spathularia* and *Neolecta* (Ascomycetes) in Finland. *Ann. Bot. Fenn.* 12: 123–130.

Rahm, E. 1966. Geoglossaceae in Hochtal von Arosa. *Scweiz. Z. Pilzk.* 44: 165–179.

Schumacher, T., Sivertsen, S. 1987. *Sarcoleotia globosa* (Sommerf.: Fr.) Korf, taxonmy, ecology and distribution. In *Arctic and Alpine Mycology 2* (eds Laursen, G.A., Ammirati, J.F.& Redhead, S.A.) pp. 163–176. Plenum Press, New York & London.

Spooner, B.M. 1987. Helotiales of Australasia: Geoglossaceae, Orbiliaceae, Sclerotiniaceae, Hyaloscyphaceae. *Biblioth. Mycol.* 116: 1–711.

Folia Cryptog. Estonica, Fasc. 37: 93–108 (2000)

The lichen genus *Heterodermia* (Lecanorales, Physciaceae) in Russia and adjacent territories

Hans Trass
Institute of Botany & Ecology, University of Tartu, 38 Lai St., 51005 Tartu, Estonia

Abstract: Twenty species of the genus *Heterodermia* are recorded from Russia and adjacent territories (former USSR): *H. boryi, H. casarettiana, H. chilensis, H. corallophora, H. dendritica, H. diademata, H. dissecta, H. hypocaesia, H. hypochraea, H. hypoleuca, H. intermedia, H. isidiophora, H. japonica, H. leucomela, H. microphylla, H. obscurata, H. podocarpa, H. propagulifera, H. speciosa, H. subascendens*. New varieties *H. hypoleuca* var. *divergens* Trass and *H. isidiophora* var. *coralligera* Trass are described. According to distribution patterns, *Heterodermia* is a tropical genus representing mainly pantropical, paleotropical, neotropical, and subtropical floristical elements. Other phytogeographical terms (cosmopolitan, western pacific) have only been used for a few species. Ecologically almost all *Heterodermia* species are hemerophobic, sensitive to all kinds of human activity. They mainly grow on mossy trunks of trees and mossy boulders and rocks. Only some species are poleotolerant (*H. dimidiata, H. isidiophora, H. leucomela, H. microphylla*). Many *Heterodermia* species are very rare, found only in a handful of localities. All such species in the tropics and the majority of *Heterodermia* species outside the tropics (in temperate regions) are in danger of extinction and should be included in Red Books.

Kokkuvõte: H. Trass. Samblikuperekond *Heterodermia* (Lecanorales, Physciaceae) Venemaal ja sellele lähedastel aladel.

Kakskümmend huulsamblike perekonna (*Heterodermia*) liiki on teada endise NSVL territooriumilt: *H. boryi, H. casarettiana, H. chilensis, H. corallophora, H. dendritica, H. diademata, H. dissecta, H. hypocaesia, H. hypochraea, H. hypoleuca, H. intermedia, H. isidiophora, H. japonica, H. leucomela, H. microphylla, H. obscurata, H. podocarpa, H. propagulifera, H. speciosa, H. subascendens*. On kirjeldatud kaks uut varieteeti – *H. hypoleuca* var. *divergens* Trass ja *H. isidiophora* var. *coralligera* Trass. Leviku järgi on huulsamblikud põhiliselt troopilised samblikud, jagunedes pantroopilise, paleotroopilise, neotroopilise ja subtroopilise floristilise elemendi vahel. Vaid üksikute liikide puhul on sobivad muud levikut iseloomustavad määratlused (kosmopoliitsed, Lääne-Vaikse ookeani liigid). Peaaegu kõik huulsamblike liigid kasvavad puukoort katvatel sammaldel, harvem paljal puukoorel või sammaldunud kaljudel. Inimmõju suhtes on peaaegu kõik huulsamblikud väga tundlikud (hemerofoobid), on teada vaid mõni poleotolerantne liik (*H. diademata, H. isidiophora, H. leucomela, H. microphylla*). Paljud huulsamblikuliigid on väga haruldased; sellised troopilised liigid ja peaaegu kõik parasvöötmeliigid on hävimisohus ja nad tuleks lülitada Punasesse Raamatusse.

INTRODUCTION

Everywhere that my lichenological expeditions and trips have taken me – in my homeland Estonia, in the other Baltic states (Latvia, Lithuania), in different European countries (Finland, Sweden, Norway, Germany, Austria, Switzerland, Bulgaria), in various parts of Russia, in Belarussia, the Ukraine, Moldavia, Armenia, Azerbaijan, Georgia, Kazakhstan, in western and eastern Siberia, Russian Far East, and in Canada., I have paid special attention to the lichen families *Cladoniaceae* and *Physciaceae* (Trass, 1978, 1992, 1998).

I found an especially rich flora of the genus *Heterodermia* during the expeditions to the Russian Far East (Primorye territory, Sikhote-Alin mountain range). Therefore my interest in the whole *Heterodermia* genus began to grow. After 1985 I was able to make several successful visits to the lichenological herbaria in Helsinki, Uppsala, Stockholm, Lund, Stuttgart, Zürich and Bern. In the herbaria of the former USSR I had studied large collections in St. Petersburg, Vladivostok, Kiev, Minsk, Yerevan, Baku, Tbilisi.

Genus *Anaptychia* s. lat. (*Anaptychia* s. str. + *Tornabea* + *Heterodermia*) has not been very extensively studied in the lichen flora of Russia and the adjacent territories. There is only one attempt to treat this genus monographically, by the Ukrainian lichenologist Alfred Oxner. In 1988 Sergey Kondratyuk discovered a manuscript by this scientist in the archives of the Institute of Botany, Kiev. Unfortunately, it is not known when the manuscript had been written (the latest citation is from the year 1943). Oxner described the following species from the former USSR (taxonomy according to

Oxner): *Anaptychia ciliaris* (L.) Körb., *A. setifera* (Mereschk.) Räsänen, *A. persica* Gyeln., *A. monticola* Oxner sp. nov. (not published), *A. isidiata* Tomin, *A. palmulata* (Michx.) Vain., *A. ulotricoides* Vain., *A. intricata* (Desf.) A. Massal., *A. fusca* (Huds.) Vain., *A. hypoleuca* (Muhl.) Vain. [= *Heterodermia hypoleuca* (Ach.) Trevis.], *A. sorediifera* (Müll. Arg.) Oxner comb. nov. (not published) [= *Heterodermia obscurata* (Nyl.) Trevis.], *A. esorediata* (Vain.) DR. & Lynge [= *H. diademata* (Taylor) D. D. Awasthi], *A. speciosa* (Wulfen) A. Massal. [= *H. speciosa* (Wulfen) Trevis.], *A. leucomelaena* (L.) Vain. [= *H. leucomela* (L.) Poelt], *A. podocarpa* (Bél.) Trevis. [= *H. podocarpa* (Bél.) D. D. Awasthi]. Altogether, Oxner knew six species of *Heterodermia* and nine species of *Anaptychia* in the USSR.

Summarizing literature data, 12 species of *Heterodermia* were known throughout the territory of the former USSR:

H. boryi – Skirina (1995);
H. chilensis – Skirina (1995);
H. corallophora – Knyazheva (1973), Skirina & Knyazheva (1985), Mikulin (1986), Skirina (1995);
H. dendritica – Tomin (1926), Knyazheva (1973), Skirina & Knyazheva (1985), Tchabanenko (1986);
H. diademata – Mikulin (1989), Skirina (1995);
H. hypoleuca – Tomin (1937), Knyazheva (1973), Insarov & Pchelkin (1983, 1984), Skirina & Knyazheva (1985), Tchabanenko (1986), Mikulin (1986, 1989), Skirina (1995);
H. isidiophora – Knyazheva (1973), Insarov & Pchelkin (1984), Skirina (1995);
H. japonica – Tchabanenko (1986), Insarov & Pchelkin (1988);
H. leucomela – Tomin (1926, 1937), Knyazheva (1973), Barkhalov (1983), Sedelnikova (1985), Kopachevskaya (1986), Tchabanenko (1986);
H. microphylla – Insarov & Pchelkin (1988);
H. obscurata – Tomin (1937), Knyazheva (1973), Tolpysheva et al. (1981), Insarov & Pchelkin (1984, 1988), Skirina & Knyazheva (1985), Tchabanenko (1986), Mikulin (1989), Skirina (1995);
H. speciosa – Elenkin (1904), Kreyer (1913), Rassadina (1935), Tomin (1937), Barkhalov (1944, 1957, 1969, 1983), Gorbach (1973), Knyazheva (1973), Sedelnikova (1977, 1985), Makarevich et al. (1982), Insarov & Pchelkin (1984), Skirina & Knyazheva (1985), Kopachevskaya (1986), Makryi (1986, 1990), Nakhutzrishvili (1986), Tchabanenko (1986), Mikulin (1986), Skirina (1995).

Not all herbarium specimens mentioned in these papers have been available. Possibly there are some misidentifications. For certain, this is the case concerning three species mentioned in literature. Both *H. polyrhiza* and *H. spinulosa* recorded by Knyazheva (1973) from the Sikhote-Alin mountain range in the Far East are actually *Everniastrum cirrhatum* (VLA, TU), while *H. dactyliza*, described by Novruzov (1982) from the Caucasus, Azerbaijan, is probably something else as Novruzov asserts: "thallus fruticose ... up to 6 cm high, loosely attached to the substrate ...". It has not been possible to examine any specimens of this species.

In addition to these twelve species mentioned in literature I have identified eight further taxa – *H. casarettiana, H. dissecta, H. hypocaesia, H. hypochraea, H. intermedia, H. podocarpa, H. propagulifera* and *H. subascescens*.

MATERIALS AND METHODS

Altogether more than 2000 specimens of *Heterodermia* were studied in different herbaria of the former USSR and Europe – in Tartu (TU), St. Petersburg, former Leningrad (LE), Kiev (KW), Minsk (MSK), Vladivostok (VLA), Yerevan (ERE), Baku (BAK), Tbilisi (TB), Helsinki (H), Turku (TUR), Uppsala (UPS), Stockholm (S), Lund (LD), Stuttgart (STU), Bern (BERN), Rostock (ROST), Halle (HAL). My own collections from the Russian Far East, eastern and western Siberia and other parts of the former USSR are deposited in TU (few specimens also in UPS).

Many years ago Dr. Syo Kurokawa, an outstanding investigater of the taxonomy of *Anaptychia* and *Heterodermia*, asserted: "It is quite impossible to make an intelligent study of *Anaptychia* without using chemistry as a taxonomic character of the same level of importance as morphological character" (Kurokawa, 1962, p. 6). It is valid all the more today. Therefore, I paid much attention to the

TLC analysis of collected specimens using standardized techniques (Culberson, 1972, 1974; White & James, 1985). More than 400 specimens were investigated chemically in solvent system A. This work was carried out by my young colleagues Tiina Randlane and Andres Saag. Atranorin and zeorin were identified in all 20 species, norstictic acid in *H. casarettiana, H. dendritica, H. dissecta, H. hypoleuca, H. japonica, H. podocarpa* and *H. propagulifera,* salazinic acid in *H. casarettiana, H. dendritica, H. dissecta, H. hypocaesia, H. hypoleuca, H. intermedia, H. japonica, H. leucomela, H. microphylla, H. podocarpa* and *H. propagulifera*, and dissectic acid in *H. dissecta*. Yellow K- pigment was found in *H. casarettiana,* pale yellow K+ yellow pigment in *H. corallophora* and *H. hypochraea*, yellow K+ purple pigment in *H. dendritica, H. hypocaesia, H. leucomela, H. obscurata, H. propagulifera* and *H. subascendens*.

In many species unidentified substances were discovered, they are denoted in descriptions of species by X_1 – X_9:

X_1 – Rf = 35, grey after developing with H_2SO_4
X_2 – Rf = 31, grey after H_2SO_4
X_3 – Rf = 17, weak grey after H_2SO_4
X_4 – Rf = 10, before developing pink fluorescence in UV, after developing weak orange spot
X_5 – Rf = 12, indistinct pale spot
X_6 – Rf = 68, indistinct pale spot
X_7 – Rf = 30, indistinct pale spot
X_8 – Rf = 20, indistinct pale spot
X_9 – Rf = 44, indistinct pale spot

GENUS *HETERODERMIA*

For a long time many lichenologists doubted in the motivation of separating the pale coloured and atranorin containing taxa in the genus *Anaptychia* into a separate genus *Heterodermia*. This was partly done already by Trevisan (1869). Poelt (1965) divided the genus *Anaptychia* into two entities – *Anaptychia* Körb. em. Poelt and *Heterodermia* Trevis. em. Poelt. He emphasized the importance of the character of spores in these genera – *Anaptychia* species with thin-walled and sculptured spores (*Physconia*-Type), *Heterodermia* species with thick-walled and smooth spores (*Pachysporaria*- and *Polyblastidium*-Type). These differences were later specified by Poelt and his disciples (Hafellner et al., 1979; Mayrhofer, 1982). Many lichenologists follow Poelt's concept because "... the type of spore provides a character based on propagative organs, to which special taxonomic value is commonly attached, and a character that is relatively unchanging thoroughout the various species within the genera defined by it" (Swinscow & Krog, 1976, p. 104). Others, among them the monographer of the genus *Anaptychia* s. lat., Kurokawa (1962, 1973), considered subgenus to be the highest possible level for *Heterodermia* inside the genus *Anaptychia*. Still, later he (Kurokawa, 1998) recognized *Heterodermia* as a separate genus.

In contemporary lichen taxonomy there prevails a trend to establish possible homogenous genera phylogenetically, based on a complex of characters. As demonstrated by Poelt (1965) and Mayrhofer (1982, fig. 3), on the basis of studies of ascospores' morphology, the genera *Anaptychia* and *Heterodermia* are not very closely related taxa. The same is indicated by the chemical compounds identified in the species of these genera. W.L. Culberson (1966, p. 476) asserts: "... it is clear that with regard to the accumulating metabolic products which the lichen substances represent, *Anaptychia* and *Heterodermia* have folloved entirely different lines of evolution".

In this paper *Heterodermia* is recognized as a separate genus. The main differing characters of *Anaptychia* and *Heterodermia* are as follows (Table 1).

81 species of *Heterodermia* were checked by me in 1992 (Trass, 1992); six years later Kurokawa (1998) compiled a new critical check-list of the *Heterodermia* species containig 92 species.

Distribution patterns

Most *Heterodermia* species are tropical (in the broad sense), e.g., belong to the pantropical, paleotropical, neotropical, or subtropical floristical elements (Galloway, 1991 a, 1991 b). Pantropical species occur in all the main tropical regions in the northern and southern hemispheres. Neotropical taxa are centered in the rain-forests of South America extending into Central America and southern regions in

Table 1. Main characters of genera *Anaptychia* and *Heterodermia*

Characters\Genera	*Anaptychia*	*Heterodermia*
Growth form	Mainly fruticose, less attached foliose	More than half of species attached foliose, less microfruticose
Thallus colour	Mainly dark grey, often brownish	Whitish grey on various ting
Spores	Thin walled and sculptured (ridges, spines)	Thick-walled and smooth
Chemical substances	No lichen substances or atranorin and zeorin only in very low concentration	Atranorin and zeorin permanent in high concentration; different medullary substances (salazinic, norstictic, dissectic acids etc.); many pigments

North America, the West Indies, etc. Paleotropical species generally occur in Indomalaysia with extensions as far as Oceania to the eastward, Africa to the west, Japan, Russian Far East and China to the north (Sipman & Harris, 1989). Subtropical taxa are similar to neo- or paleotropical ones but they have more clear tendencies to grow in temperate zones (including in Europe). A term other than 'tropical' has only been used for a few species – cosmopolitan for *H. podocarpa, H. boryi* and *H. obscurata*, western pacific for *H. microphylla*. Even such a widespread species of temperate regions as *H. speciosa* is sometimes classified as pantropical (Aptroot, 1987; Sipman, 1989, 1992). Of the 92 known taxa only nine *Heterodermia* species are recorded in the flora of Europe; the majority of them are rare or very rare here. Exceptions include the Azores and other Macronecian islands, where seven species are known; some species are rather common and widespread, for example *H. japonica, H. leucomela, H. lutescens* (Moberg & Purvis, 1997).

The area with the greatest concentration of Heterodermias in Russia is the Far East glaciation-free region, particularly Primorye and Khabarovsk territories with the Sikhote-Alin mountain range. Only five species are found outside this area (*H. japonica* in eastern Siberia, *H. leucomela* in the European part of the former USSR, *H. obscurata* and *H. propagulifera* in middle and southern Siberia). Only *H. speciosa* is a species which has localities almost in all the temperate regions of the former USSR, but nevertheless is more or less common only in the Asian part of Russia. Almost all *Heterodermia* species are mountainous or submountainous, growing usually in low or middle altitudinal zones of rain-forest or temperate deciduous broad-leaved forests, more rarely in treeless areas (on mossy rocks, etc.). In their distribution many species have oceanic (or atlantic, subatlantic) tendencies. *Heterodermia* species occurring on the territory of the former USSR are divided into the following elements.

