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Additions and amendments to the list of Estonian bryophytes

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Abstract: Investigations during last two years (1994–1996) have added 13 new species and 4 varieties to the list of Estonian bryophytes. Also, several new localities for 54 very rare and rare species and two varieties have been found. Eight species are no longer considered to be rare in Estonia and two must be excluded from the list of Estonian bryophytes due to misidentifications.

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

Viimase kahe aasta (1994–1996) uurimistööde tulemusel on Eesti sammalde nimestikule (510 liiki) lisandunud 13 uut liiki (*Harpanthus flotovianus, Jungermannia subulata, Aloina rigida, Bartramia ithyphylla, Bryum arcticum, B. calophyllum, B. klingraeffi, Dichelyma capillaceum, Pohlia sphagnicola, Physcomitrium eurystomum, Racomitrium elongatum, Rhytidium rugosum, Tetraplodon mnioides*) ja neli uut varieteeti (*Lophozia ventricosa* var. *silvicola, Aulacomnium palustre* var. *imbricatum, Dicranella schreberiana* var. *robusta, Schistidium rivulare* var. *rivualre*). Üks uutest liikidest (*Dichelyma capillaceum*) kuulub Euroopa punase raamatu ohustatud liikide kategooriasse. On leitud uusi leiukohti 54 liigile ja kahele varieteedile haruldaste ja väga haruldaste taksonite seast. Harulduste hulgast on mitmete uute leiukohtade tõttu välja arvatud kaheksa liiki ning nimestikust valemäärangute tõttu kaks liiki (*Orthotrichum tenellum* ja *Ditrichum heteromallum*).

INTRODUCTION

The list of Estonian bryophytes (Ingerpuu et al., 1994) contains 510 species, two hornworts (*Anthocerotopsida*), 112 liverworts (*Marchantiopsida*) and 396 mosses (*Bryopsida*). Since 1994 several new localities have been found. Collections of bryophytes are kept in the Herbarium of the Institute of Botany and Ecology of the University of Tartu (TU), in the Herbarium of the Institute of Zoology and Botany (TAA) and in the Herbarium of the Estonian Nature Museum (TAL).

RESULTS

Taxa of bryophytes new for Estonia

Nomenclature according to Corley et al., 1981; Corley & Crundwell, 1991; Grolle, 1983. After the Latin names the Estonian names are given for those species that are new for Estonia.

MARCHANTIOPSIDA – HELVIKSAMBLAD

HARPANTHUS FLOTOVIANUS (Nees) Nees – Flotovi harpantus. 1st locality (loc.): Pärnumaa Co., Nigula Nature Reserve, in the northern part of forest sq. no. 88, at a ditchside, 18 July 1996, leg. K. Vellak, det. N. Ingerpuu (TAA).

JUNGERMANNIA SUBULATA Evans – naaskelkulbik. 1st loc.: Pärnumaa Co., 1,5 km from Potsep Forestry Station, in a spruce forest on peaty soil near a spring stream, 30 July 1909, leg. J. Mikutowicz (sub nom. *Cephalozia pleniceps* in Bryotheca Baltica no.459) (Váña, 1973).

LOPHOZIA VENTRICOSA *var.* SILVICOLA (Buch) Jones. 1st loc.: Pärnumaa Co., Sauga, swampy birch forest near Nurme Bog, on decaying wood, 26 June1996, leg. M. Leis, det. N. Ingerpuu (TAA); 2nd loc.: Pärnu Co., Nigula Nature Reserve, forest ride 76/77, on a decaying stump, 4 Aug. 1996, leg. M. Leis, det. N. Ingerpuu (TAA).

BRYOPSIDA – LEHTSAMBLAD

ALOINA RIGIDA (Hedw.) Limpr. – rabe aloina. 1st loc.: Harjumaa Co., Suur-Pakri Is., on stony ruins at the Suurkilla Village, 17

June 1994, leg. & det. L. Kannukene (TAL).

AULACOMNIUM PALUSTRE *var.* IMBRICATUM B., S. & G. 1st loc.: Raplamaa Co., Jalase Village Reserve, Karukella Alvar, on ground, 4 May 1995, leg. & det. M. Leis (TU); 2nd loc.: Harjumaa Co., Väike-Pakri Is., on shingle beach ridge of the south-eastern coast, 31 May 1995, leg. & det. L. Kannukene (TAL); 3rd loc.: Harjumaa Co., Väike-Pakri Is., moist juniper alvar meadow on the southern part of the island, on ground, 31 May 1995, leg. & det. L. Kannukene (TAL).

BARTRAMIA ITHYPHYLLA Brid. – püstlehine bartraamia. 1st loc.: Harjumaa Co., Tallinn, Rocca al Mare, on sandstone, 11 Apr. 1926, leg. & det. T. Lippmaa (TU).