1) Pantropical–East Asian element – *H. boryi, H. casarettiana, H. diademata, H. hypocaesia, H. hypoleuca, H. isidiophora, H. japonica, H. microphylla, H. podocarpa.*
2) Pantropical– American el. – *H. chilensis.*
3) Neotropical–East Asian el. – *H. corallophora, H. dendritica, H. dissecta.*
4) Subtropical–temperate el. – *H. leucomela, H. obscurata, H. propagulifera, H. speciosa.*
5) Temperate East Asian el. – *H. subascendens.*
6) Russian Far East endemic – *H. intermedia.*

Annotated list of species

20 species of *Heterodermia* are known from Russia and adjacent territories (former USSR). Descriptions of these species are presented below. For each species the following data is given: (1) short morphological description, (2) known chemical substances and reactions with K and P, (3) distribution (states or / and regions, where the species has been recorded) and habitats, (4) notes on allied species, (5) special diagnostic characters of species (SDC), (6) stud-

ied specimens from Russia and adjacent territories, (7) additional studied specimens from different herbaria.

Abbreviations of names of herbaria follow Holmgren et al. (1990). Other abbreviations:
Alt. – altitude
Mtr. – mountain range
Mt. – mount
NCA – nature conservation area
Rg. – region (oblastj, administrative unit)
SDC – special diagnostic characters
TLC – thin layer chromatography
Tr. – territory (kraij, administrative unit)

Heterodermia boryi (Fée) Kr. P. Singh & S. R. Singh.

Thallus grayish white, loosely attached to substrate, tangled, forming irregular patches 5–15 cm in width. Lobes disjunct, linear-elongate, with uneven upper cortex, dichotomously branched, 0,2–1,0 mm broad, narrowing and ascending towards the apices, circinately revolute at apices, margin declined downwards, with 5–15 mm long black rhizines, very rarely with marginal soredia, without isidia and squamules. Under side decorticate, white, non-pigmented, arachnoid, sometimes with soredia. Apothecia common, apical, 1–5 mm width, disc brown, margin sometimes with squamules bearing short black rhizines. Spores 36–54 × 20–25 µm, without sporoblastidia.

Substances. Atranorin, zeorin. Thallus K+ yellow, medulla K+ yellow, P- or + pale yellowish.

Distribution. East Asia (Russia, China, Japan), Nepal, East Africa. In Russia this species seems to be restricted only to the southern part of the Far East (Primorye Tr., Sikhote-Alin Mtr.), and there it is a rather common lichen. On old mossy tree trunks, boulders and rocks.

Allied species. *H. leucomela* is the nearest species. A thorough treatment of *H. leucomela-boryi* complex is given by Swinscow & Krog (1976). The authors assert that *H. boryi* differs from *H. leucomela* in usually having narrower lobes, more circinately revolute tips of the distal lobes, an arachnoid more often than pulverulent under side, a lower frequency of soralia and a higher frequency of apothecia, and in lacking depsidones (op. cit., p. 124–125). In spite of expressiveness of these differences, Swinscow and Krog are on position that *H. boryi* is not worthy of to be accepted on the species level, even if its essentially different distribution from *H. leucomela* is considered. I came to the conclusion that if *H. boryi* is not recognized on the species level, many other *Heterodermia* species must be incorporated into a few broad and very variable species as well. Thus I treat *H. boryi* as a "good" separate species.

SDC. Thallus tangled, lobes linear-elongate, apices circinately revolute, under side arachnoid, salazinic acid absent.

Selected specimens examined. RUSSIA, Far East, Primorye Tr., Sikhote-Alin Mtr.: Kedrovaya Padj NCA, e.g. 4.10.1935 *Kabanov* (TU, KW); 26.09.1955 *Koval* (TU, KW); 17.09.1961 *Pärn* (TU); 26.08.1965 *Blum* (KW), on *Tilia amurensis*, *Betula schmidtii* and rocks. – Lazovski NCA, 8.10.1936 *Kolesnikov* (KW), on *Picea*. – Ussuriiski NCA, 1968 *Knyazheva* (TU). – By settlement Meteoritnaya, 25.09.1973 *Laanetu* (TU), on rocks. – By Khassansk, 01.10.1983 *Randlane* (TU). – Mt. Bidau, 25.07.1985 *Roosma* (TU), on rocks. – Mt. Oblatshnaya, 7.08.1977 *Trass* (TU), on *Abies nephrolepis*. – Mt. Ostryi, 7.08.1977 *Trass* (TU), on *Abies nephrolepis*. – Putyatin Island, 19.07.1985 *Roosma* (TU), on rocks.

Additional specimens examined. AFRICA. KENYA, *Almborn*, Lich. Afric. 100 (LE). TANZANIA, *Santesson* 21 287, 22 847 (LE); *Vezda*, Lich. Sel. Exs. 923, 1150 (H). ASIA. CHINA, *Wei*, Lich. Sinenses Exs. 49, 50 (LE). INDIA, *Vezda*, Lich. Sel. Exs. 1421 (LE). NEPAL, det. Kurokawa (LE).

Heterodermia casarettiana (A. Massal.) Trevis.

Thallus whitish gray forming rosettes up to 15 cm in width. Lobes 0,5–3mm broad, dichotomously or digitately branched, with short marginal lobules, cortex even, with labriform soralia. Lower side non-corticate, smooth (not arachnoid), in peripheral parts pigmented, pale or lemon-yellow, in central part dark (even black). Rhizines marginal, 1–3 mm long, simple or branched, black. Apothecia 1–7 mm across, laminal, adnate or substipitate, disc brown, sometimes with pruina, margin sorediate. Spores 32–48 × 18–25 µm, with sporoblastidia.

Substances. Atranorin, zeorin, pigment (Swinscow & Krog, 1976, p. 115: "... deposited in the lower layers of the medulla, not in a superimposed layer of hyphae as in *H. obscurata*", but in our specimens the pigment is deposited in whole medulla), frequently

norstictic and/or salazinic acid. Kashiwadani et al. (1990, p. 151) notes, that depsidones do not seem to be constant components for this species and the presence of yellow pigment on the lower surface seems to be a more reliable character to indentify it. Thallus K+ yellow, P-, medulla K- or + yellow → reddish yellow, P- or + yellow, pigment K- or brownish yellow (but not red).

Distribution. Common species in tropical, Central and South America, North America, West-Indies, East Africa, South East Asia; rare in Russian Far East. On mossy trunks, boulders, earth.

Allied species. Similar to the depsidones-containing chemical strain of *H. japonica*, but this species lacks the yellow pigment. *H. propagulifera* also has labriform soralia, but its lower side is arachnoid and the pigment reacts K+ purple red.

SDC. Apical labriform soralia, non-corticate smooth, pigmented under side, norstictic and salazinic acids.

Specimens examined. RUSSIA, Far East, Primorye Tr., Sikhote-Alin Mtr., Lazovski NCA, 20.09.1983 *Krivoshtshekova* (TU), TLC: atranorin, zeorin, salazinic and norstictic acid, X_3. – Sikhote-Alin Mtr., settlement Meteoritnaya, Mt. Bezymjannaya 25.09.1973 *Laanetu* (TU), TLC: atranorin, zeorin, salazinic and norstictic acids.

Additional specimen examined. NORTH AMERICA. MEXICO, 1960 *Hale* (H).

Heterodermia chilensis (Kurok.) Swinscow & Krog

Thallus grayish white, lobes linear, plane, not ascending, 0,8–1,5 mm broad, with thick corticate border, with apical labriform soralia. Upper cortex uneven, under side arachnoid, white, pigments absent, rhizines black or gray. Apothecia laminal, spores 28–39 × 18–22 µm, few with sporoblastidia.

Substances. Atranorin, zeorin.

Distribution. Australia, South America (Chile, Argentina), Africa (Kenia), Russian Far East (Sikhote-Alin Mtr.). Epiphyte on mossy trunks of deciduous forest trees. Skirina (1995, p. 82) found this species on bark of oak (specimen not seen by me).

Allied species. Similar to *H. dactyliza*, differs in having soralia, smaller spores, absent of pigments.

SDC. Thick corticate border, labriform soralia, arachnoid under side.

Heterodermia corallophora (Taylor) Skorepa

Thallus gray, sometimes greenish, forming rosettes up to 10 cm in width, attached to the substrate. Lobes 1–2 mm broad, disjunct in peripheral part, dichotomously branched, with laminal and marginal coralloid isidia, which frequently cover whole central part of the thallus. Marginal rhizines black. Upper cortex even. Under side decorticate (in India, according to Awasthi 1960 corticate), white, arachnoid, locally with pale yellow pigment. Apothecia 2–4 mm across, disc dark brown. Spores 33–46 × 16–20 µm, with 2–3 sporoblastidia.

Substances. Atranorin, zeorin, pale yellow pigment. In Peru, Kashiwadani et al. (1991, p. 15) discovered norstictic acid. Thallus K+ yellow, P-, medulla K- or + yellow, pigmented parts K+ yellow.

Distribution. South, Central and North America, India, Nepal, West-Indies, East Asia (Russia).

Allied species. *H. microphylla* (but in this species dissected squamules are present, yellow pigment and sporoblastidia absent), *H. isidiophora* (also with isidia, but these are mainly cylindrical, under side corticate, pigment absent, sporoblastidia absent).

SDC. Coralloid isidia, black rhizines, decorticate under side, yellow pigment.

Specimens examined. RUSSIA, Far East, Primorye Tr., Kedrovaya Padj NCA 26.07.1967 *Masyuk* (KW), TLC: atranorin, zeorin, X_4, X_5. – Sikhote-Alin Mtr., Mt. Bezymjannaya, 25.09.1973 *Laanetu* (TU), TLC: atranorin, zeorin. – Khassansk, on rocks, 29.09.1983 *Randlane* (TU), TLC: atranorin, zeorin. – Between Olga and Lazo, on *Quercus mongolica*, 23.09.1983 *Randlane* (TU), TLC: atranorin, zeorin.

On all studied specimens most of isidia coralloid, few cylindrical or squamulose, tips of some isidia sorediose.

Additional specimens studied. ASIA. INDIA, South India, *Magnusson* (UPS). JAPAN, 1901, *Faurie*, det. Hue (LE).

Heterodermia dendritica (Pers.) Poelt

Thallus grayish white, forming patches up to 15 cm in width. Lobes dichotomously or digitately branched, 0,7–2 mm broad, plane, even,

without soredia, isidia, squamules. Upper cortex uneven. Under side non-corticate, arachnoid, white in peripheral, darkening (blackish) in central part, locally with yellow or brownish-yellow pigment. With conspicuous black, 1–3 mm long marginal rhizines. Apothecia laminal, stipitate, 1–4 mm across, disc black, margin sometimes with squamules, their under side decorticate and partly yellow. Spores 35–46 × 16–20 µm, with sporoblastidia.

Substances. Atranorin, zeorin, norstictic and salazinic acids (occasionally one of these acids can be absent), yellow pigment. Thallus K+ yellow, medulla K+ yellow – reddish yellow, P+ yellow, pigment K+ purple red. Kurokawa (1962, p. 54) and Yoshimura (1979, p. 9) have identified norstictic and salazinic acids in this species, we have found only the former.

Distribution. North America, East and South-East Asia (China, India, Japan, Papua New Guinea, Philippines, Russia, Taiwan, Thailand), Oceania. On mossy tree trunks.

Allied species. *H. propagulifera* (with labriform soralia), *H. obscurata* (with labriform soralia, depsidones absent).

SDC. Vegetative propagules absent, under side non-corticate, pigmented, norstictic and/or salazinic acid present.

Specimens examined. RUSSIA, Far East, Primorye Tr., Sikhote-Alin Mtr., by the settlement Meteoritnaya, on rocks, 25.09.1973 *Laanetu* (TU), TLC: atranorin, zeorin, norstictic acid.

Additional specimens examined. ASIA. JAPAN, *Kurokawa*, Lich. Rar. et Crit. Exs. 1, (UPS). NORTH AMERICA. MEXICO, *Purpus* 53 (LE).

Heterodermia diademata (Taylor) D. D. Awasthi

Thallus light gray, grayish white, forming great (up to 15 cm across) patches. Lobes slightly disjunct or adjacent, 0,5–2,5 mm broad, repeatedly dichotomously or irregularly branched, with short lateral lobes, plane (not ascending), upper cortex even, sometimes covered with pruina, without soralia and isidia, rare with marginal squamules. Lower side corticate, white or brownish towards the centre, without pigments. Rhizines marginal, concolorous with the thallus, only tips slightly darkening. Apothecia often, laminal, 1,5–5 mm across, margin mostly entire, seldom crenulate, disc dark brown, spores 23–31 × 10–15 µm, without sporoblastidia (may occur in single spores).

Substances. Atranorin, zeorin. Thallus K+ yellow, medulla K+ yellow, P- or + pale yellow.

Distribution. East and South-East Asia (China, India, Japan, Korea, Nepal, Russia), South, Central and North America, East Africa. Grows on trunks and branches of trees; Swinscow and Krog (1976, p. 116) note that this species "... tolerates artificial habitats such as parks, street avenues, and trees on cultivated land ...".

Allied cpecies. *H. hypoleuca*, but its under side is decorticate and upper cortex is uneven.

SDC. Vegetative propagules absent, lower cortex present, no other identified substances besides atranorin and zeorin (but in our specimens unknown substances X_1, X_2, X_3, X_4, X_5, X_8, X_9).

Specimens examined.

H. d. f. *diademata* – RUSSIA, Far East, Amurskaya Rg., Nemtu, on *Populus tremula*, 22.08.1927 *Savicz* (KW), TLC: atranorin, zeorin, X_1, X_4. – Same Rg., Mukden, 14.09.1927 *Kardakov* (KW). – Primorye Tr., Mt. Lisa, 3.10.1934 *Lazarenko* (KW). – Same Tr., Sikhote-Alin Mtr., Mt. Galin-Cheran, 8.10.1936 *Kolesnikov* (KW). – Same Tr., Kedrovaya Padj NCA, 16.09.1961 *Pärn* (TU), TLC: atranorin, zeorin; 26.07.1977 *Roosma* (TU), TLC: atranorin, zeorin, X_5. – Same Tr., Ussuriiski NCA, on *Quercus*, 31.08.1961 *Pärn* (TU), TLC: atranorin, zeorin, X_1, X_4. – Same Tr., settlement Kamenushka, on *Juglans mandschurica*, 25.09.1986 *Trass* (TU), TLC: atranorin, zeorin, X_1, X_4, X_8. – Jewish Autonomic Region, Oblutshenski district, Yadrina, on *Betula*, 8.08.1961 *Pärn* (TU), TLC: atranorin, zeorin, X_1, X_8.

H. d. f. *brachyloba* (Müll. Arg.) Kurok. – RUSSIA, Far East, Primorye Tr., Kedrovaya Padj NCA, 1966 *Knyazheva* (TU), TLC: atranorin, zeorin, X_1. – Same Tr., Sikhote-Alin Mtr., Mt. Chernyi, 1050 m alt., on *Pinus sibirica*, 27.07.1977 *Trass* (TU), TLC: atranorin, zeorin, X_1, X_2, X_3. – Same Tr., 9.08.1954 *Vassilyeva* (TU), TLC: atranorin, zeorin, X_4, X_9. – Same Tr., river Sandagon valley, on *Tilia amurensis*, 8.09.1961 *Pärn* (TU), TLC: atranorin, zeorin, X_1, X_4.

Additional specimens examined. AFRICA. East Africa, *Holm*, det. R. Moberg (UPS). SOUTH AMERICA. BRAZIL, *Malme*, exp. Regn. 1319 (LE), TLC: atranorin, zeorin, X_1, X_3. ASIA. JAPAN, Hokkaido, *Koponen*, det. Kashiwadani (H).

Heterodermia dissecta (Kurok.) D. D. Awasthi

Thallus grayish white, loosely attached to substrate, forming 10–15 cm in width regular

rosettes or, more seldom, irregular patches. Lobes 0,7–2 mm broad, dichotomously branched, with marginal short gray rhizines, with small subisidial dissected marginal squamules. Upper cortex even. Under side decorticate, white, not pigmented, towards center brownish. Apothecia rare, laminal, 1–5 mm in diameter, disc brown, margin isidiate. Spores 28–32 × 12–17 µm. Sporoblastidia present.

Substances. Atranorin, zeorin, norstictic, salazinic and dissectic acid. Thallus K+ yellow, medulla K+ yellow, P+ deep yellow.

Distribution. Asia (China, India, Japan, Nepal, Russian Far East), North America (Mexico). On mossy rocks.

Allied species. *H. isidiophora* and *H. microphylla*; differs from these by chemical substances (dissectic acid, P+ deep yellow).

SDC. Lobe margins with subisidial dissected squamules, lower cortex white, not pigmented, dissectic acid present.

Specimen examined. RUSSIA, Far East, Primorye Tr., Sikhote-Alin Mtr., Ussuriiski NCA, on stones, 29.10.1973 *Trass* (TU), TLC: atranorin, zeorin, norstictic, salazinic and dissectic acids.

Additional specimens examined. JAPAN, S. *Kurokawa*, Lich. Rar. et Crit. Exs. 104 (TU), TLC: atranorin, zeorin, dissectic acid, norstictic acids (traces); Japan, *Koponen*, det. Kashiwadani (H). NEPAL, *Thor*, det. Moberg (UPS).

Heterodermia hypocaesia (Yasuda) D. D. Awasthi

Thallus grayish-greenish-white forming patches up to 10 cm in width. Lobes digitately or dichotomously branched, 1–3 mm broad, apices of short lateral branches with labriform soralia. Upper cortex uneven. Under side noncorticate, arachnoid, in central part black, peripheral – white, yellowish or brownish yellow (pigment). Marginal rhizines black, shiny, simple or branched. Apothecia rare, laminal, 1–4 mm across, margin with squamules, their margin with soredia and under side decorticate, yellow. Spores 35–46 × 16–18 µm, with sporoblastidia.

Substances. Atranorin, zeorin, salazinic acid, pigment. Thallus K+ yellow, medulla K+ yellow → red, P+ yellow.

Distribution. Asia (China, India, Indonesia, Japan, Nepal, Papua New Guinea, Philippines, Russia, Sikkim, Taiwan, Thailand), Australia, Africa. On bark of trees, on rocks.

Allied species. *H. obscurata* (but this species is without salazinic acid and spores are smaller).

SDC. Labriform soralia on lateral lobes, noncorticate pigmented under side, salazinic acid.

Specimen examined. RUSSIA, Far East, Primorye Tr., Sikhote-Alin Mtr., Yekaterinovka, on the basal part of an old oak (*Quercus mongolica*), 9.08.1977 *Trass* (TU), TLC: atranorin, zeorin, salazinic acid.

Additional specimen examined. AUSTRALIA, NSW, *Streimann*, det. Elix (H, UPS).

Heterodermia hypochraea (Vain.) Swinscow & Krog

Thallus grayish white forming small (2–6 cm in width) irregular patches, in center attached to the substrate, in peripheral part ascending. Lobes suberect or ascending, 0,5–2 mm broad, convex, upper cortex uneven, without soredia, isidia and squamules. Under side decorticate, arachnoid, white, with yellow or brownish yellow K+ purple spots (pigment). Rhizines 1–4 mm long, gray, mainly simple. Apothecia common, apical, 1–5 mm across, stipitate, disc brown, margin with squamules. Spores 30–42 × 17–19 µm, with sporoblastidia.

Substances. Atranorin, zeorin, two pigments (with different reactions). Thallus K+ yellow, medulla K+ yellow or K+ purple red, P- or + pale yellow.

Distribution. Asia (China, Japan, Philippines, Russian Far East, Taiwan), South America (Uruguay), Africa (Uganda). On tree bark and especially twigs, in tropics frequently on bamboo.

Allied species. *H. podocarpa* (but this species is without K+ purple pigment).

SDC. Lobes ascending, vegetative propagules absent, under side decorticate, two pigments.

Specimens examined. RUSSIA, Far East, southern part of Primorye Tr. 1968 *Knyazheva* (TU), identified as *Anapthychia spinulosa* by Kurokawa, TLC: atranorin, zeorin. – Same Tr.; Ussuriiski NCA, on twigs of *Pinus coraiensis*, 28.10.1973 *Trass* (TU), TLC: atranorin, zeorin, medulla K+ purple red.

Additional specimens examined. ASIA. JAPAN, Hokkaido, *Koponen*, det. Kashiwadani (H). INDIA, Eastern Himalaya, *Awasthi* (UPS). North-western Himalaya, Awasthi (UPS).

HETERODERMIA HYPOLEUCA (Ach.) Trevis. var. **HYPOLEUCA**

Thallus forming circles up to 15 cm in width, whitish or greenish gray. Lobes adjacent, 0.5–2 mm broad, plane or little convex, not ascending, with distinctly uneven upper cortex, without soredia and isidia, rarely with squamules. Under side non-corticate, white, towards center dirty brown. Marginal rhizines gray with dark tips, branched. Apothecia common, laminal, 3–10 mm across, margin crenulate or with conspicuous squamules, disc dark brown. Spores 23–30 × 10–16 µm, without sporoblastidia.

Substances. Atranorin, zeorin, sometimes salazinic or/and norstictic acid. Thallus K+ yellow, medulla K+ yellow (rarely + reddish yellow), P+ pale yellow or rarely + deep yellow. Many compounds remained unidentified in our TLC analyses: X_1, X_4, X_5, X_8. Unknown substance X_4 was observed in 86 specimens.

Distribution. East and South-East Asia (China, India, Japan, Korea, Nepal, Papua New Guinea, Russia), East and South Africa, North America. Beside *H. speciosa* this species is the most common *Heterodermia* in the Far East of Russia. On bark of trees and on mossy rocks.

Allied species. *H. diademata* (but this taxon is with lower cortex), *H. dendritica* (with pigmented under side and spores with sporoblastidia).

SDC. Uneven upper cortex, soralia and isidia absent, under side decorticate and without pigments.

Selected specimens examined (more than 120 specimens from TU, KW and LE have been checked). RUSSIA, Far East, Primorye Tr., Sikhote-Alin Mtr. (southern and middle parts): Kedrovaya Padj NCA, 2.10.1935 *Kabanov* (KW), 2.10.1955 *Koval* (KW), 20.06.1967 *Krasnova* (KW), 16.09.1961 *Pärn* (TU), 25.08.1965 *Blum* (KW), 22.07.1985 *Roosma* (TU). – Ussuriiski NCA, 27.10.1973 and 24.09.1986 *Trass* (TU). – Mt. Tshandalaz, 14.08.1968 and 7.08.1970 *Knyazheva* (TU). – Lazovski NCA, 23.09.1983 *Randlane* (TU). – Mt. Snezhnaya, 15.09.1983 *Randlane* (TU), 5.08.1977 *Trass* (TU). – Marine Experimental Station, 29.09.1983 *Randlane* (TU). – Ternei, 1.08.1977 *Trass* (TU). – Kitovoya Rebro, 2.08.1977 *Roosma* (TU). – Plastun, 22.07.1977 *Trass* (TU). – Mt. Ostryi, 7.08.1977 *Trass* (TU). – Cape Yelagin, 26.08.1977 *Trass* (TU). – Mt. Vorobey, 9.08.1977 *Knyazheva* (TU). – Mt. Oblatshnaya, 9.08.1977 *Roosma* (TU). – Mt. Khualaza, 9.08.1964 and 9.08.1971 *Knyazheva* (TU). – Bay Posset coast, 3.07.1982 *Krivoshtshekova* (TU). – Lidovski, 21.07.1977 *Trass* (TU). – City Vladivostok, 3.09.1927 *Oxner* (KW). – Vladivostok-Akademgorodok, 1973 *Knyazheva* (TU). – Nakhodka, 8.08.1977 *Trass* (TU). – Dalnegorsk, 20.07.1977 *Trass* (TU). – Olga, 28.08.1961 *Pärn* (TU). – River Yodzikhe bank, 1.08.1977 *Trass* (TU).

Additional specimens examined. AFRICA. MADAGASCAR, Central Madagascar, *Wildebranth* 2166, comm. Rensch (LE). ASIA. JAPAN, Rokkô, *Asahina*, det. Zahlbruckner (LE); Japan, *Kurokawa* & *Kashiwadani*, Lich. Rar. et Crit. Exs. 302, (LE). PHILIPPINES, Java, Iter Indicum 1893/94 Nº 3268, *Schiffner*, det. Zahlbruckner (LE). NORTH AMERICA. USA, Maryland, *Hale* 14 866 (LE); West Virginia, *Hale* 19 250 (LE); Baltimore Co., *Plitt*, (LE). SOUTH AMERICA. BRAZIL, Brasilia Lich. Austroamer. ex Herb. Regnell. 52, *Malme*, det. Lynge (LE).

H. HYPOLEUCA var. **DIVERGENS** Trass, var. nov.

Subsimilis *Heterodermiae hypoleucae* var. *hypoleucae*, sed differt ab ea acidum salazinicum continente et in marginibus lobi squamulis numerosis, convexis, parvis (0.2–0.4 × 0.4–0.8 mm) ornatis.

Differs from *H. hypoleuca* var. *hypoleuca* in producing salazinic acid and having many small (0.2–0.4 × 0.4–0.8 mm), convex (under side decorticate) squamules on lobe margins.

Holotype: RUSSIA, Far East, Primorye Tr., Sikhote-Alin Mtr., Mt. Snezhnaya, on rocks, 4.08.1977 *Trass* (TU, Het-140), TLC: atranorin, zeorin, salazinic acid, X_2, X_3.

Additional specimen examined. RUSSIA, Far East, Primorye Tr., Yekaterinovka, on *Quercus mongolica*, 9.08.1977 H. Trass (TU, Het-189), TLC: atranorin, zeorin, salazinic acid, X_4.

HETERODERMIA INTERMEDIA Trass

Thallus foliose, appressed, grayish white, 4–5 cm across. Lobes 0.3–1.0 mm width, dichotomously divided, plane, soralia apical, labriform, located on short lateral lobules, soredia granular. Under side corticate, with pink or (in central part) ochraceous K+ orange pigment, with marginal, white or grayish, simple or scarcely branched rhizines. Apothecia common and numerous, laminal, stipitate, 0.5–1 mm in diameter, margin without soredia. Spores ellipsoid, dark brown, 28–32 × 14–16 µm, 1-septate, without sporoblastidia.

Substances. Atranorin, zeorin, salazinic acid, unidentified substances X_1, X_4, pigment. Thal-

lus K+ yellow, P+ yellow, medulla K+ yellow turning orange.

Distribution. Russia (Far East) (Trass, 1992 p. 23–24).

Allied species. This species differs from *H. speciosa* and *H. pseudospeciosa* by presence of salazinic acid (in *H. pseudospeciosa* – norstictic acid), pigmented under side, narrow (not over 1 mm) lobes and by numerous small apothecia.

SDC. Narrow lobes, corticate under side, pigment, salazinic acid.

Specimens examined. RUSSIA, Far East, Primorye Tr., middle Sikhote-Alin Mtr., Ternei, on rocks of the river Velikaya Kema, 25.07.1977 *Trass* (holotype, TU, Het-169).

HETERODERMIA ISIDIOPHORA (Nyl.) D. D. Awasthi var. **ISIDIOPHORA**

Thallus grayish white, loosely attached to the substrate, forming great (up to 20 cm in width) patches. Lobes 0.5–2.5 mm broad, plane, even, with marginal and laminal cylindrical or coralloid isidia, their tips sometimes sorediate. Upper cortex even. Under side corticate, white, sometimes dirty brown. Rhizines mainly marginal, gray or rarely black. Apothecia laminal, 1.5–5 mm across, margin by mature apothecia with isidia, disc dark brown. Spores 25–32 × 10–15 µm, without sporoblastidia.

Substances. Atranorin, zeorin. Thallus K+ yellow, medulla K+ yellow, P- or + pale yellow.

Distribution. Asia (China, India, Japan, Nepal, Russia), South and North America, (Mexico), Australia, East Africa. On bark of trees. According to Swinscow and Krog (1976) this species is a poleotolerant species in East Africa growing in city avenues and parks.

Allied species. *H. microphylla* (but in this species lower cortex is absent).

SDC. Marginal and laminal isidia, under side corticate.

Specimens examined. RUSSIA, Far East, Primorye Tr., Kedrovaya Padj NCA – many collections by *Koval* (KW), *Knyazheva* (TU), *Vassilyeva* (LE), *Pärn* (TU), TLC: atranorin, zeorin, X_1, X_2, X_3. – Same Tr., middle Sikhote-Alin Mtr., Ternei, 24.07.1977 *Roosma* and *Trass* (TU), TLC: atranorin, zeorin. – Khabarovsk Tr., in vicinities of the city Khabarovsk, 19.08.1927 *Oxner* (KW). – Same Tr., Badzhal Mtr., upper course of the river Urmi, on *Picea*, 2.07.1981 *Randlane* (TU), TLC: atranorin, zeorin. – Amurskaya Rg., river Sidimi valley, on *Pinus coraiensis*, 22.08.1927 *Savicz* (LE), TLC: atranorin, zeorin.

Additional specimens examined. JAPAN, Kyushu, *Koponen*, det. Kashiwadani (H);

H. ISIDIOPHORA var. **CORALLIGERA** Trass, var. nov.

Thallus lobiis in marginibus et superne cum isidiae coralloformis, rhizinae glaucescenti.

Thallus isidiate, isidia short, coralloid, not cylindrical, rhizines grey.

Holotype: RUSSIA, Far East, Primorye Tr., Sikhote-Alin Mtr., Mt. Snezhnaya, 900 m alt., on *Betula middendorfii*, 6.08.1977 Trass (TU, Het-121), TLC: atranorin, zeorin.

Additional specimens examined. RUSSIA, Far East, Primorye Tr., Mt. Bidau, on *Pinus sibirica*, 25.07.1985 *Roosma* (TU), TLC: atranorin, zeorin. – Same Tr., Kedrovaya Padj NCA, 26.07.1967 *Masjuk* (KW), TLC: atranorin, zeorin, X_4, X_5 – suburb Akademgorodok of city Vladivostok, on *Quercus mongolica*, 28.07.1977 *Trass* (TU).

HETERODERMIA JAPONICA (M. Satô) Swinscow & Krog

Thallus grayish white, towards center darkening, forming circles up to 15 cm in width. Lobes 0.7–2 mm broad, even, plane or slightly convex, apices covered with pruina, on short lateral lobules labriform soralia. Upper cortex uneven. Under side non-corticate, arachnoid, white, towards center blackening. Marginal rhizines black, simple or branched, 1–3 mm long. Apothecia rare, 1–8 mm across, with marginal squamules and occasionally with soredia, disc dark brown. Spores 30–46 × 15–20 µm, with sporoblastidia.

Substances. Atranorin, zeorin, sometimes norstictic or/and salazinic acid. Three chemical strains (morphologically identical): (1) atranorin and zeorin, (2) atranorin, zeorin and norstictic acid (= var. *reagens* Kurok.), (3) atranorin, zeorin, norstictic and salazinic acids (according to Swinscow and Krog, 1976; this may be *Heterodermia chilensis* var. *austroafricana* Kurok.). Reactions: thallus K+ yellow, medulla K+ yellow, sometimes reddish yellow, P-, + pale yellow or + yellow.

Distribution. Asia (China, India, Indonesia, Japan, Malaysia, Nepal, Russia, Sri Lanka, Taiwan), Europe (Azores, Canary Islands), New Zealand, South and North America, South and East Africa. On bark and thick twigs of trees.

Allied species. *H. obscurata* (but this species has pigmented under side, on margin of apothecia soredia, not squamules), *H. propagulifera* (with yellow pigment on under side).

SDC. Labriform soralia on lateral lobules, decorticate under side without pigment, soredia on apothecial margin.

Specimens examined.
H. j. var. *japonica* – RUSSIA, Eastern Siberia, Lake Baikal region, Khamar-Daban Mtr., river Vydrinnaya valley, 700 m alt., on *Populus suaveolens*, 10.08.1978 *Trass* (TU), TLC: atranorin, zeorin. – Same region, river Pereyomnaya valley, 1100 m alt., on *Populus suaveolens*, 14.08.1980 *Trass* (TU), TLC: atranorin, zeorin. – Same region, river Mishikha valley, 600 m alt., on *Populus*, 10.08.1981 *Roosma* (TU), TLC: atranorin, zeorin. – Far East, Primorye Tr., middle Sikhote-Alin Mtr., Ternei, on *Pinus coraiensis*, 12.08.1977 *Roosma* and *Trass* (TU), TLC: atranorin, zeorin. – Same Tr., Lazovski NCA, on mossy rocks, 20.09.1983 *Randlane* (TU), TLC: atranorin, zeorin, X_2.
H. j. var. *reagens* Kurok. – RUSSIA, Far East, Primorye Tr., Sikhote-Alin Mtr., by settlement Meteoritnaya, on rocks, 25.09.1973 Laanetu (TU), TLC: atranorin, zeorin, nortictic acid, X_5.