BRYUM ARCTICUM (R. Brown) B., S. & G. – arktika pungsammal. 1st loc.: Harjumaa Co., Väike-Pakri Is., on a cliff in the northern part of island, 1 Aug. 1995, leg. T. Ploompuu, det. L. Kannukene (TAL).

BRYUM CALOPHYLLUM R. Brown – laialehine pungsammal. 1st loc.: Harjumaa Co., valley of the Kroodi Stream near the Kroodi Village, on the moist, sandy, periodically flooded ground, 15 Aug. 1935, leg. & det. T. Lippmaa (TU).

BRYUM KLINGGRAEFFI Schimp. – Klinggraeffi pungsammal. 1st loc.: Saaremaa Co., Saaremaa Is., Kihelkonna-Veere road, about 3 km from Kihelkonna, on a big erratic boulder covered with limestone-rich dust, 24 July 1979, leg. & det. L. Kannukene (TBA); 2nd loc.: Harjumaa Co., Tallinn, Keemia St. 41, in the garden on beds, 5 Sep. 1995, leg. & det. L. Kannukene (TAL).

DICRANELLA SCHREBERIANA *var.* ROBUSTA (Schimp. ex Braithw.) Crum & Andr. 1st loc.: Viljandimaa Co., Kõpu, Tipu, near Räksi Farm in a wet forest, 10 July 1988, leg. & det. M. Leis (TU); 2nd loc.: Viljandimaa Co., Loodi, on moist meadow near the Sinialliku Stream between *Carex* hummocks, 6 June 1996, leg. K. Vellak, det. M. Leis (TAA).

DICHELYMA CAPILLACEUM (Hedw.) Myr. – juuskiilsirbik. 1st loc.: Jõgevamaa Co., in the Muda River on stones, 20 May 1975, leg. & det. L. Kannukene (TAA, TAL); 2nd loc.: Lääne-Virumaa Co., Kaukvere Forestry, on a stone in a dry stream, 18 Aug. 1995, leg. N. Ingerpuu, det. K. Vellak (TAA).

PHYSCOMITRIUM EURYSTOMUM Sendt. – väike mütshellik. 1st loc.: Harjumaa Co., Tallinn, Keemia St. 41, in the garden on beds, 5 Sep. 1995, leg. & det. L. Kannukene (TAL).

POHLIA SPHAGNICOLA (B., S. & G.) Broth. – rabapirnik. 1st loc.: Jõgevamaa Co., Endla Nature Reserve, Männikjärve Bog, between peatmosses, Sep. 1996, leg. R. Stamer, det. N. Ingerpuu, L. Kannukene (TAA). 2nd loc.: Ida-Virumaa Co., in the northern part of the Sirtsi Bog, on a hummock in a quagmire, Aug. 1996, leg. T. Ploompuu, det. L. Kannukene, (TAL).

RACOMITRIUM ELONGATUM Frish. – pikalehine härmik. 1st loc.: Harjumaa Co., Naissaar Is., on a sandy beach ridge of the southern coast, 14 Aug. 1993, leg. & det. L. Kannukene (TAL).

RHYTIDIUM RUGOSUM (Hedw.) Kindb. – kurdsammal. 1st loc.: Harjumaa Co., Väike-Pakri Is., on a limestone shingle ridge of the south-eastern coast, 31 May 1995, leg. & det. L. Kannukene (TAL, TAA).

SCHISTIDIUM RIVULARE *var.* RIVULARE (Brid.) Limpr. 1st loc.: Jõgevamaa Co., on stones on the bank of Muda River, 20 May 1975, leg. & det. L. Kannukene (TAA, TAL); 2nd loc.: Harjumaa Co., Kostivere Karst Area, July 1990, leg. M. Temina, det. L. Kannukene (TAL); 3rd loc.: Saaremaa Co., Saaremaa Is., Tornimäe, on stone, 1995, leg. K. Ruus, det. L. Kannukene (TAL).

TETRAPLODON MNIOIDES (Hedw.) B. & S. – punane tetraploodon. 1st loc.: Saaremaa Co., Saaremaa Is., on Harilaid Peninsula, in central part in a *Calluna* pine forest, June 1996, leg. H. Orav, det. L. Kannukene (TAL).

New localities of bryophytes rare in Estonia

MARCHANTIOPSIDA – HELVIKSAMBLAD

ANASTROPHYLLUM HELLERIANUM (Nees ex Lindenb.) Schust. 4th loc.: Ida-Virumaa Co., Kaukvere Primeval Forest, on a big log, 18 Aug. 1996, leg. K. Vellak, det. N. Ingerpuu (TAA); 5th loc.: Raplamaa Co., Vardi Forestry, in an alvar forest near road, 54 km

from Tallinn towards Pärnu, on a log, 17 June 1996, leg. & det. N. Ingerpuu (TAA); 6th loc.: Tartumaa Co., Alam-Pedja Nature Reserve, Nugissaare, on a log, 4 Sep. 1996, leg. & det. N. Ingerpuu (TAA); 7th loc.: Tartumaa Co., Alam-Pedja Nature Reserve, Põltsamaa Bog, Peterna Nina, in the forest on a log, 11 July 1996, leg. & det. N. Ingerpuu (TAA).

BARBILOPHOZIA KUNZEANA (Hüb.) K. Müll. 3rd loc.: Lääne-Virumaa Co., the field of erratic boulders in the northern part of the Käsmu Peninsula, on stones, litter and mosses, 11 June 1994., leg. M. Leis, det. N. Ingerpuu (TAA); 4th loc.: Viljandimaa Co., 1 km SE of the Tipu Schoolhouse, in a swampy forest on litter, 24 June 1994, leg. & det. N. Ingerpuu (TAA).

CEPHALOZIA LOITLESBERGERI Schiffn. 3rd loc.: Pärnumaa Co., near Rongu Bog, forest sq. no. 165, 7 Aug. 1996, leg. & det. N. Ingerpuu (TAA).

CALYPOGEIA SPHAGNICOLA (H. Arn. & J. Perss.) Warnst. & Loeske. 5th loc.: Jõgevamaa Co., Endla Nature Reserve, Männikjärve Bog, between *Sphagnum*, Aug. 1996, leg. R. Stamer, det. N. Ingerpuu; 6th loc.: Lääne-Virumaa Co., Tudu, Järvesoo Bog, between *Sphagnum*, 7 Oct. 1996, leg. T. Ploompuu, det. N. Ingerpuu (TAA).

GEOCALYX GRAVEOLENS (Schrad.) Nees. 7th loc.: Jõgevamaa Co., Alam-Pedja Nature Reserve, Põltsamaa Bog, Peterna Nina, in the forest near a stream, on soil and litter, 11 July 1996, leg. & det. N. Ingerpuu (TAA).

LEJEUNEA CAVIFOLIA (Ehrh.) Lindb. 6th loc.: Pärnumaa Co., Nigula Nature Reserve, forest ride 76/77, on aspen trunks on mosses, 4 Aug. 1996, leg. & det. N. Ingerpuu (TAA).

METZGERIA CONJUGATA Lindb. 1st loc.: Pärnumaa Co., Nigula Nature Reserve, forest sq. no. 80, in nemoral forest on a granite stone, 18 July 1996, leg. & det. N. Ingerpuu (TAA). No precise localities were known for this species earlier, just a literature reference.

LOPHOZIA BANTRIENSIS (Hook) Steph. 4th loc.: Raplamaa Co., Jalase Village Reserve, Seavanni Springs E of the Parka Bog, in a spring stream on mud and on decaying wood, 4 May 1995, leg. & det. N. Ingerpuu (TAA).

LOPHOZIA RUTHEANA (Limpr.) Howe. 2nd loc.: Jõgevamaa Co., Endla Nature Reserve, near Haava Spring, 12 July 1995, leg. & det. N. Ingerpuu (TAA); 3rd loc.: Harjumaa Co., Kernu Forestry, Külmallika Fen, among mosses, 27 July 1995, leg. K. Vellak, det. N. Ingerpuu (TAA); 4th loc.: Tartumaa Co., Alam-Pedja Nature Reserve, Kariste Bog, 1 Sep. 1996, leg. & det. N. Ingerpuu (TAA).

RICCARDIA CHAMAEDRYFOLIA (With.) Grolle. 5th loc.: Jõgevamaa Co., Kursi Forestry, sq. no. 328, open area, on the bank of a bomb crater, on sand, 20 Aug. 1993, leg. L. Kannukene, det. N. Ingerpuu (TAA); 6th loc.: Tartumaa Co., E of Palupõhja Village, Kulu Bog, 9 May 1996, leg. & det. N. Ingerpuu (TAA).

RICCARDIA INCURVATA Lindb. 2nd loc.: Jõgevamaa Co., Alam-Pedja Nature Reserve, former military area S of the Pedja River, on sandy soil, 30 July 1996, leg. H. Krall, det. N. Ingerpuu (TAA); 3rd loc.: Lääne-Virumaa Co., in the south-western part of Varudi Bog, on peaty soil, 4 Oct. 1996, leg. T. Ploompuu, det. N. Ingerpuu (TAA).

SCAPANIA APICULATA Spruce. 2nd loc.: Viljandimaa Co., 1 km NE of the Tipu Schoolhouse, in a forest near road on decaying wood, leg. & det. N. Ingerpuu (TAA): 3rd loc.: Ida-Virumaa Co., Kaukvere Primeval Forest, on a big log, 18 Aug. 1995, leg. K. Vellak, det. N. Ingerpuu (TAA); 4th loc.: Pärnumaa Co., W of Kodaja Bog, in a ditch on forest ride 144/145, on decaying wood, 8 Aug. 1996, leg. & det. N. Ingerpuu (TAA).