Additional specimens examined. ASIA. JAPAN, *Kurokawa & Kashiwadani*, Lich. Rar. et Crit. Exs. 53 (LE), TLC: atranorin, zeorin. PAPUA NEW GUINEA, 1981 *Koponen*, det. Aptroot (H); French-Guinea, *Santesson*, det. Kurokawa (UPS). NORTH AMERICA. GUATEMALA, *Kalb*, Lich. Neotrop. 93 (H).

Heterodermia leucomela (L.) Poelt

Thallus light gray, grayish white, sometimes greenish, forming 3–10(12) cm in width irregular patches, flutty and loosely attached to substrate. Lobes 0.5–3 mm broad, with uneven upper cortex, disjunct, tangled, dichotomously branched, towards apices a little ascending, not circinately revolute at apices, without isidia, margins under side sorediate. Under side decorticate, white to yellowish or brownish (pigment), rough, not arachnoid. Rhizines marginal, black, 5–10 mm long, simple. Apothecia rare, laminal or apical, stipitate, disc often covered with bluish pruina, margin crenulate or with squamules. Spores 35–52 × 18–25 µm, with sporoblastidia.

Substances. Atranorin, zeorin, salazinic acid, consalazinic acid, pigment; Swinscow and Krog (1988) report norstictic acid too. Thallus K+ yellow, P-, medulla K+ yellow → red, P+ orange.

Distribution. Asia (China, India, Indonesia, Japan, Mongolia, Philippines, Taiwan), East Africa, Europe, North, Central and South America. I have not seen true *H. leucomela* from Siberia and Far East of Russia, though there are records in literature (Tomin, 1926, 1937; Knyazheva, 1973; Chabanenko, 1986). All corresponding identifications in LE and KW actually belong to *H. boryi*. On mossy tree trunks and rocks.

Allied species. *H. boryi* (see p. xx), *H. appalachensis* (salazinic acid absent, labriform soralia present).

SDC. Flutty thallus, disjunct lobes, pigmented decorticate under side, salazinic acid.

Specimens examined. ASIA. GEORGIA, Caucasus, Borzhomy, 1914 *Kozolovsky*, det. Pakhunova (LE). EUROPE. UKRAINE, Carpathian Mtr., *Makarevitsh* (KW); Crimea peninsula, *Kopachevskaya* (KW).

Additional specimens examined. EUROPE. GREAT BRITAIN, Cornwall, Scilly Isles, *Santesson* (UPS). SWITZERLAND, Aathal Hegetschweiler (TU), TLC: atranorin, zeorin, salazinic acid; *Hepp*, Lich. Helv. Exs. 573 (LE); Insel Hierro, Valverde, Herb. Wasmuth (TU, collector unknown), TLC: atranorin, zeorin, salazinic acid. AMERICA. COSTA RICA, *Stanley*, det. Merrill (LE). MEXICO, Bye, Lich. Exs., Boulder, Arizona, 577, *Weber* (LE).

Heterodermia microphylla (Kurok.) Skorepa

Thallus ashy gray, sometimes brownish, forming circles up to 20 cm in width. Lobes 0.7–2 mm broad, plane, not ascending in apices, with short lateral lobules, upper cortex uneven, on lobes margins dissected squamules, between them sometimes isidia. Under side noncorticate, white. Rhizines ashy grey, marginal. Apothecia rare, margin often with squamules. Spores 25–35 × 12–18 µm, without sporoblastidia.

Substances. Atranorin, zeorin. Kurokawa (1962) notes that locally there may be norstictic and salazinic acids, same declares Yoshimura (1979). Reactions: thallus K+ yellow, medulla K+ yellow or + reddish yellow, P+ pale yellow or + deep yellow.

Distribution. Asia (China, Japan, Korea, Russia), Australia, New Zealand, North America, East Africa. On bark of trees, sometimes in towns on roadside trees.

Allied species. *H. hypoleuca* (but this species is without dissected squamules), *H.*

corallophora (but this species has lateral and laminal coralloid isidia, black rhizines, under side pigmented).

SDC. Dissected squamules and simple isidia, decorticate white under side.

Specimens examined. RUSSIA, Far East, Primorye Tr., southern Sikhote-Alin Mtr., Kedrovaya Padj NCA, 15.08.1935 *Kabanov* (KW), TLC: atranorin, zeorin; 17.09.1961 *Masing* (TU), TLC: atranorin, zeorin; 20.06.1967 *Krasnova* (KW), TLC: atranorin, zeorin, X_4. – Same Tr., Mt. Peishula, on *Abies*, 18.08.1967 *Knyazheva* (TU), TLC: atranorin, zeorin, X_4. – Same Tr., Ussuriiski NCA, on *Acer mandschurica*, 27.10.1973 *Trass* (TU), TLC: atranorin, zeorin. – Same Tr., suburb of city Vladivostok, on *Quercus mongolica*, 3.09.1927 *Oxner* (KW), TLC: atranorin, zeorin, X_4. – Kurile Islands, island Kunashir, on *Abies sachalinensis*, 30.09.1980 *Parmasto* (TU), TLC: atranorin, zeorin, X_2. – Khabarovsk Tr., Chechzyr, 22.09.1927 *Oxner* (KW), TLC: atranorin, zeorin, X_1. – Same Tr., Badzhal Mtr., upper course of the river Urmi, on *Alnus*, 5.07.1981 *Randlane* (TU), TLC: atranorin, zeorin, X_2, X_5. – Same locality, on *Abies*, 28.06. and 17.07.1981 *Randlane* (TU), TLC: atranorin, zeorin, salazinic acid, X_5.

Additional specimens examined. AMERICA. BRAZIL, *Kalb*, Lich. Neotrop. 95 (H). ASIA. JAPAN, Hokkaido, 1970 *Koponen*, det. Kashiwadani (H). AUSTRALIA, Queensland, *Tibell* (UPS).

Heterodermia obscurata (Nyl.) Trevis.

Thallus gray or greenish white, darkening towards the center, forming rosettes or irregular patches up to 15 cm in width. Lobes 0.7–2 mm broad, becoming broader towards apices, dichotomously branched, on tips of short lateral ascending lobules capitate or labriform soralia. Rhizines black, 1–2 mm long. Under side decorticate, arachnoid, deep or browhish yellow (pigment). Apothecia rare, laminal, 1–5 mm across, margin sorediate, disc dark brown. Spores 29–35 × 15–19 µm, with sporoblastidia.

Substances. Atranorin, zeorin, pigment. Thallus K+ yellow, medulla K+ yellow, P- or + pale yellow, pigmented parts K+ purple red.

Distribution. Common in tropics and subtropics, extending temperate zone. Africa, Asia (China, India, Japan, Nepal, Russia, Taiwan), Australia, New Zealand, Europe, South and North America (Mexico, Hawai). On mossy tree trunks.

Allied species. *H. propagulifera* (but this species is with norstictic and salazinic acids, rhizines grey), *H. dendritica* (without labriform soralia, norstictic and salazinic acids present).

SDC. Capitate or (more often) labriform soralia on apices of short lateral lobules, under side decorticate, with K+ purple red pigment.

Specimens examined. RUSSIA, Altayski Tr., river Katuni, on rocks, 11.08.1940 *Oxner* (KW), TLC: atranorin, zeorin, X_1. – Far East, middle Sikhote-Alin Mtr., on rocks of the river Velikaya Kema, 25.07.1977 *Trass* (TU), TLC: atranorin, zeorin, X_4. – Southern Sikhote-Alin Mtr., Olga, on rocks, 29.08.1961 *Pärn* (TU), TLC: atranorin, zeorin, X_4. – Primorye Tr., Petrov island, on rocks, 02.09.1961 *Masing* (TU), TLC: atranorin, zeorin.

Additional specimens examined. AMERICA. USA, New Mexico, *Weber* (LE), TLC: atranorin, zeorin, X_2; Shushan, Arizona, 1957 *Weber* (LE). ASIA. JAPAN, *Merrill* 3878, det. Hue (LE); Muroi, Lich. Jap. Exs. 153, Taison-zi, Kóbe (H); NEW GUINEA, *Streimann*, det. Sipman (H). EUROPE. ITALY, Crypt. Exs. Vindob. 4432, *Poelt* (LE). SPAIN, Tenerife, *Santesson* (UPS).

Heterodermia podocarpa (Bél.) D. D. Awasthi

Thallus grayish white, forming rosettes 1–3 cm in width, loosely attached to the substrate. Lobes 0.3–3 mm across, convex, ascending or suberect, becoming broader towards tips, with lateral lobules. Upper cortex uneven, without soredia and isidia. Under side non-corticate, white. Rhizines 1–2 mm long, simple or scarsely branched, grey. Apothecia common, 0.5–5 mm across, apical or marginal, margin crenulate or with small squamules, disc brown. Spores 36–51 × 17–23 µm, with sporoblastidia.

Substances. Three chemical strains are known: I – atranorin and zeorin, II – atranorin, zeorin and norstictic acid, III – atranorin, zeorin, norstictic and salazinic acids. Reactions: Thallus K+ yellow, medulla K+ yellow, sometimes reddish yellow, P+ pale or deep yellow.

Distribution. Asia (China, India, Nepal, Philippines, Russia, Taiwan), Hawai, West Indies, South, Central and North America, East Africa. Mainly tropical and subtropical species, but extending into temperate zone too; according to Awasthi (1960), it is common species in Himalayan temperate climate zone. On trunks and twigs of deciduous trees and shrubs, in East Africa “mainly on twigs of bamboo in montane forest” (Swinscow & Krog, 1988, p. 99).

Allied species. This species belongs to the group of fruticose *Heterodermia*'s with ascending, suberect or erect lobes and marginal or apical

apothecia. Close to *H. hypochraea*, differs from it by lacking pigments and larger spores.

SDC. Ascending lobes, non-corticate white under side, marginal apothecia, soredia and isidia absent, large spores.

Specimen examined. RUSSIA, Far East, Primorye Tr., city Vladivostok, in forest "Sad Gorod", on *Quercus mongolica*, 3.11.1927 *Oxner* (KW).

Additional specimens examined. AMERICA. COSTA RICA, Plantae Graecenses 264 (TU), TLC (Tartu): atranorin, zeorin, norstictic acid. ASIA. JAPAN, Hakone, *Asahina*, det. Zahlbruckner (LE), TLC (Tartu): atranorin, zeorin; Lich. du Japon. *Faurie* 720, det. Hue (LE).

Heterodermia propagulifera (Vain.) J. P. Dey

Thallus grayish white, forming extensive patches up to 10 (15) cm in width. Lobes 1–2 mm broad, plane, on apices of lateral lobules soralia. Under side non-corticate, arachnoid, white, in peripheral parts yellow (pigment). Rhizines marginal, black, simple or branched. Apothecia rare, spores 16–20 × 35–46 µm, with sporoblastidia.

Substances. Atranorin, zeorin, norstictic and salazinic acids, yellow pigment. Thallus K+ yellow, medulla K+ yellow → reddish yellow, P+ yellow, pigmented spots K+ purple red.

Distribution. Common in tropical and subtropical areas – South America, Hawai, Java, extending to temperate zone in Asia (China, Japan, Nepal, Russia), Europe (France) and North America. On tree trunks and rocks.

Allied species. *H. dendritica* (but this species lacks soralia), *H. obscurata* (but this is without norstictic and salazinic acids), *H. japonica* (without yellow pigment). Moberg & Purvis (1997, p. 19) treat this species as a synonym of *H. japonica* (M. Satô) Swinscow & Krog. In my tentative opinion *H. propagulifera* and *H. japonica* are still different species – the former without pruina on lobes and with yellow pigment on under side, the latter with pruina and without pigment. *H. propagulifera* contains norstictic and salazinic acids constantly, *H. japonica* – only occasionally.

SDC. Soralia on lateral lobules, under-side non-corticate, yellow pigment, norstictic and salazinic acids.

Specimens examined. RUSSIA, Altayski Tr., river Katun, not far from Askata, 450 m alt., on rocks, 19.08.1940 *Oxner* (KW), TLC: atranorin, zeorin, norstictic and salazinic acids. – Far East, Primorye Tr., Ternei, 23.07.1977 *Trass* (TU). – Same Tr., Mt. Chernaya, 25.07.1977 *Trass* (TU).

Additional specimens examined. ASIA. JAPAN, *Kurokawa*, Lich. Rar. et Crit. Exs. 2 (LE), TLC: atranorin, zeorin, salazinic and norstictic acids. AMERICA. MEXICO, *Purpus* 53 (identified as *Anaptychia dendritica* var. *dendritica*; soralia on lateral lobules), TLC: atranorin, zeorin, salazinic and norstictic acids. AUSTRALIA, Queensland, *Tibell* (UPS).

Heterodermia speciosa (Wulfen) Trevis.

Thallus grayish white, forming often great (up to 20 cm in width) patches. Lobes 1–2 mm broad, plane or a little convex, not ascending, dichotomously or digitately branched, with many short lateral lobules with capitate or labriform soralia on tips. Under side corticate, white or slightly fuscous towards the center. Rhizines gray, apices darkening. Apothecia rare, 1–3 mm across, margin crenulate and sorediose, disc brown. Spores 30–37 × 12–18 µm, with sporoblastidia.

Substances. Atranorin, zeorin. Thallus K+ yellow, medulla K+ yellow, P- or + pale yellow.

Distribution. Europe, North America, East Asia (China, India, Japan, Mongolia, Russia), East Africa. Swinscow & Krog (1988, p. 100) consider its distribution cosmopolitan, while Kurokawa (1962, p. 25) is on different opinion: "as far as is known, this species occurs only in Europe ...". Northernmost record for this species is from Tshukotka peninsula, eastern coast of the Bering sea (Rassadina, 1935, p. 335).

Allied species. *H. pseudospeciosa* (with black rhizines, norstictic acid present), *H. intermedia* (pigment and salazinic acid present).

SDC. Labriform soralia, under side corticate, apothecial margin sorediose, norstictic and salazinic acids absent.

Note. Taxonomists have met difficulties in the differentiation of *H. speciosa*, *H. pseudospeciosa* and the most ill-defined *H. tremulans* (Müll. Arg.) W. L. Culb. Kurokawa (1962, p. 27) emphazises, that the diagnostic feature of *H. pseudospeciosa* var. *tremulans* is size of spores and the sorediate margin of apothecia, by which it is separated from closely allied *A. speciosa*. Later on (Kurokawa 1998: 24) he raised this variety to the rank of species.

Culberson (1966: 485) notes that *H. tremulans* in the Carolina differs from *H. pseudospeciosa* in visible traits by having fine, very abundant soredia in large soralia (coarse but sparsely developed ones in *Heterodermia pseudospeciosa*) and in always having white or pale rhizines (dark or black ones in *H. pseudospeciosa*). I have not identified *H. pseudospeciosa* among materials from Russia, though its occurrence there is quite plausible. All the *H. speciosa* specimens from Siberia and the Russian Far East are sterile. I was unable to distinguish *H. tremulans* from *H. speciosa*, as were Swinscow & Krog (1976, 1988) when treating African specimens. Aptroot (1987) asserts, that he does not find morphological differences between *H. tremulans* and *H. speciosa*; specimens with granular soredia originate in sheltered habitats. The soredia of specimens from Russian Far East are mainly granulose, thus as in *H. pseudospeciosa*, but they lack norstictic acid, which is characteristic for this species. So I classify all specimens with labriform soralia, non-pigmented lower cortex, and without norstictic acid as *H. speciosa*.