SCAPANIA CALCICOLA (H. Arn. & I. Press.) Ingh. 2nd loc.: Saaremaa Co., Saaremaa Is., Lõo Alvar, 23 June 1993, leg. E. Roosaluste, det. N. Ingerpuu (TU); 3rd loc.: Hiiumaa Co., Aruküla Alvar, 11 Aug. 1993, leg. M. Zobel, det. N. Ingerpuu (TU).

SCAPANIA UMBROSA (Schrad.) Dum. 3rd loc.: Pärnumaa Co., Nigula Nature Reserve, forest ride 114/119, on decaying wood, 3 Aug. 1996, leg. & det. N. Ingerpuu (TAA).

SCAPANIA UNDULATA (L.) Dum. 2nd loc.: Ida-Virumaa Co., Kaukvere, forest sq. no. 190, in a stream on stones and decaying wood, 12 Aug. 1996, leg. & det, N. Ingerpuu (TAA); 3rd loc.: Pärnumaa Co., W of Kodaja Bog,

in a ditch on forest ride 144/145, on decaying wood, 8 Aug. 1996, leg. & det. N.Ingerpuu (TAA); 4th loc.: Pärnumaa Co., Nigula Nature Reserve, in a ditch on forest ride 87/88, on decaying wood, 5 Aug. 1996, leg. & det. N.Ingerpuu (TAA).

TRITOMARIA QUINQUEDENTATA (Huds.) Buch. 6th loc.: Raplamaa Co., Jalase Village Reserve, Abru Alvar Forest, beside a road near Huntaugu, on a granite stone, 6 May 1995, leg. & det. N. Ingerpuu (TAA).

BRYOPSIDA – LEHTSAMBLAD

AMBLYSTEGIUM CONFERVOIDES (Brid.) B. S. & G. 2.nd loc.: Saaremaa Co., Saaremaa Is., Undva Cliff, on soil, 28 July 1969, leg. & det. L. Kannukene (TAA, TAL).

AMBLYSTEGIUM TENAX (Hedw.) C. Jens. 5th loc.: Ida-Virumaa Co., on a limestone outcrop in the Tõrvajõe Stream, 19 July 1977, leg. & det. L. Kannukene (TAA, TAL); 6th loc.: Viljandimaa Co., Loodi Põrguorg, on stones in the Viraski Stream, 13 May 1996, leg. & det. N. Ingerpuu (TAA); 7th loc.: Pärnumaa Co., Nigula Nature Reserve, forest ride 76/77, in Arakaoja Stream on a granite stone, 4 Aug. 1996, leg. & det. N. Ingerpuu (TAA).

ATRICHUM ANGUSTATUM (Brid.) B. & S. 2nd loc.: Ida-Virumaa Co., Kurtna, on peat on the bank of Ahvenjärve Lake, 19 July 1993, leg. & det. L. Kannukene (TAL); 3rd loc.: Jõgevamaa Co., Alam-Pedja Nature Reserve, S of the Pedja River, former military open area, on sandy soil, 30 July 1996, leg. & det. N. Ingerpuu (TAA).

BARTRAMIA POMIFORMIS Hedw. 3rd loc.: Ida-Virumaa Co., in a swampy forest W of Sõrumaa, 2 June 1932, leg. & det. T. Lippmaa (TU); 12 June 1932, leg. S. Talts, det. L. Kannukene (TAA, TAL); 4th loc.: Viljandimaa Co., Loodi Nature Park, Mäemets, on a sandy roadside, 17 June 1996, leg. & det. M. Leis (TU).

BRACHYTHECIUM STARKEI (Brid.) B., S. & G. 4th loc.: Harjumaa Co., Naissaar Is., spruce forest on the southern part of the island, on the ground beside footpath, 1 Aug 1993, leg. L. Kannukene, det. L. Hedenäs (TAL); 5th loc.: Saaremaa Co., Vilsandi National Park, Vilsandi Is., in pine forest on a decaying juniper, 5 July 1996, leg./det. L. Kannukene (TAL); 6th loc.: Tartumaa Co., Varnja, on willow roots, 16 Aug. 1988, leg./det. A. Kalda (TAA).

BRACHYTHECIUM TURGIDUM (Hartm.) Kindb. 4th loc.: Harjumaa Co., Suur-Pakri Is., on a denudated limestone on the bottom of a bomb crater in the northern part of island, 17 June 1994, leg. & det. L. Kannukene (TAL).

BRYUM BLINDII B., S. & G. 2nd loc.: Saaremaa Co., Kalarahu Is., in a juniper shrubbery on ground, 28 May 1978, leg. & det. L. Kannukene (TAL).

BRYUM MAMILLATUM Lindb. 2nd loc.: Harjumaa Co., Väike-Pakri Is., on the north-western coast on concrete, 17 May 1994, leg. & det. L. Kannukene (TAL).