Specimens examined. ASIA. RUSSIA, Far East, Primorye Tr., Sikhote-Alin Mtr., Kedrovaya Padj NCA, many collectors: 2.10.1955 *Koval* (TU), TLC: atranorin, zeorin, X_1; 1961 *Masing* (TU), TLC: atranorin, zeorin; 20.06.1967 *Krasnova* (KW), TLC: atranorin, zeorin, X_1. – Same Tr., Khassansk, 30.09.1983 *Randlane* (TU), TLC: atranorin, zeorin, X_1, X_4. – Same Tr., Ternei, 23.07.1977 *Trass* (TU), TLC: atranorin, zeorin, X_1, X_4. – Same Tr., river Velikaya Kema lower reaches, 25.07.1977 *Trass* (TU), TLC: atranorin, zeorin, X_1, X_4. – Same Tr., Ussuriiski NCA, 28.09.1960 *Pärn* (TU), TLC: atranorin, zeorin, X_1; 14.09.1986 *Trass* (TU), TLC: atranorin, zeorin, X_1, X_4. – Same Tr., Lazovski NCA, 23.08.1936 *Kolesnikov* (KW), TLC: atranorin, zeorin, X_1; 20.09.1983 *Randlane* (TU), TLC: atranorin, zeorin, X_1, X_4. – Same Tr., Mt. Chernaya, alt. 900–1100 m, 25.07.1977 *Trass* (TU), TLC: atranorin, zeorin, two specimens with X_1, two with X_4. – Same Tr., Mt. Oblatshnaya, alt. 1200 m, 6.08.1977 *Trass* (TU), TLC: atranorin, zeorin, X_4. – Same Tr., Marine Experimental Station, 30.09.1983 *Randlane* (TU), TLC: atranorin, zeorin, X_1, X_4. – Same Tr., Olga, river Avvakumovka bank, 22.09.1983 *Randlane* (TU), TLC: atranorin, zeorin, X_1. – Same Tr., city Vladivostok suburb, 6.09.1927 *Oxner* (KW), TLC: atranorin, zeorin, X_1, X_4, one specimen without unidentified substances. – Same Tr., river Sandagon bank, 8.09.1961 *Masing* (TU). – Same Tr., Dalnegorsk, 21.07.1977 *Roosma* (TU), TLC: atranorin, zeorin (two specimens), $+X_1$ (two specimens). – Same Tr., Gornoretshensk, 20.07.1977 *Roosma* (TU). – Bay Posset coast, 29.06.1982 *Krivoshtshekova* (TU). – Same Tr., Kavalerovo, 2.08.1977 *Trass* (TU), TLC: atranorin, zeorin, X_1. – Same Tr., Cape Yelagin, 22.07.1977 *Trass* (TU), TLC: atranorin, zeorin. – Same Tr., southern Sikhote-Alin Mtr., 17.08.1967 *Knyazheva* (TU), TLC: atranorin, zeorin. –Khabarovsk Tr., Mt. Chechzyr, 23.08.1927 *Oxner* (KW), TLC: atranorin, zeorin, X_1, X_4. – Same Tr., Selikhin, 17.08.1961 *Pärn* (TU), TLC: atranorin, zeorin, X_1, X_4. – Amurskaya Rg., Mogot, 29.07.1961 *Pärn* (TU). TLC: atranorin, zeorin, X_1. – Republic of Sakha (Yakutia), 1953 *Fesko* (TU), TLC: atranorin, zeorin. – Eastern Siberia, Lake Baikal region, Khamar-Daban Mtr., settlement Baikalsk, 11.08.1979 *Trass* (TU), TLC: atranorin, zeorin (4 specimens), $+X_4$ (2). – Same Rg., river Solzen valley, 29.07.–3.08.1979 *Trass, Roosma, Levoll* (TU), TLC: atranorin, zeorin (1) $+X_4$ (4), $+X_1$, X_4 (4). – Same Rg., river Kharlahta valley, 12.08.1979 *Trass, Pärn* (TU), TLC: atranorin, zeorin. – Same Rg., river Slyudyanka valley, 9.08.1980 *Levoll* (TU), TLC: atranorin, zeorin. – Same Rg., river Bezgolovka valley, 9.08.1979 *Trass* (TU), TLC: atranorin, zeorin. – Same Rg., river Bolshaya Ossinovka valley, 3.08.1979 *Trass* (TU), TLC: atranorin, zeorin. – Same Rg., river Vydrinnaya valley, 10.08.1979 *Trass* (TU), TLC: atranorin, zeorin. – Same Rg., Baikalski NCA, Tanhoy, 9.08.1979 *Trass* (TU), TLC: atranorin, zeorin, X_1. – Same Rg., river Pereyomnaya valley, 16.08.1980 *Trass* (TU), TLC: atranorin, zeorin (16 specimens), + X_1 (2), + X_4 (2), + X_2 (2). – Altayski Tr., Katun, 18.08.1940 *Oxner* (KW), TLC: atranorin, zeorin, X_1 (3), + X_4 (2). GEORGIA, Caucasus, Lagoheti, 10.09.1959 *Shapiro* (KW). – Bakuriani, 1935 *Oxner* (KW). TLC: atranorin, zeorin, X_1. – Teberda NCA, 12.07.1958 Trass (TU). EUROPE. BYELORUSSIA, Mogilyovskaya Rg., 1913 *Kreyer* (LE). ESTONIA, Abruka island, 1936 *Lippmaa* (TU). UKRAINE, Transcarpathian Mtr., 21.07.1954 *Kopachevskaya* (KW).

Additional specimens examined. EUROPE. AUSTRIA, Plantae Graecenses 389, *Türk* (TU), TLC: atranorin, zeorin, X_1. YUGOSLAVIA, *Vezda*, Lich. Exs. 795 (TU).

HETERODERMIA SUBASCENDENS (Asahina) Trass

Thallus ashy gray, 3–5 cm in width. Lobes ascending or suberect, dichotomously or irregularly branched, 2–5 mm broad, towards apices dilated, spathuliform, with marginal (broad sublabriform) soralia. Upper cortex uneven. Under side non-corticated, arachnoid, in central part veined, white with yellow pigment spots (K+ purple red). Rhizines simple or branched, 1–3 mm long, gray, apices darker. Apothecia rare, 1–3 mm in diameter, margin sorediate, disc brown. Spores 34–41 × 16–20 µm, with sporoblastidia.

Substances. Atranorin, zeorin, pigment. Thallus K+ yellow, medulla K+ yellow, P- or pale yellow, pigment K+ purple red.

Distribution. Asia (China, Japan, Russia, Taiwan). On shrub (*Morus, Thea*), mossy rocks.

Allied species. *H. podocarpa* (but this species is without soredia and under-side is without pigment).

SDC. Spathuliform, ascending lobes, broadening towards apices soralia, yellow pigment.

Specimens examined. RUSSIA, Far East, Khabarovsk Tr., Chechzyr, on rocks, 23.08.1927 *Oxner*, identified as *Anaptychia podocarpa* (KW), TLC: atranorin, zeorin, X_4.

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REFERENCES

Aptroot, A. 1987. Pyxinaceae. In *Flora of the Guianas*. Ser. E: *Fungi and Lichens* 1 (ed. van Rijn, A. R. A.), pp. 1–59. Utrecht.

Awasthi, D. D. 1960. Contibutions to the lichen flora of India and Nepal. *Journ. Indian Bot. Soc.* 39(3): 415–442.

Barkhalov, Sh. 1944. Lichens of the Khanlaski district of Azerbaidjan (in Russian). *Bull. Azerbaidjan Fil. Ac. Sci. of the USSR* 4: 45–54.

Barkhalov, Sh. 1957. Preliminary list of the lichens of Talysh (in Russian). *Contr. of the Institute of Botany of the Ac. Sci. Azerbaidjan* 20: 33–63.

Barkhalov, Sh. 1969. *Foliose and fruticose lichens of Azerbaidjan* (in Russian). Institute of Botany, Ac. Sci. Azerbaidjan S.S.R., Baku. 307 pp.

Barkhalov, Sh. 1983. *Lichen flora of Caucasus* (in Russian). Elm, Baku. 338 pp.

Culberson, W. L. 1966. Chemistry and taxonomy of the lichen genera Heterodermia and Anaptychia in the Carolinas. *Bryologist* 69: 472–487.

Culberson, W. L. 1972. Improved conditions and new data for the identification of lichen products by a standardized thin-layer chromatographic method. *Journ. of Chromatography* 72: 123–125.

Culberson, W. L. 1974. Conditions for the use of Merck silica gel 60F 254 plates in the standardized thin-layer chromatography technique for lichen products. *Journ. of Chromatography* 97: 107–108.

Elenkin, A. 1904. Lichenes florae Rossiae et regionum confinium orientalium. II, III, IV. *Acta Horti Petropolitani* 24: 55–170.

Galloway, D. J. 1991a. Biogeographical relationships of Pacific tropical lichen floras. In *Tropical lichens: their systematics, conservation, and ecology* (ed. Galloway, D. J.), pp. 1–16. Clarendon Press, Oxford.

Galloway, D. J. 1991b. Phytogeography of southern hemisphere lichens. In *Qualitative Approaches to Phytogeography* (eds Nimis, P. L. & Crovello, T. J.), pp. 233–262. Kluwer, Dordrecht.

Gorbach, N. 1973. *Lichens of Byelorussia* (in Russian). Institute of Experimental Botany. Ac. Sci. Byelorussian S.S.R., Minsk. 336 pp.

Hafellner, J., Mayhofer, H. & Poelt, J. 1979. Die Gattungen der Flechtenfamilie Physciaceae. *Herzogia* 5: 39–79.

Holmgren, P. K., Holmgren, N. H. & Barnett, L. C. 1990. *Index Herbariorum. Part I: The herbaria of the world*. 8th ed. New Yotk Botanical Garden, New York. 693 pp.

Insarov, G. & Pchelkin, A. 1983. *Quantitative characteristics of the epiphytic lichens conditions in biosphere reserves. Sikhote-Alin Reserve* (in Russian). Laboratory of Monitoring of Environment and Climate, Moscow. 61 pp.

Insarov, G. & Pchelkin, A. 1984. *Quantitative characteristics of the epiphytic lichens conditions in biosphere reserves. Sikhote-Alin Reserve,* II part (in Russian). Laboratory of Monitoring of Environment and Climate, Moscow. 70 pp.

Insarov, G. & Pchelkin, A. 1988. *Quantitative characteristics of the epiphytic lichens conditions on the Kurile Islands Nature Reserve* (in Russian). Laboratory of Monitoring of Environment and Climate, Moscow. 174 pp.

Kashiwadani, H., Kurokawa, S. & Murakami, S. 1990. Enumeration and chemical variations of the lichen genus Anaptychia (s.lat.) in Peru. *Bull. Natn. Sci. Mus.* (Tokyo), Ser. B, 16(4): 147–156.

Knyazheva, L. 1973. Lichens in the south of the Primorye territory (in Russian with English summary). *Komarov Readings* (Vladivostok) 20: 34–46.

Kopachevskaya, E. 1986. *Lichen flora of Crimea and its analysis* (in Russian). Institute of Botany, Ac. Sci. Ukrainian S.S.R., Kiev. 296 pp.

Kreyer, G. 1913. Contributio ad floram lichenum gub. Mohilevensis, annis 1908–1910 lectorum (in Russian). *Acta Horti Petropolitani* 31: 263–440.

Kurokawa, S. 1962. A monograph of the genus Anaptychia. *Beihefte zur Nova Hedwigia* 6: 1–115.

Kurokawa, S. 1973. Supplementary notes on the genus Anaptychia. *Journ. Hattori Bot. Lab.* 37: 563–607.

Kurokawa, S. 1998. A catalogue of Heterodermia (Physciaceae). *Folia Cryptog. Estonica* 32: 21–25.

Makarevitsh, M., Navrotskaya, I. & Yudina, I. 1982. *Atlas of geographical distribution of lichens in the Ukrainian Carpathians* (in Russian). Institute of Botany, Ac. Sci. of the Ukrainian S.S.R., Kiev. 402 pp.

Makryi, T. 1986. Materials to the lichen flora of Altai mountain range (in Russian). In *New to the flora of Siberia* (eds Krasnoborov, J. & Safonova, T.), pp. 52–76. Siberian Central Botanical Garden, Novosibirsk.

Makryi, T. 1990. *The lichens of the Baikalsky range* (in Russian with English summary). Siberian Central Botanical Garden, Novosibirsk. 199 pp.

Mayrhofer, H. 1982. Ascosporen und Evolution der Flechtenfamilie Physciaceae. *Journ. Hattori Bot. Lab*. 52: 313–321.

Mikulin, A. 1986. Lichens (in Russian). In *Flora and vegetation of the Bolshekhehtzirski Nature Reserve (Khabarovsk territory)*, pp. 71–78. Vladivostok.

Moberg, R. & Purvis, W. 1997. Studies on the lichens of the Azores. Part 4. The genus Heterodermia. *Acta Univ. Ups. Symb. Bot. Ups*. 32: 187–194.

Nakhutzrishvili, I. (ed.) 1986. *Flora of cryptogamic plants of Georgia* (in Russian). Institute of Botany, Ac. Sci. Georgian S.S.R., Tbilisi. 885 pp.

Novruzov, V. 1982. Heterodermia dactyliza – a new species for the lichenoflora of the USSR (in Russian). *Bot. Zhurn.* 67: 1675–1676.

Poelt, J. 1965. Zur Systematik der Flechtenfamilie Physciaceae. *Nova Hedwigia* 9: 21–32.

Rassadina, K. 1935. Lichens récoltés par V.B. Sozhawa en 1929 dans le pays Anadyr (in Russian with French summary). *Acta Inst. Bot. Ac. Sci. U.R.P.S.*, Ser. II, *Plantae Cryptogamae* 2: 321–338.

Sedelnikova, N. 1977. Lichen flora of mountainous Shoria (in Russian). In *Nature complexes of the cryptogamic plants of Western Siberia* (ed. Popova, T.), pp. 194–208. Siberian Central Botanical Garden, Novosibirsk.

Sedelnikova, N. 1985. *Lichen flora of the Sangilen mountain range* (in Russian). Siberian Central Botanical Garden, Novosibirsk. 180 pp.

Sipman, H. J. M. 1989. Lichen zonation in the Parque Los Nevados transect. In *Studies on tropical Andean ecosystems* 3, pp. 461–483.

Sipman, H. J. M. 1992. The origin of the lichen flora of the Colombian paramos. In *Paramo, an Andean ecosystem under human influence* (eds Balslev, H. & Luteyn, J. L.), pp. 95–109. Acad. Press, London.

Sipman, H. J. M. & Harris, R. C. 1989. Lichens. In *Tropical Rain Forest Ecosystems* (eds Lieth, H. & Werger, M. J. A.), pp. 303–309. Elsevier Sci. Publ., Amsterdam.

Skirina, I. F. 1995. *Lichens of Sikhote-Alin biospheric region* (in Russian). Dalnauka, Vladivostok. 131 pp.

Skirina, I. & Knyazheva, L. 1985. *Lichens of eastern slopes of middle Sikhote-Alin mountain range* (in Russian). Pacific Institute of Geography, Vladivostok. 41 pp.

Swinscow, T. D. V. & Krog, H. 1976. The genera Anaptychia and Heterodermia in East Africa. *Lichenologist* 8: 103–138.

Swinscow, T. D. V. & Krog, H. 1988. Macrolichens of East Africa. British Museum (Nat. Hist.), London.

Tolpysheva, T., Petelin, D. & Tarassov, K. 1981. Lichens (in Russian). In *Flora and vegetation of the Tukuringa mountain range* (ed. Gubanov, I.), pp. 52–62. Moscow University, Moscow.

Tomin, M. 1926. List of lichens of the South Ussuriiski territory (in Russian). *Izvestija Juzhno-Ussuriiskogo Otdelenija Russkogo Geografitsheskogo Obshestva* 12: 211–224.

Tomin, M. 1937. *Key-book of the fruticose and foliose lichens of the U.S.S.R.* (in Russian). Minsk. 311 pp.

Trass, H. 1978. Cladoniaceae (in Russian). In *Handbook of the lichens of the U.S.S.R.* 5 (Golubkova, N. S., Savicz, V. P. & Trass, H. H.), pp. 7–79. Nauka, Leningrad.

Trass, H. 1992. Synopsis of the lichen genus Heterodermia (Ascomycotina, Physciaceae sive Pyxinaceae). *Folia Cryptog. Estonica* 29: 2–24.

Trass, H. 1998. List of physcioid macrolichens of Russian Far East and Siberia. *Folia Cryptog. Estonica* 33: 147–151.

Trevisan, V. 1869. Sul genere Dimelaena di Norman. *Atti Soc. Ital. Sci. Nat.* 11: 604–650.

Tchabanenko, S. 1986. Lichen flora of the Putyatin Island (in Russian). In *Flora and systematics of cryptogamic plants of the Far East* (ed. Vassilyeva, L.), pp. 151–162. Institute of Biology and Pedology, Far East Scientific Centrum, Ac. Sci. U.S.S.R., Vladivostok.

White, F. J. & James, P. W. 1985. A new guide to microchemical techniques for the identification of lichen substances. *British Lichenol. Soc. Bull.* 57 (suppl.): 1–41.

Yoshimura, I. 1979. *Lichen flora of Japan in colour*. Hoikusha Publishing Co., Osaka. 349 pp.