BRYUM WARNEUM Bland. 4th loc.: Saaremaa Co., Vilsandi Is., on the northern coast, 20 July 1933, leg. & det. T. Lippmaa (TU); on biohermic dolomite, 4 July 1996, leg. & det. L. Kannukene (TAL); 5th loc.: Raplamaa Co., Jalase Village Reserve, Karukella Alvar, on the ground, Aug. 1994, leg. & det. L. Kannukene (TAL).

CALLIERGON MEGALOPHYLLUM Mik. 2nd loc.: Põlvamaa Co., Värska, submerged in the Kaanjärve Lake, 21 Sep. 1994, leg. & det. L. Kannukene (TAL, TAA).

CAMPYLIUM HALLERI (Hedw.) Lindb. 3rd loc.: Harjumaa Co., Kernu Forestry, Külmallika, on the bank of a ditch, on limestone, 2 July 1995, leg. & det. N. Ingerpuu (TAA); 4th loc.: Tartumaa Co., in a drained birch grove at Ülenurme, 30 Sep. 1995, leg. M. Temina, det. L. Kannukene (TAL).

DICHELYMA FALCATUM (Hedw.) Myr. 4th loc.: Ida-Virumaa Co., Kaukvere Primeval Forest, sq. no. 190, on a dead branch in a dry stream, 18 Aug. 1995, leg. & det. N. Ingerpuu (TAA); 5th loc.: Viljandimaa Co., Loodi Põrguorg, on stones in the Viraski Stream, 13 May 1996, leg. & det. K. Vellak (TAA).

DICHODONTIUM PELLUCIDUM (Hedw.) Schimp. 4th loc.: Viljandimaa Co., Loodi Põrguorg, on stones in the Viraski Stream, 13 May 1996, leg. N. Ingerpuu, det. L. Kannukene (TAA); 5th loc.: Viljandimaa Co., Õisu, on a stone on the Vidva River bank, 17 June 1996, leg. & det. M. Leis (TU); 6th loc.: Põlvamaa Co., Suur-Taevaskoda, Ahja River bank, on sandstone, 13 Aug. 1996, leg. & det. N. Ingerpuu (TAA).

DICRANELLA SUBULATA (Hedw.) Schimp. 4th loc.:

Jõgevamaa Co., Kursi Forestry, on a clean-cut area in a rut, 20 July 1994, leg. & det. M. Leis (TU); 5th loc.: Ida-Virumaa Co., Oonurme Forestry,. Kaukvere, *Vaccinium*-type pine forest, on a sandy hummock of roots of a wind-fallen tree, 18 Aug. 1995, leg. N. Ingerpuu, K. Vellak, det. M. Leis (TU).

DICRANUM FLEXICAULE Brid. 7th loc.: Tartumaa Co., Alam-Pedja Nature Reserve in the northern part of the Karisto Bog in a swampy forest, 22 Aug. 1996, leg. & det. N. Ingerpuu (TAA).

DICRANUM MONTANUM *var.* TRUNCICOLUM (De Not.) Podp. 3rd loc.: Raplamaa Co., Jalase Village Reserve, Huntaugu Alvar Forest, on a small stone, 12 Aug. 1994, leg. & det. L. Kannukene (TAL) ; 4th loc.: Raplamaa Co., Jalase Village Reserve, on a big erratic boulder near the Mullasoo Bog, 3 May 1995, leg. & det. L. Kannukene (TAL).

DICRANUM VIRIDE (Sull. & Lesq.) Lindb. 5th loc.: Lääne-Virumaa Co., Rägavere Mu., Võlumäe Village, 0.5 km W of Tammemäe Farmhouse, on an oak trunk, 17 Aug. 1996, leg. & det. N.Ingerpuu (TAA).

EUCLADIUM VERTICILLATUM (Brid.) B., S. & G. 1st loc.: Saaremaa Co., Saaremaa Is., Mustjala, Kooru Leik Stream, limestone cliff of the streambank, in crevices, 29 July 1969, leg. & det. L. Kannukene (TAL, TAA). Specimen, collected by A. Üksip in 1933 and identified by E. Varep as *E. verticillatum* (Ingerpuu et al., 1994), is *Gymnostomum aeruginosum.*

FISSIDENS GRACILIFOLIUS Brugg.-Nann. & Nyh. 2nd loc.: Ida-Virumaa Co., Ontika, on sandstone at the foot of the cliff, 10 June 1993, leg. & det. N. Ingerpuu, K. Vellak (TAA); 3rd loc.: Saaremaa Co., Vilsandi National Park, juniper alvar meadow in the northern part of Vilsandi Is., on a shaded limestone outcrop, in crevices, 2 July 1996, leg. & det. L. Kannukene (TAL).

FISSIDENS PUSILLUS (Wils.) Milde. 6th loc.: Harjumaa Co., Rannamõisa Cliff, on shaded sandstone outcrop, 29 March 1974, leg. & det. L. Kannukene (TAA).

GYMNOSTOMUM AERUGINOSUM Sm. 3rd loc.: Harjumaa Co., Pakri Peninsula, Leetse Cliff, on outcrop, 31 May 1933, leg. A. Üksip (see *Eucladium verticillatum),* det. L. Kannukene (TU); 4th loc. Harjumaa Co., Väike-Pakri Is., on a moist limestone outcrop of the glint on the northern coast, 18 May 1994; 30 May 1995 leg. & det. L. Kannukene (TAL).

HYLOCOMIUM UMBRATUM Hedw. 4th loc.: Jõgevamaa Co., Huuksi Forestry, 1,5 km from the Kapu road crossing towards Koeru, in a mixed forest, 10 June 1996, leg. & det. K. Vellak (TAA).

ISOPTERYGIOPSIS PULCHELLA (Hedw.) Iwats. 2nd loc.: Harjumaa Co., Tallinn, 19th c., E. Russow (Malta, 1930); 3rd loc.: Ida-Virumaa Co., Kurtna, in a drained forest E of the Haugjärve Lake, 20 July 1993, leg. & det. L. Kannukene (TAL).

ISOTHECIUM MYUSUROIDES Brid. 2nd loc.: Lääne-Virumaa Co., forest in the centre of the Käsmu Peninsula, on stone, 10 June 1994, leg. & det. N. Ingerpuu (TAA); 3rd loc.: Ida-Virumaa Co., 1 km E of Tudu, in a mixed forest on a big granite block, 12 Aug. 1996, leg. & det. M. Leis (TU).

MEESIA ULIGINOSA Hedw. 3rd loc.: Lääne-Virumaa Co., Sämi-Kuristiku Bog, on sides of hummocks, 10 Aug. 1996, leg. T. Ploompuu, det. L. Kannukene (TAA,TAL).

PLAGIOPUS OEDERIANA (Sw.) Crum & Anders. 6th loc.: Harjumaa Co., Tiskre Cliff, 20 Aug. 1932, leg. & det. T. Lippmaa (TU).

PLAGIOTHECIUM LATEBRICOLA B.,S. & G. 4th loc.: Harjumaa Co., Viimsi Forestry, alder-birch forest, on a base of an alder trunk, 5 June 1969, leg. L. Kannukene, det. L. Hedenäs (TAA); 5th loc.: Viljandimaa Co., Loodi Põrguorg, on a trunkbase, 13 May 1996, leg. & det. K. Vellak (TAA); 6th loc.: Pärnumaa Co., Nigula Nature Reserve, forest sq. no. 89, on a stone under the roots of a fallen tree, 5 Aug. 1996, leg. & det. M. Leis (TU).

PLAGIOTHECIUM RUTHEI Limpr. 3rd loc.: Lääne-Virumaa Co., Käsmu, swampy forest near the road crossing towards Keripõ1lu, on ground, 10 June 1994, leg. K. Vellak, det. N. Ingerpuu (TAA).

PLAGIOTHECIUM UNDULATUM (Hedw.) Schimp. 3rd loc.: Hiiumaa Co., Hiiumaa Is., Tornimäe Forestry, in a spruce forest on ground, 14 Aug. 1995, leg. Ü. Püttsepp, det. N. Ingerpuu (TAA); 4th loc.: Pärnumaa Co., Nigula Nature Reserve, forest sq. no. 70, in an old spruce forest on ground, 4 Aug. 1996, leg. & det. M.Leis (TU).

POGONATUM DENTATUM (Brid.) Brid. 5th loc.: Ida-Virumaa Co., Kurtna, pine forest W of the Särgjärve Lake, on ground, 19 Sep. 1994, leg. & det. L. Kannukene (TAL); 6th loc.: Viljandimaa Co., on sandstone outcrops of the Vidva River bank, 17 June 1996, leg. & det. M. Leis (TU); 7th loc.: Pärnumaa Co., Sauga, in a birch forest near the Nurme Bog, 26 June 1996, leg. & det. M. Leis (TU).

POHLIA BULBIFERA (Warnst.) Warnst. 3rd loc.: Harjumaa Co., coastal dunes of the Keibu Bay, on moist sand, 10 Aug. 1996, leg. & det. L. Kannukene (TAL).

POTTIA DAVALLIANA (Sm.) C. Jens. 4th loc.: Läänemaa Co., on the boundary of the municipalities of Taebla and Ridala, on a ploughed field N of the Laheva Village, on moist calcareous soil, 15 Oct. 1995, leg. T. Ploompuu, det. L. Kannukene (TAL).

SCHISTIDIUM RIVULARE *var.* LATIFOLIUM (J. E. Zett.) Crum & Anders. 2nd loc.: Harjumaa Co., Kostivere Karst Area, on limestone, July 1990, leg. M. Temina, det. L. Kannukene (TAL), 3rd loc.: Harjumaa Co., Maardu Quarry, on a limestone, July 1990, leg. M. Temina, det. L. Kannukene (TAL); 4th loc.: Harjumaa Co., Vasalemma Quarry, 1991, leg. M. Temina, det. L. Kannukene (TAL).