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Lichenicolous fungi and some lichens from the Russian Altai, southern Siberia

Mikhail P. Zhurbenko[1] & Evgeny A. Davydov[2]

[1]Komarov Botanical Institute, Russian Academy of Sciences, Russia, 197376, St.-Petersburg, 2 Professor Popov St.
E-mail: zhurb@MZ3838.spb.edu

[2]Altai State University, South-Siberian Botanical Garden, Russia, 656099, Barnaul, 66 Dimitrov St.
E-mail: davydov@biogeo.dcn.asu.ru

Abstract: 27 species of lichenicolous fungi and three lichens are reported from the Russian Altai. The lichenicolous fungi *Dactylospora lobariella, Lichenostigma maureri, Nectria lecanodes, Plectocarpon lichenum, Scutula epiblastematica, Tremella hypogymniae*, and *Muellerella pygmaea* var. *ventosicola* are new to Russia. The remaining lichenicolous fungi and the lichen *Lecanora geophila* are new to southern Siberia. The lichenicolous lichen *Thelocarpon epibolum* is new to the Altai.

Kokkuvõte: M. P. Zhurbenko ja E. A. Davydov. Lihhenikoolsed seened ja mõned samblikud Vene Altaist (Siberi lõunaosa).

Teatatakse 27 lihhenikoolse seene ja kolme samblikuliigi leiust Vene Altais. Lihhenikoolsed seened *Dactylospora lobariella, Lichenostigma maureri, Nectria lecanodes, Plectocarpon lichenum, Scutula epiblastematica, Tremella hypogymniae* ja *Muellerella pygmaea* var. *ventosicola* on esmasleiud Venemaal. Nimestiku ülejäänud lihhenikoolsed seened ja samblik *Lecanora geophila* on esmasleiud Siberi lõunaosas. Lihhenikoolne samblik *Thelocarpon epibolum* on leitud Altaist esmakordselt.

INTRODUCTION

Although the lichenicolous fungi of Russia have been the subject of several studies in recent years (Karatygin et al., 1999; Zhurbenko, 1996, 1998a,b; Zhurbenko & Hafellner, 1999; Zhurbenko & Santesson, 1996), most work to date has focussed on species of Arctic and Subarctic regions. This paper presents the first list of lichenicolous fungi from the Altai area in southern Siberia (Fig. 1). The lichen flora of this region has been rather thoroughly studied, for instance by Sedel'nikova (1994), who reported 908 lichen species. Nevertheless, a few remarkable lichen findings are as well presented here.

The Altai is an extensive mountainous region situated in central Eurasia. Only the Russian portion is considered in this paper, i. e. those parts bordering on the Mongolian Altai, the Gobi Altai and the Khangai in the south, the Saur and Tarbagai regions in the west, and the Abakan Range, the Kuznets Alatau, the Gornaya Shoriya, and the Salair Range at the north. The summits of the highest ranges rise above the snow line (2700–2950 m), with the tallest mountain being Mt. Belukha, at 4506 m. These mountains give rise to several creeks and rivers, most of which eventually join the Ob' River. The western and north-eastern portions of the Altai experience an oceanic climate, with more than 1500 mm of precipitation per year. By contrast, the south-eastern Altai has a mongolian climate characterised by low precipitation and snowless winters. Winter is long (5–9 months) and severe in the study area, while summer is short and hot. Reflecting this, the transitions between summer and winter are sharp, particularly in the alpine belt (Kuminova, 1960).

The Altai is situated largely within the steppe zone, and accordingly supports various types of steppe vegetation, including: shrub steppe, forest-steppe, meadow-steppe, typical steppe, and desert steppe. The altitudinal vegetation belts are represented by: the shrub steppe, forest-steppe, different types of taiga forest, subalpine meadows with shrubs and herb *Betula* forests, alpine meadows, and mountain tundra. Taiga forests are mainly composed of *Abies sibirica* Ledeb., *Pinus sibirica* Du Tour, and *Larix sibirica* Ledeb. (Kamelin, 1998). Timberline in the Altai mountains ranges from 1700–1800 m in the north to 2200–2300 m in the south.

MATERIAL AND METHODS

This study is based on material collected by E. A. Davydov in connection with studies of Altai lichen flora between 1994–1999, and identified by M. P. Zhurbenko. It should be noted that the following list of lichenicolous fungi presented here is very incomplete: firstly, because the collector did not specifically intend to study lichenicolous fungi; and secondly, because our examination of the lichen host taxa is itself incomplete. Special attention was paid to the lichen genus *Peltigera*.

Macroscopic features were examined with a LOMO stereomicroscope MBS-1. Microscopic characters were studied in squash preparations or hand sections in water, 10% KOH (K), or Lugol's iodine solution (J) in a LOMO microscope MBR-3 (to × 900). Microscopic measurements were performed in water, unless otherwise indicated.

Most of the specimens cited are deposited in the fungi herbarium of the Komarov Botanical Institute in St. Petersburg (LE), while some are kept in the herbarium of the South-Siberian Botanical Garden (SSBG) in Barnaul.

RESULTS AND DISCUSSION

Annotated list

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.

ABROTHALLUS PARMELIARUM (Sommerf.) Arnold – Russia, Altai, Charysh Region, Mt. Chern' on the left bank of Sentelek River near the community of Pokrovka, 51°01'N, 83°37'E, elev. 600 m, on epiphytic *Parmelia sulcata* Taylor (thallus), 3 Aug. 1997, E. A. Davydov 2347. Known distribution in Russia: Karelia (Fadeeva et al., 1997; Norrlin, 1876), Leningrad region (Brenner, 1886; Wainio, 1878), Putorana Plateau (Zhurbenko & Hafellner, 1999), Altai.

ARTHONIA PELTIGERINA (Almq.) H. Olivier – Russia, Altai, Kosh-Agach Region, Ukok Tableland, at the junction of the Sadakbai and Dzhumaly Rivers, 49°32'N, 87°58'E, elev. 2400–2500 m, in *Betula rotundifolia* Spach and *B. humilis*

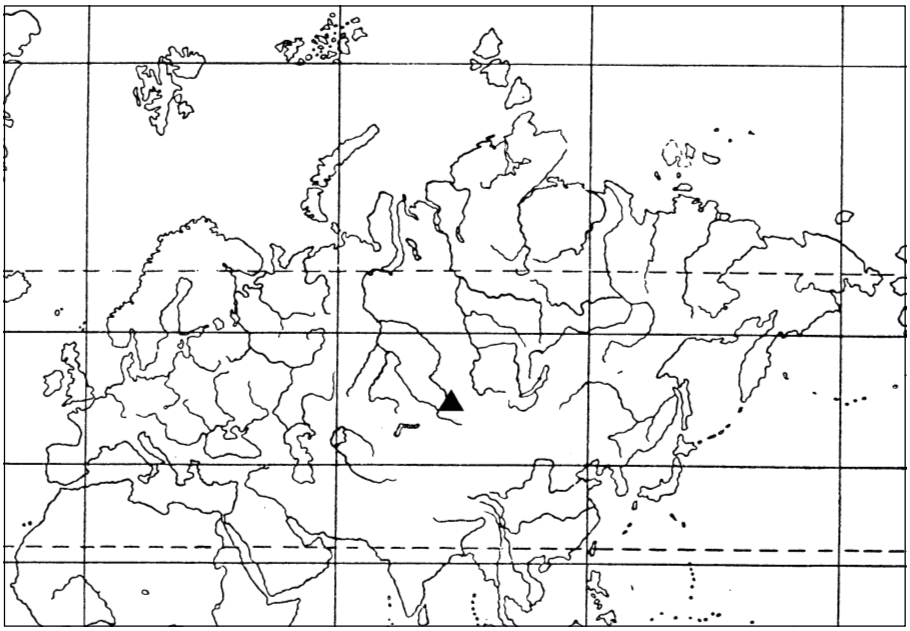

Fig. 1. Study area in southern Siberia (▲).

Schrank shrubs, on *Peltigera canina* (L.) Willd. (covering the upper surface of the lobes), 22 July 1999, E. A. Davydov 2302. Apothecia brown, 0.1–0.2 mm diam. Ascospores 12–15 × 5–6.5 µm (n = 15). The occurrence of the fungal apothecia over the entire upper surface of the host is more typical of *Arthonia peltigerea* Th. Fr., while in *A. peltigerina* the apothecia are usually restricted to the lobe margins (Zhurbenko & Santesson, 1996). Nevertheless, taking into consideration the smaller apothecia and ascospores, and paler hypothecium, the fungus is determined as *A. peltigerina*. Known distribution in Russia: Taimyr Peninsula, Altai, Chukotka (Karatygin et al., 1999; Zhurbenko & Santesson, 1996).

CALOPLACA EPITHALLINA Lynge – Russia, Altai. Kosh-Agach Region: 20 km ENE of Kosh-Agach, at the foot of Mt. Tobozhok near Kokorya creek, 50°03'N, 88°55'E, elev. 2050 m, in alpine steppe with scattered stones, on *Rhizoplaca* spp. (thallus), 10 Aug. 1993, M. P. Zhurbenko; Ukok Tableland, at the junction of the Ak-Alakha and Kalguty Rivers, 49°23'N, 87°38'E, elev. 2200 m, on rocks on a river valley slope, on *Rhizoplaca peltata* (Ramond) Leuckert & Poelt (upper lobe surface), 23 July 1998, E. A. Davydov 2243. Kur'ya Region, Belaya River at 5 km SE of the community of Podpalattsy, 51°12'N, 82°45'E, elev. 300 m, in rock outcrops, on *Rhizoplaca peltata* (thallus), 5 July 1996, E. A. Davydov 1927. Sedel'nikova (1990: 132) reported this lichenicolous lichen from the Altai as very rare in the alpine belt. Nevertheless, it can be locally very abundant there, as has been observed by the first author in the alpine-steppe at the foot of Mt. Tobozhok in the Kosh-Agach Region. Known distribution in Russia: Taimyr Peninsula, Putorana Plateau (Zhurbenko, 1996), Salair Range (Sedel'nikova, 1993), Altai.

CORTICIFRAGA PELTIGERAE (Nyl.) D. Hawksw. & R. Sant. – Russia, Altai: Kosh-Agach Region, Ukok Tableland, mid sections of the Kara-Chad River, 49°16'N, 83°38'E, elev. 2400–2600 m, in mountain tundra, on *Peltigera rufescens* (Weiss) Humb. (upper lobe surface), 16 Aug. 1996, E. A. Davydov 2303; Ongudai Region, urochishche Belyi Bom by the left bank of Chuya River, 50°22'N, 87°03'E, elev. 1300–1600 m, in taiga forest, on *Peltigera praetextata* (Flörke ex Sommerf.) Zopf. (upper lobe surface), 24 July 1995, E. A. Davydov 2349. Ascospores colourless, 2–3-septate, constricted at the septum, 12–19 × 5–7 µm (n = 18), 8 per ascus. Apothecia are aggregated in groups on the bleached spots of the host thallus. Known distribution in Russia: Franz-Josef Land, Kola Peninsula, Karelia (Hawksworth & Santesson, 1990; Räsänen, 1939), Taimyr Peninsula (Karatygin et al., 1999; Zhurbenko & Santesson, 1996), Altai.

*DACTYLOSPORA LOBARIELLA (Nyl.) Hafellner – Russia, Altai, Turochak Region, near the mouth of the Iogach River, 51°45'N, 87°20'E, elev. 600–900 m, on mossy boulder in taiga forest, on *Lobaria isidiosa* (Müll. Arg.) Vain. (upper lobe surface, predominantly on isidiose ridges), 24 August 1997, E. A. Davydov 2304. Apothecia black, glossy, sessile, constricted at the base, with prominent margin, 0.1–0.3 mm diam. Exciple and hypothecium brown, massive. Hymenium KJ + blue. Ascospores brown, 1-septate, 10–14(–17) × 3.5–5 µm (n = 15).

ECHINOTHECIUM RETICULATUM Zopf – Russia, Altai: Tigiretskii Range, in mid sections of the Malyi Tigirek River, 51°06'N, 83°03'E, elev. 700–1000 m, on mossy boulder in taiga forest, on *Parmelia omphalodes* (L.) Ach. (upper lobe surface), 12 July 1996, E. A. Davydov 2305; Kosh-Agach Region, Yuzhno-Chyuiskii Range, at the junction of the Dzhazator and Il'degem Rivers, 49°40'N, 87°40'E, elev. 1800 m, in a *Larix sibirica* dominated taiga forest, on *Parmelia sulcata* (thallus), 5 July 1993, E. A. Davydov 2351. Known distribution in Russia: Taimyr Peninsula (Zhurbenko & Santesson, 1996), Altai.

GRAPHIUM APHTHOSAE Alstrup & D. Hawksw. – Russia, Altai, Ulagan Region, Kurai Range, 4 km W of Balyktukel' Lake, 50°32'N, 87°39'E, elev. 2200 m, on soil in *Pinus sibirica* forest, on *Peltigera aphthosa* (L.) Willd. (old darkened parts of upper lobe surface), 14 Aug. 1997, E. A. Davydov 2306. Conidia colourless, mortar-shaped, rounded at the apices, 7–10 × 3.5 µm (n = 15). Known distribution in Russia: Franz-Josef Land (Zhurbenko & Santesson, 1996), Altai, Arctic Yakutiya (Karatygin et al., 1999).

LECANORA GEOPHILA (Th. Fr.) Poelt – Russia, Altai, Charysh Region, near headwaters of the Sentelek River, 51°03¢N, 83°43¢E, elev. 2000–2200 m, on soil in *Dryas*-lichen alpine tundra, 19 Aug. 1996, E. A. Davydov 1876. *L. geophila* was earlier reported in Russia and Asia only from the Arctic: Taimyr Peninsula (its western coast and Byrranga mountains; Zhurbenko & Hansen, 1993; Zhurbenko, 1996) and Severnaya Zemlya (Bol'shevik island; unpublished data of M. Zhurbenko). In these arctic regions, *L. geophila* occurs sporadically but is locally rather abundant, especially in wet habitats. The global distribution of this species has been described as including Arctic North America, Greenland (Poelt, 1986; Thomson, 1997), and the Siberian Arctic. Its range is now extended to alpine regions, suggesting that its distribution should be described as arctic-alpine.

LICHENOCONIUM cfr. ERODENS M. S. Christ. & D. Hawksw. – Russia, Altai, Turochak Region, near the mouth of the Iogach River, 51°45'N, 87°20'E, in taiga forest, on epiphytic *Hypogymnia physodes* (L.) Nyl. (on galls of the host thallus caused by *Tremella hypogymniae*), 24 Aug. 1997, E. A. Davydov 2308. Conidia colourless, usually obovate, sometimes clearly truncate at the base, 3–4 × 2.5–3 µm (n = 10). Pathogenic, induce darkening of gall tissue. Diederich (1996: 93) reported that the galls caused by *Tremella hypogymniae* are often infected by *Lichenoconium lecanorae* (Jaap) D. Hawksw., but that species differs from *L. erodens* by its larger pycnidia and slightly bigger conidia (Hawksworth, 1981: 33). Known distribution in Russia: Franz-Josef Land (Zhurbenko & Santesson, 1996), Altai.

LICHENOCONIUM PYXIDATAE (Oudem.) Petr. & Sydow – Russia, Altai, Kosh-Agach Region, Ukok Tableland, Kolgutinskaya hollow, 49°23'N, 87°38'E, elev. 2200 m, in meadow-steppe, on *Cladonia* cfr. *convoluta* (Lam.) Anders (squamules of primary thallus), 29 July 1998, E. A. Davydov 2309. Pycnidia 0.05–0.10 mm diam. Conidia brown, ellipsoidal to nearly globose, sometimes clearly truncate at the base, 3.5–4 × 3–3.5 µm (n = 10). [Hawksworth (1977: 184) reported somewhat smaller conidia for *L. pyxidatae*: (2–)2.5–3.5(–4) × 2–3 µm]. Pathogenic, infected host thallus becoming decolourized. Known distribution in Russia: Franz-Josef Land (Zhurbenko & Santesson, 1996), Altai.

LICHENODIPLIS LICHENICOLA Dyko & D. Hawksw. – Russia, Altai, Charysh Region, near headwaters of the Sentelek River, 51°02'N, 83°38'E, elev. 1200 m, in taiga forest, on *Rinodina septentrionalis* Malme (in disks of apothecia) growing on branches of *Abies sibirica*, 22 May 1996, E. A. Davydov 2310. Pycnidia black, glossy, 0.075 mm diam., $^{1}/_{4}$–$^{1}/_{2}$ protruding, up to 6 per host apothecium. Conidia pale greyish-olive, 1-septate, cuneate, 7.5–12 × 3.5–4 µm (n = 15). Pathogenic effects not observed. This is the second report of *L. lichenicola* in Russia, after *"locus classicus"*: Central Siberia, Taimyr Peninsula, Enisey River, Nikandrovskii Is., 70°20'N, 13 Aug. 1876, M. Brenner, on *Rinodina septentrionalis* (apothecia), UPS – holotype, examined by M. Zhurbenko. This is a rather rare species known also from Alaska (Zhurbenko et al., 1995), Norway (Santesson, 1993), Austria (Obermayer, 1993), and Madeira, Portugal (Kalb & Hafellner, 1992).