SELIGERIA CALCAREA (Hedw.) B., S. & G. 5th loc.: Harjumaa Co., Pakri Peninsula, on shaded limestone of the Leetse Cliff, 05 May 1994, leg. & det. L. Kannukene (TAL).

SELIGERIA PUSILLA (Hedw.) B., S. & G. 3rd loc.: Harjumaa Co., Väike-Pakri Is., on limestones of the glint on the north coast, 18 May 1994, leg. & det. L. Kannukene (TAL); 4th loc.: Harjumaa Co., Pakri Peninsula, on shaded limestone of the Leetse Cliff, 5 May 1994, leg. & det. L. Kannukene (TAL).

SPHAGNUM LINDBERGII Schimp. ex Lindb. 7th loc.: Jõgevamaa Co., Endla Nature Reserve, Männikjärve Bog, 3 Sep. 1996, leg. & det. R. Stamer (TAA).

THAMNOBRYUM ALOPECURUM (Hedw.) Gang. 5th loc.: Viljandimaa Co., Loodi Põrguorg, on stones in the Viraski Stream, 13 May 1996, leg. & det. N. Ingerpuu (TAA); 6th loc:. Viljandimaa Co., sandstone outcrops near Õisu, on a stone near the Vidva River 17 June 1996, leg. & det. M. Leis (TU).

TORTELLA RIGENS Alb. 3rd loc.: Harjumaa Co., Väike-Pakri Is., on the glint in the northern part of the island, 18 May 1994, leg. & det. L. Kannukene (TAL); 4th loc.: Harjumaa Co., Suur-Pakri Is., on alvar in the northern part of the island, 12 June 1996, leg. & det. L. Kannukene (TAL).

TORTULA LINGULATA Lindb. 7th loc.: Valgamaa Co., on sandstone of the Helme Cave, 31 July 1995, leg. & det. N. Ingerpuu (TAA).

TREMATODON AMBIGUUS (Hedw.) Hornsch. 6th loc.: Ida-Virumaa Co., 1 km E of Tudu, in a mixed forest on a ditchbank, 12 Aug. 1996, leg. & det. M. Leis (TU).

DISCUSSION

New localities for 54 very rare (1–3 localities) and rare (4–7 localities) species and two varieties have been found for Estonia. Also, 13 species and 4 varieties have been found new for Estonia from recent or earlier collections and from literature data. For liverworts three new taxa must be added to the list. *Jungermannia subulata* Evans was identified by J. Váña from specimen, no. 459 (labelled as *Cephalozia pleniceps)* in the exsiccata Bryotheca Baltica of J. Mikutowicz, S-PA (Váña, 1973). The exsiccata specimen no. 459 in TU does not contain *Jungermannia subulata.*

Metzgeria conjugata Lindb. and *Scapania apiculata* Spruce had been reported only once on the territory of Estonia last century. The first species is on the northeastern border of its distribution and lacking in Latvia and Lithuania. *Scapania apiculata* together with *Anastrophyllum hellerianum* (Nees ex Lindenb.) Schust. grows mainly on large logs. Such logs can be found only in more or less primeval forests – which are quite rare in Estonia nowadays.

New localities have been found for *Barbilophozia lycopodioides* (Wallr.) Loeske, *B. hatcheri* (Evans) Loeske, *Jungermannia caespiticia* Lindenb. and *Riccia fluitans* L. They are no longer considered rare species in Estonia.

Fourteen new moss taxa are reported for the first time in Estonia. Two of them – *Bartramia ithyphylla* Brid. and *Bryum calophyllum* R. Brown were found during the

reorganization of the TU herbarium.

The find of *Dichelyma capillaceum* (Hedw.) Myr. which belongs to the category of vulnerable species in the Red Data Book of European Bryophytes (Schumacker & Martiny, 1995) is noteworthy. Both species of the genus *Dichelyma (D. falcatum* (Hedw.) Myr. and *D. capillaceum)* are rare because they can only be found in Estonia in such relatively rare habitats as periodically submerged stones or branches in unpolluted streams of forests.

Several new species have been found recently on the North Estonian islands. These islands have been closed to researchers for almost 50 years since they were part of the military border zone of the former Soviet Union. Three new species were found on the Pakri islands – *Aloina rigida* (Hedw.) Limpr., *Bryum arcticum* (R. Brown) B., S. & G. and *Rhytidium rugosum* (Hedw.) Kindb. (Kannukene, 1995.). Interesting is also the find of *Aulacomium palustre* var. *imbricatum B.,* S. & G. on the alvars of the Pakri islands and Jalase Village Reserve. It prefers dryer habitats, contrary to var. palustre.

New localities for *Bryum blindii* B., S. & G., *Meesia uliginosa* Hedw. and *Isopterygiopsis pulchella* (Hedw.) Iwats. have been found. These species were earlier found only in one or two localities each in the previous century and were therefore considered to be extinct in Estonia (Kalda et al., 1992).