LICHENOSTIGMA MAURERI Hafellner – Russia, Altai: Charysh Region, near headwaters of the Sentelek River, 51°02'N, 83°38'E, elev. 900–1200 m, in taiga forest, on *Usnea scabrata* Nyl. (thallus), growing on branches of *Abies sibirica*, 3 July 1994, E. A. Davydov 2353; on *Usnea filipendula* Stirt. (thallus) and *Usnea lapponica* Vain. var. *altaica* Räsänen (thallus: on main stem and branches.), growing on branches of *Betula pendula* Roth., 3 July 1994, E. A. Davydov 2354, 2355; Tigiretskii Range, in mid sections of the Malyi Tigirek River, 51°09'N, 83°04'E, elev. 800–1000 m, in taiga forest, on *Usnea fulvoreagens* (Räsänen) Räsänen (thallus) and *Usnea lapponica* (thallus), growing on branches of *Abies sibirica*, 12 June 1996, E. A. Davydov 2356, 2357; Kur'inskii Region, Belaya River at 5 km SE of the community of Podpalattsy, 51°12'N, 82°45'E, elev. 400 m, in taiga forest, on *Usnea lapponica* var. *altaica* (thallus: on main stem and branches), growing on *Betula pendula*, 5 July 1996, E. A. Davydov 2358. Apothecia often numerous, dispersed on main stem and branches of the host

thallus, arising singly or sometimes aggregated by a few, black (when wet more or less translucent and with a brownish tinge), shiny, rough, appressed-convex, rather irregular in shape, 0.05–0.15 mm diam. Outer layers of the apothecia consisting of brown globose cells 4–7.5 µm diam., their inner layers composed of colourless globose cells 3–4 µm diam. Apothecia sections J-, KJ: outer brown layers becoming somewhat purplish, inner colourless layers becoming moderately blue. Asci bitunicate, flask-shaped to subglobose, 17–27 × 13.5–17 µm (n = 4), protoplast J+ yellow, apex KJ+ blue, 4–8-spored. Ascospores at first colourless or pale but becoming medium to dark olive-brown or brown, smooth and often thick-walled (to 2 mm) when young, later often becoming verruculose (best seen in KOH), soleiform, 1-septate, (5–)8.5–13.5 × (3.5–)5–7 µm (n = 35), 13.5–17 × 6.5–9 µm (n = 10, in KOH) [Hafellner (1982) gave the ascospore size as 9–12 × 4–6 µm]. Though the fungus is often abundant, no pathogenic effect was observed.

LICHENOSTIGMA RUGOSA Thor – Russia, Altai, Charysh Region, Tigiretskii Range, near headwaters of the In'ya River, 51°02'N, 83°33'E, elev. 1400 m, boulder field in taiga forest, on *Diploschistes scruposus* (Schreb.) Norman (apothecia and thallus), 2 Aug. 1997, E. A. Davydov 2311. Hamathecial filaments and asci not found, which is typical for the species, since they soon disintegrate (Thor, 1985: 271). Ascospores brown, soleiform, 1-septate, apparently always smooth, 10–11 × 5–6 µm (n = 10). Known distribution in Russia: Altai, Chukotka (Karatygin et al., 1999).

*MUELLERELLA PYGMAEA (Körb.) D. Hawksw. var. VENTOSICOLA (Mudd) Triebel – Russia, Altai, Charysh Region, Gorelyi Korgon River at 8 km upstream from its mouth, 51°02'N, 83°46'E, elev. 1400 m, in boulder field, on *Rhizocarpon* sp. (thallus), 27 July 1998, E. A. Davydov 2350. Though *Muellerella pygmaea* has been reported from Russia from Karelia (Fadeva et al., 1997), Franz Josef Land, Severnaya Zemlya, Taimyr Peninsula, New Siberian Is. (Karatygin et al., 1999; Zhurbenko & Hafellner, 1999; Zhurbenko & Santesson, 1996), and Chukotka (Triebel, 1989) this variety is new for Russia.

*NECTRIA LECANODES Cesati – Russia, Altai, Tigiretskii Range, an island among Bol'shoi Tigirek River, 51°07' N, 82°56' E, elev. 600 m, on soil in taiga forest, on *Peltigera canina* (mostly on upper lobe surface, occasionally on its lower surface and apothecia), 14 June 1994, E. A. Davydov 2333. Apothecia superficial, at first globose and closed becoming cupulate with depressed center and "porus", markedly constricted below, white when young but becoming cinnamon-buff with age, densely covered by hyaline hairs, 0.15–0.3 mm diam., arising singly or in groups. Exciple colourless to pale-yellowish inside, yellowish outside, orange in the upper marginal part. Hamathecial filaments poorly developed, filiform, straight, not branched, 0.75–1 µm diam. below, 1–1.2 µm above. Interascal filaments not seen. Asci cylindrical, 50–68 × 5–7 µm (n = 4), 8-spored. Ascospores colourless, guttulate, ellipsoid with rounded apices, 1-septate, 8.5–10.5 × 4 µm (n = 10), 7.5–10 × 3–4 µm (n = 10, in KOH), uniseriate, sometimes overlapping. Morphologically this fungus somewhat resembles *Polydesmia lichenis* Huhtinen & R. Sant. (Huhtinen & Santesson, 1997), but differs from that species in the absence of conspicuous undulating interascal filaments with coiled or branched apices, in the smaller (50–68 × 5–7 vs. 82–123 × 10–13.5 µm), cylindrical vs. clavate-cylindrical asci, and the shorter ascospores (7.5–10.5 × 3–4 vs. 15–24 × 3–5 µm). No visible damage to the host thallus was observed. This is a rather common parasite on many *Peltigera* spp., and is also found on *Nephroma* and *Lobaria* spp. (R. Santesson, pers. comm.).

NEOLAMYA PELTIGERAE (Mont.) Theiss. & Syd. – Russia, Altai, Kosh-Agach Region, Ukok Tableland, at the junction of the Ak-Alakha and Kalguty Rivers, 49°23'N, 87°38'E, elev. 2200 m, on soil in *Betula*-shrubs, on *Peltigera didactyla* (With.) Laundon, *P. praetextata* (upper lobe surface), 23 July 1998, E. A. Davydov 2312, 2352. Ascospores colourless, needle-shaped, tapering at the apices, usually somewhat curved, up to 10-septate, 60–85 × 2.5–3 µm (n = 13). Though abundantly developed, this fungus causes little or no visible damage to the host thallus. It may, however, suppress

soralia formation in *P. didactyla*, as no soralia were observed in densely infected areas. Known distribution in Russia: Putorana Plateau (Zhurbenko & Hafellner, 1999), Altai.

PHACOPSIS OXYSPORA (Tul.) Triebel & Rambold var. OXYSPORA – Russia, Altai, Turochak Region, near the mouth of the Iogach River, 51°45'N, 78°20'E, elev. 600–900 m, in taiga forest, on *Parmelia sulcata* (upper lobe surface), 24 Aug. 1997, E. A. Davydov 2346. Known distribution in Russia: Karelia (Fadeeva et al., 1997; Räsänen, 1939), Leningrad region (Brenner, 1886), Putorana Plateau (Zhurbenko & Hafellner, 1999), Altai.

PHAEOSPORA PELTIGERICOLA D. Hawksw. – Russia, Altai, Ulagan Region, Kurai Range, 4 km W of Balyktukel' Lake, 50°32'N, 87°39'E, elev. 200 m, in taiga forest, on *Peltigera rufescens* (on old decaying parts of upper lobe surface), 14 Aug. 1997, E. A. Davydov 2313. Perithecia black, glossy, 0.1–0.2 mm diam., conspicuously protruding to nearly sessile. Ascospores at first hyaline, later becoming light-brown, (0–)3(–4)-transseptate, occasionally with an additional oblique septum, 12–15.5 × 4.5–6.5 µm (n = 15, in KOH). No pathogenic effect on the host thallus was observed. Known distribution in Russia: Putorana Plateau (Zhurbenko & Hafellner, 1999), Altai.

PHAEOSPOROBOLUS USNEAE D. Hawksw. & Hafellner – Russia, Altai, Zmeinogorsk Region, Tigiretskii Range, lower portions of Batalikha River, 51°00'N, 82°49'E, elev. 600 m, in taiga forest, on *Ramalina pollinaria* (Westr.) Ach. (thallus, including soralia), 9 July 1996, E. A. Davydov 2314. Known distribution in Russia: Taimyr Peninsula (Zhurbenko & Santesson, 1996), Altai.

*PLECTOCARPON LICHENUM (Sommerf.) D. Hawksw. – Russia, Altai, Turochak Region, near the mouth of the Iogach River, 51°45'N, 78°20'E, elev. 600–900 m, in taiga forest, on epiphytic *Lobaria pulmonaria* (L.) Hoffm. (both sides of lobes), 24 Aug. 1997, E. A. Davydov 2341.

PROTOTHELENELLA SANTESSONII H. Mayrhofer – Russia, Altai: Charysh Region, near headwaters of the Sentelek River, 51°03'N, 83°43'E, elev. 1900–2200 m, boulder field in mountain tundra, 19 Aug. 1996, E. A. Davydov 2315; Ulagan Region, Kurai Range, 4 km W of Balyktukel' Lake, 50°32'N, 87°39'E, elev. 2200–2300 m, on conifer log, 14 Aug. 1997, E. A. Davydov 2316. Both specimens grow on *Cladonia* spp. (squamules of primary thallus). Perithecia black, glossy, 0.15–0.20 mm diam. Ascospores colourless, lemon-shaped, 2–5-transseptate and 1-longiseptate, occasionally with an additional oblique septum, 17–23.5 × 9–12 µm (n = 16), 8 per ascus. The infection producing lightly decoloured patches on the host thallus. Known distribution in Russia: Putorana Plateau (Zhurbenko & Hafellner, 1999), Altai.

PYRENIDIUM ACTINELLUM Nyl. – Russia, Altai. Charysh Region: mid sections of the Kumir River, 50°59'N, 84°18'E, elev. 760 m, in taiga forest, on *Peltigera rufescens* (upper lobe surface), 1 Aug. 1995, E. A. Davydov 2317; Mt. Tolstaya near the community of Shchebnyukha, 51°32'N, 83°22'E, elev. 300–400, in *Betula* forest, on *Peltigera elisabethae* Gyeln. (upper lobe surface), 19 May 1996, E. A. Davydov 2318. Kur'ya Region, Belaya River at 5 km SE of the community of Podpalattsy, 51°12'N, 82°45'E, elev. 300 m, in forested rocks, on *Peltigera elisabethae* (upper lobe surface), 5 July 1996, E. A. Davydov 2319. Solonesh Region, Chernovoi Anyui River near the community of Telezhikha, 51°31'N, 84°16'E, elev. 500 m, in taiga forest, on *Peltigera rufescens* (upper lobe surface), 3 Sept. 1994, E. A. Davydov 2348. Perithecia crowded in large groups, 0.075–0.125 mm diam. Ascospores brown to dark brown, elongate-ellipsoid, symmetrical, 2–3-septate, occasionally with paler apical cells, markedly constricted at the septum, 22–26 × 8.5–11.5 µm (n = 30), 4 per ascus. Interascal filaments branched, anastomosing. Pathogenic, infected host thallus becoming brownish and slightly swollen. Known distribution in Russia: Franz-Josef Land, Taimyr Peninsula (Zhurbenko & Santesson, 1996), Altai.

*SCUTULA cfr. EPIBLASTEMATICA (Wallr.) Rehm – Russia, Altai, Kosh-Agach Region, Katun' Range, in mid sections of the Direntai River, 49°45'N, 87°10'E, elev. 1600–2000 m, in taiga forest, on *Peltigera canina* (upper lobe surface),

12 July 1995, E. A. Davydov 2320. Apothecia cinnamon-buff, sessile, with slightly protruding margins, 0.15–0.2 mm diam. Hypothecium colourless. Ascospores colourless, (0–)1-septate, 7–10.5 × 3.5–4.5 µm (n = 25). No pathogenic effect on the host thallus observed. [According to Triebel et al. (1997: 329) *Scutula epiblastematica* is a parasite and should have longer (8–)8.6–12.6(17) × (2.5–)2.9–4.2(–4.5) µm, (0–)1(–3)-septate ascospores].

Sphaerellothecium minutum Hafellner – Russia, Altai, Ulagan Region, Kurai Range, near headwaters of the Chibitka River, 50°24'N, 87°39'E, elev. 2750 m, in mountain tundra, on *Sphaerophorus globosus* (Huds.) Vain. (thallus), 13 Aug. 1997, E. A. Davydov 2321. This fungus is very common on its host, at least in the Russian Arctic. Known distribution in Russia: Franz-Josef Land, Taimyr Peninsula (Zhurbenko & Santesson, 1996), Putorana Plateau (Zhurbenko & Hafellner, 1999), Altai.

Stigmidium peltideae (Vain.) R. Sant. – Russia, Altai, Kosh-Agach Region: Yuzhno-Chuiskii Range, Tara River, 49°39'N, 88°15'E, elev. 2200 m, in *Larix sibirica* taiga forest, on *Peltigera venosa* (L.) Hoffm. (old darkened parts of lobes), 25 July 1999, E. A. Davydov 2322; Ukok Tableland, Ak-Alakha River near Bertek meteostation, 49°18'N, 87°37'E, elev. 2400 m, in mountain tundra, on *Peltigera aphthosa* (upper lobe surface), 23 July 1998, E. A. Davydov 2323; Ukok Tableland, near headwaters of the Zhumaly River, 49°28'N, 88°02'E, elev. 2400–2700 m, in mountain *Dryas*-tundra, on *Peltigera* cfr. *rufescens* (upper lobe surface), 30 July 1998, E. A. Davydov 2324. Ascospores colourless, 1-septate, 10–12 × 3–4 µm (n = 30). Known distribution in Russia: Franz-Josef Land, Taimyr Peninsula (Zhurbenko & Santesson, 1996), Altai, Chukotka (Karatygin et al., 1999).

Stigmidium pseudopeltideae Cl. Roux & Triebel – Russia, Altai, Kosh-Agach Region, Yuzhno-Chuiskii Range, Tara River, unnamed mountain "3425 m", 49°42'N, 88°14'E, elev. 2600–3425 m, on soil in mountain tundra, on *Peltigera venosa* (upper lobe surface), 26 July 1999, E. A. Davydov 2325. Perithecia mostly protruding, 50–75 µm diam. Ascospores colourless, 1-septate, 10.5–13 × 3.5–4 µm (n = 8). Known distribution in Russia: Taimyr Peninsula (Zhurbenko & Santesson, 1996), Altai.

Stigmidium cfr. pseudopeltideae Cl. Roux & Triebel – Russia, Altai, Charysh Region, near headwaters of the Sentelek River, Teploe Lake, 51°03'N, 83°38'E, elev. 1400 m, in boulder field, on *Peltigera aphthosa* (old darkened parts of lobes), 18 Aug. 1996, E. A. Davydov 2326. Perithecia black, glossy, ½ immersed, 0.05–0.1 mm diam. Ascospores colourless to brownish, 1–3-septate, 10.5–13.5 × 3.5–5 µm (n = 15, in KOH), 8 per ascus. [According to Roux and Triebel (1994: 502) mature ascospores of *St. pseudopeltideae* can be brownish, but are 1-septate].

Taeniolella pertusariicola D. Hawksw. & H. Mayrhofer – Russia, Altai, Zmeinogorsk Region, Belaya River near Mt. Stanovaya, 51°00'N, 82°44'E, elev. 600 m, in taiga forest, on *Pertusaria alpina* Hepp ex H. E. Ahles (in hymenium of apothecia) growing on *Sorbus sibirica* Hedl., 12 June 1999, E. A. Davydov 2328. No pathogenic effect on the host thallus observed. Known distribution in Russia: Taimyr Peninsula (Zhurbenko, 1998a), Altai.

Thelocarpon epibolum Nyl. var. epibolum – Russia, Altai, Zmeinogorsk Region, Tigirets Range, Zagornaya Amelikha River near Mt. Lugovaya, 51°04'N, 82°52'E, elev. 770 m, in taiga forest, on *Peltigera* cfr. *polydactylon* (Neck.) Hoffm. (upper surface of decaying thallus), 23 July 1997, E. A. Davydov 2345. Ascospores 4.5–6 × 1.5–2 µm (n = 8). This variety usually grows on rotten wood and soil, while var. *epithallinum* is characteristic of decaying lichen thalli (*Baeomyces*, *Peltigera*, *Solorina*; Ahti. 1973). Known distribution in Russia: Caucasus (Oxner, 1977), Kola Peninsula (unpublished materials of M. Zhurbenko kept as LE 207588), Karelia (Fadeeva et al., 1997), Western Sayan (Sedel'nikova, 1996), Taimyr Peninsula (unpublished materials of M. Zhurbenko kept as LE 207599: b), Altai, NE Yakutiya (Poryadina, 1998).

*Thelocarpon epibolum Nyl. var. epithallinum (Leighton ex Nyl.) G. Salisb., Syn. *Thelocarpon epithallinum* Leighton ex Nyl. – Russia, Altai,

Ulagan Region, Kurai Range, 4 km W of Balyktukel' Lake, 50°32'N, 87°39'E, elev. 2200 m, in taiga forest, on *Peltigera aphthosa* (upper lobe surface; associated with *Graphium aphthosae*), 14 Aug. 1997, E. A. Davydov 2329. Ascospores 5.5–7.5 × 2.5–3 µm (n = 10).

*Tremella hypogymniae Diederich & M. S. Christ. – Russia, Altai, Turochak Region, near the mouth of the Iogach River, 51°45'N, 87°20'E, elev. 600–900 m, in taiga forest, on epiphytic *Hypogymnia physodes* (thallus), 24 Aug. 1997, E. A. Davydov 2330. This fungus causes characteristic light-coloured galls on the host thallus, which are in turn inhabited by *Lichenoconium* cfr. e*rodens*.

Wentiomyces cfr. peltigericola D. Hawksw. – Russia, Altai, Kosh-Agach Region, Ukok Tableland, near confluence of the Sadakbai and Dzhumaly Rivers, 49°32'N, 87°58'E, elev. 2400–2500 m, in *Larix sibirica* taiga forest, on *Peltigera malacea* (Ach.) Funck (lower lobe surface), 22 July 1999, E. A. Davydov 2331. Ascospores colourless, 1-septate, 8–10 × 3–3.5 µm (n = 10). Hawksworth (1980: 385) reported somewhat larger ascospores for *W. peltigericola*: 12–16 × 3.5–4.5 µm. Known distribution in Russia: Kola Peninsula (Karatygin et al., 1999), Taimyr Peninsula (Zhurbenko & Santesson, 1996), Altai.

In this work we report 24 genera with 27 species of lichenicolous fungi, two lichenicolous lichens (*Caloplaca epithallina* and *Thelocarpon epibolum*), and the lichen *Lecanora geophila*. All of the lichenicolous fungi are new to southern Siberia, while seven of them (*Dactylospora lobariella, Lichenostigma maureri, Nectria lecanodes, Plectocarpon lichenum, Scutula epiblastematica, Tremella hypogymniae* and *Muellerella pygmaea* var. *ventosicola*) are also new to Russia. *Thelocarpon epibolum* is new to the Altai. The occurrence of *Lecanora geophila* in the Altai mountain tundra is especially noteworthy, as this species has hitherto been assumed to belong to the arctic geographic element; evidently its distribution is more appropriately described as arctic-alpine. This suggests that purely Arctic (Metaarctic) lichen distribution patterns may be less common than previously believed; many species described as "arctic" proved to be actually arctic-alpine.

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REFERENCES

Ahti, T. 1973. Notes on the lichens of Newfoundland. 2. Thelocarpon epibolum Nyl. *Ann. Bot. Fennici* 10: 66–67.

Brenner M. 1886. Bidrag till kannedom af Finska vikens vegetation. IV. Hoglands lafvar. *Medd. Soc. Fauna et Flora Fennica* 3: 1–144.

Diederich, P. 1996. The lichenicolous Heterobasidiomycetes. *Biblioth. Lichenol.* 61. 198 pp.

Fadeeva, M. A., Golubkova, N. S., Vitikainen, O. & Ahti, T. 1997. *Preliminary list of lichens and lichenicolous fungi of Karelia* (in Russian). Karel'skii nauchnyi tsentr RAN, Petrozavodsk. 100 pp.

Hafellner J. 1982. Studien über lichenicole Pilze und Flechten II. Lichenostigma maureri gen. et spec. nov., ein in den Ostalpen häufiger lichenicoler Pilz (Ascomycetes, Arthoniales). *Herzogia* 6: 299–308.

Hawksworth, D. L. 1977. Taxonomic and biological observations on the genus Lichenoconium (Sphaeropsidales). *Persoonia* 9 (2): 159–198.

Hawksworth, D. L. 1980. Notes on some fungi occurring on Peltigera, with a key to accepted species. *Trans. British Mycol. Soc.* 74 (2): 363–383.

Hawksworth, D. L. 1981. The lichenicolous Coelomycetes. *Bull. Br. Mus. nat. Hist. (Bot.)* 9 (1): 1–98.

Hawksworth, D. L. & Santesson, R. 1990. A revision of the lichenicolous fungi previously referred to *Phragmonaevia*. *Biblioth. Lichenol.* 38: 121–143.

Huhtinen, S. & Santesson, R. 1997. A new lichenicolous species of *Polydesmia* (Leotiales: *Hyaloscyphaceae*). *Lichenologist* 29(3): 205–208.

Kalb, K. & Hafellner, J. 1992. Bemerkenswerte Flechten und lichenicole Pilze von der Insel Madeira. *Herzogia* 9: 45–102.

Kamelin R. V. 1998. *Materials for a history of the Asian flora (Altai mountain country)* (in Russian). Altai state Univ., Barnaul. 240 pp.

Karatygin, I. V., Nezdoiminogo, E. L., Novozhilov, Y. K. & Zhurbenko, M. P. 1999. *Russian Arctic Fungi. Check-list* (in Russian). St.-Petersburg. 212 pp.

Kuminova, A. V. 1960. *Plant cover vegetation of the Altai* (in Russian). Novosibirsk. 450 pp.

Norrlin, J. P. 1876. Flora Kareliae Onegensis. II. Lichenes. *Medd. Soc. Fauna et Flora Fennica*. 1: 1–46.

Obermayer, W. 1993. Die Flechten der Seetaler Alpen (Steiermark, Österreich). *Mitt. naturwiss. Ver. Steiermark* 123: 91–166.

Oxner, A. N. 1977. Fam. Thelocarpaceae. (in Russian). In *Handbook of the lichens of the U.S.S.R.* (ed. Makarevich, M. F.). Vol. 4, pp. 106–111. Nauka, Leningrad.

Poelt, J. 1986. Placodium geophilum Th. Fries – eine vergessene Flechte. *Int. J. Mycol. Lichenol.* 3(1): 55–65.

Poryadina, L. N. 1998. New and rare for Asia lichen species (in Russian). *Novitates Systematicae Plantarum non Vascularium* 32: 76–81.

Roux Cl. & Triebel, D. 1994. Révision des espèces de Stigmidium et de Sphaerellothecium (champignons lichénicoles non lichénises, Ascomycetes) correspondant à Pharcidia epicymatia sensu Keissler ou à Stigmidium schaereri auct. *Bull. Soc. linn. Provence* 45: 451–542.

Räsänen, V. 1939. Die Flechtenflora der nördlichen Küstengegend am Laatokka-See. *Ann. Bot. Soc. Zool.-Bot. Fenn. Vanamo*. 12(1): 1–240.

Santesson, R. 1993. *The lichens and lichenicolous fungi of Sweden and Norway*. SBT-förlaget, Lund. 240 pp.

Sedel'nikova N. V. 1990. *Lichens of the Altai and Kuznetskoe Tableland* (in Russian). Nauka, Novosibirsk. 175 pp.

Sedel'nikova N. V. 1993. Lichens of Salair (in Russian). In *Flora of Salair Range* (ed. Lashchinskii, N. N.), pp. 33–78. Central Siberian Botanical Garden, Novosibirsk.

Sedel'nikova N. V. 1994. Biological diversity of Siberian lichens (in Russian). *Sibirskii Ekologicheskii Zhurnal* 1 (6): 563–575.

Sedel'nikova N. V. 1996. Peculiarities of the lichen flora of Western Sayan (in Russian). *Botanicheskii Zhurnal* (St.Petersburg) 84(3): 75–83.

Thomson, J. W. 1997. *American Arctic Lichens. 2. The Microlichens*. University of Wisconsin Press, Madison. 675 pp.

Thor, G. 1985. A new species of Lichenostigma, a lichenicolous ascomycete. *Lichenologist* 17(3): 269–272.

Triebel, D. 1989. Lecideicole Ascomyceten. Eine Revision der obligat lichenicolen Ascomyceten auf lecideoiden Flechten. *Biblioth. Lichenol.* 35. 278 pp.

Triebel, D., Wedin, M. & Rambold, G. 1997. The genus Scutula (lichenicolous ascomycetes, Lecanorales): species on the Peltigera canina and P. horizontalis groups. *Acta Univ. Ups. Symb. Bot. Ups.* 32 (1): 323–337.

Wainio E. 1878. Lichenes in viciniis Viburgi observati. *Medd. Soc. Fauna et Flora Fennica* 2: 35–72.

Zhurbenko M. P. 1996. Lichens and lichenicolous fungi of the northern Krasnoyarsk Territory, Central Siberia. *Mycotaxon* 58: 185–232.

Zhurbenko, M. P. 1998a. Lichens and lichenicolous fungi from the north of Pyasino lake, Taimyr peninsula, Siberia. *Folia Cryptog. Estonica* 32: 153–159.

Zhurbenko M. P. 1998b. Lichenicolous fungi: their recognition and use in lichen studies (in Russian). *Novitates Systematicae Plantarum non Vascularium* 32: 28–40.

Zhurbenko, M. P. & Hafellner, J. 1999. Lichenicolous fungi from the Putorana plateau, Siberian Subarctic. *Folia Cryptog. Estonica* 34: 71–79.

Zhurbenko, M. P. & Hansen E. S. 1993. *Lecanora geophila* and *Arctopeltis thuleana* (Lichenes) from the Siberian Arctic. *Botanicheskii Zhurnal* (St.Petersburg) 78(5): 125–127.

Zhurbenko, M. P. & Santesson, R. 1996. Lichenicolous fungi from the Russian Arctic. *Herzogia* 12: 147–161.

Zhurbenko, M., Santesson, R., Walker D. A., Auerbach N. A. & Lewis, B. 1995. New and interesting lichenicolous fungi and lichens from Alaska. *Evansia* 12 (3): 92–97.

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NEW ESTONIAN RECORDS: FUNGI

Pezizales

Bellis Kullman
Institute of Zoology and Botany, Estonian Agricultural University, 181 Riia St., 51014 Tartu, Estonia. E-mail: bellis@zbi.ee

ALEURIA LUTEONITENS (Berk. & Broome) Gillet – Lääne-Virumaa Co., Rakke Comm., Emumägi (58°55.5'N 26°21'E), on sandy ground, 24 Sept 2000 B. Kullman (TAA 159540). Apothecia up to 1.5 cm in diameter, disc bright golden-yellow. Spores narrow ellipsoid 13.4–15.2 × 6.3–7 µm measured without ornamentation.

Rather rare in Europe. Found in Great Britain, France, Germany and Corsica, not found in the Nordic countries.

ANTHRACOBIA MAURILABRA (Cooke) Boud. – Lääne-Virumaa Co., Viru-Nigula Comm., S of Kunda, Varudi bog (59°27'N 26°35'E), on debris of *Pinus silvestris* in an ant nest, 23 Sept 2000 T. Ploompuu, det. B. Kullman (TAA 159539).

KOTLABAEA DELECTANS (Starbäck) Svrcek – Lääne-Virumaa Co., Vihula Comm., Rutja (59°32.5'N 26°23.5'E), on sandy ground in a roadside in a mixed forest, 16 Sept 2000 B. Kullman (TAA 159534). Apothecium 7 mm in diameter, paraphyses slender, not enlarged upwards, 1.9–2.2 µm. thick.

PEZIZA PSEUDOVESICULOSA Donadini (1981) – Tartumaa Co., Nõo Comm., E of Peedu (58°14'N 26°28'E), on wet ground under hazels in a mixed forest, 16 Aug 2000 B. Kullman (TAA 159346). Apothecia without coloured juice, up to 11 cm in diameter, spores narrow ellipsoid (15.6)16.6(17.0) × (7.2)7.7(8.2) µm, with two guttules, ornamented with isolated, regular warts.

PLICARIA CARBONARIA (Fuckel) Fuckel – Raplamaa Co., Kaiu Comm., Kaiu (59°01'N 25°03'E), on burnt ground, 5 Aug 2000 B. Kullman (TAA 159421).

SCUTELLINIA HETEROSCULPTURATA Kullman & Raitv. – Järvamaa Co., Ambla Comm., Rava Forestry, block no. 212 (59°07.6'N 25°46.3'E), on wet humus, 2 Oct 2000 B. Kullman (TAA 159550); on wet wood debris, 2 Oct 2000 B. Kullman (TAA 159551).

Spores from fresh fuitbodies measured in CB: (21.4)21.9–22.6(23.3) × (10.7)11.2–11.3(11.4) µm. The species is characterized by irregular tuberculate spore sculpturing.

This humus and debris saprotroph was described from the former USSR (Kullman & Raitviir 1977), where it was distributed from the Kola Peninsula to the Far East (Kullman 1982) and referred to by Schumacher (1990) as belonging to a group of boreo-polar species, distributed also in Norway, Iceland (Schumacher, 1990) and Canada (Huhtinen, 1985).

REFERENCES

Donadini, J.-C. 1981. *Le genre Peziza dans le sud-est de France.* Marseille. 119 pp.

Huhtinen, S. 1985. Mycoflora of Poste-de-la-Baleine, Northern Québec. Ascomycetes. *Naturaliste Canad.* 112: 473–524.

Kullman, B. 1992. *A revision of the genus Scutellinia (Pezizales) in Soviet Union.* Tallinn. 158 pp. (In Russian).

Kullman, B. & Raitviir, A. 1977. The new species in the genus *Scutellinia*. *Folia Cryptog. Estonica* 7: 3–6 (in Russian).

Schumacher, T. 1990. The genus *Scutellinia* (Pyronemataceae). *Opera Bot.* 101: 1–107.

Lichenicolous fungi

Ave Suija
Institute of Botany and Ecology, University of Tartu, 38 Lai St., 51005 Tartu, Estonia. E-mail: avesuija@ut.ee

Abbreviations of distribution regions and of frequency classes follow Randlane & Saag (1999).

ABROTHALLUS PRODIENS (Harm.) Diederich & Hafellner in Diederich – SW: Viljandimaa, Taevere, in spruce forest near Olustvere (58°35'N 25°29'E), on thallus of *Hypogumnia physodes* (L.) Nyl., 17. Aug. 1947 E. Parmasto, det. A. Suija. Freq.: rr.

BACHMANNIOMYCES UNCIALICOLA (Zopf) D. Hawksw. – NW: Läänemaa Co., Kesu bog (58°41'N 24°18'E), on *Cladonia uncialis* (L.) Weber ex F. H. Wigg, 22 July 1951 H. Trass, det. A. Suija. Freq.: rr.

BISPORA CHRISTIANSENII D. Hawksw. – NW: Harjumaa Co., Tallinn, Pääsküla (59°22'N 24°38'E), in apothecia and thallus *of Lecidella elaeochroma* (Ach.) M. Choisy, 26 Jan 1947 E. Parmasto, det. A. Suija. Freq.: rr.

LICHENOSTICTA ALCICORNARIA (Linds.) D. Hawksw. – SE: Võrumaa Co. , Kasaritsa, in pine forest near Võru-Kubja (57°49'N 27°01'E), on *Cladonia uncialis* (L.) Weber ex F. H. Wigg., 5 Dec. 1948 H. Trass, det. A. Suija. Freq.: rr.

SCUTULA MILIARIS (Wallr.) Trevis – NE: Jõgevamaa Co., Kurista Forestry, Lombi (58°46'N 26°20'E), on *Peltigera* sp., 14 Aug. 1957 S. Pärn, det. A. Suija; SE: Tartumaa Co., Alatskivi Forestry (58°36'N 27°02'E), in *Populus tremula* forest, on *Peltigera* sp., 3 Juny 1998, leg. and det. A. Suija; Tartumaa Co., Vasula (58°28'N 26°44'E), on *Peltigera praetextata* (Flörke ex Sommerf.) Zopf, 17 May 1928 H. Mühlberg, det. A. Suija; Valgamaa Co., Pikasilla (58°05'N 26°03'E), in pine forest, on *Peltigera rufescens* (Weiss) Humb., 5. Juny 1959 H. Trass, leg. A. Suija. Freq.: r.

REFERENCES

Randlane, T. & Saag, A. (eds.) 1999. Second checklist of lichenized, lichenicolous and allied fungi of Estonia. Folia Cryptog. Estonica 35: 1–132.