Remarkable is the new locality of *Dicranum viride* (Sull. & Lesq.) Lindb. It grows abundantly on about hundred years old oak trunks near Võlumäe village. This species is included to the Red Data Book of European Bryophytes.

Andreaea rupestris Hedw., Bryum neodamense Itzig. ex C. Müll., *Drepanocladus tenuinervis* T. Kop., *Hypnum pratense* (Rabenh.) W. Koch ex Hartm. and *Pohlia proligera* (Lindb. ex Breidl.) Lindb. ex H. Arn. are no longer considered to be rare since they have now been found from more than 7 localities in Estonia.

Two species *Orthotrichum tenellum* Bruch ex Brid. and *Ditrichum heteromallum* (Hedw.) Britt. must be excluded from the list of Estonian bryophytes. The former specimen was identified as *Orthotrichum pallens* Bruch ex Brid. by J. Lewinsky-Haapasaari and latter as *Ditrichum flexicaule* (Schwaegr.) Hampe by N. Malta (Malta, 1930).

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Bryophyte communities of limestone grasslands on Saaremaa and Vilsandi Islands

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Abstract: Data of 202 sample plots from 18 limestone grassland sites on Saaremaa and Vilsandi Islands in the West-Estonian Archipelago were analysed using the statistical method of interspecific association. The results allow the division of the bryophyte species into two groups; named after the main species as the *Ditrichum flexicaule* community and the *Dicranum scoparium* community. The former is distributed in open places with thin soil and a scarce grass layer, and the latter between the shrubs where the grass layer is dense and, as compared to the first habitat, the soil is thicker. The species composition of the *Ditrichum flexicaule* community coincides rather well with that of the *Thuidium abietinum-Ditrichum flexicaule* union widely distributed on the limestone grasslands. Further studies are needed to describe the structure and development of the *Dicranum scoparium* community. The *Stereodon-Camptothecium-Thuidium* union described on alvars is also expected to occur, but obviously it is not well enough represented in the present dataset to be distinguished with the method used.

Kokkuvõte: M. Tobias ja L. Kannukene. Loopealsete samblakooslused Saaremaal ja Vilsandil.

Saaremaa ja Vilsandi 18 looalalt pärit andmete (202 kirjeldust) töötlemisel kasutati liikide koosesinemise statistilist analüüsi. Tulemuste põhjal jaotati liigid kahte gruppi, mida olulise (keskse) liigi järgi nimetati vastavalt *Ditrichum flexicaule* ja *Dicranum scoparium*'i koosluseks. Esimene kooslus esineb avatud, õhukese mullakihi ja hõreda rohurindega aladel ning teine enam põõsaste vahel, kus rohurinne on tihedam ning mullakiht tüsedam. *Ditrichum flexicaule* koosluse liigiline koosseis vastab üsna hästi loopealsetel laialt levinud *Thuidium abietinum-Ditrichum flexicaule* ühingule. Edasised uurimused on vajalikud selgitamaks teise – *Dicranum scoparium*'i koosluse struktuuri ja arengut. *Stereodon-Camptothecium-Thuidium*'i ühing on käesolevas andmestikus samuti esindatud, kuid mitte piisavalt, et teda saaks eristada antud meetodit kasutades.

INTRODUCTION

In Estonia phytosociological studies of the bryophyte communities began with the works of Lippmaa. He restricted the community concept to the individual horizontal strata designing a general classification scheme of all Estonian plant communities. He distinguished about 150 communities (unions), of which almost 1/3 were bryophyte communities (Lippmaa, 1933, 1935, 1940). The unions are separated according to the characteristic species and the ecotope.

The limestone grasslands (alvars) are habitats with xerophilous and calciphilous vegetation developed on the thin soil layer, restricted to the Silurian and Ordovician outcrops. The vegetation is rich in bryophyte species, especially in mosses. On the alvars in the West-Estonian Archipelago 119 bryophyte species have been recorded (Kannukene, 1984, 1987). The large number and high biomass of the bryophyte (and lichen) species is considered to be the result of moderate grazing (Albertson, 1950; Rosén, 1982). A too high grazing pressure is reducing the species diversity on the alvars (Rosén & Sjögren, 1973) as well as a too low grazing pressure does (During & Willems, 1986).

On the alvars Lippmaa (1933, 1940) has described two unions: *Thuidium abietinum-Ditrichum flexicaule*[1] and *Stereodon-Camptothecium-Thuidium.* Trass (1949) in his phytosociological study on Pääsküla alvar additionally described two unions: 1) *Ditrichum flexicaule* on the exposed rock and on the karst; 2) *Encalypta contorta* on the walls of the deep ditches. In the juniper shrubbery Trass (1949) recognised the *Pleurozium schreberi-Hylocomium proliferum* union described earlier on the sandy soils (Lippmaa, 1933), and in alvar forests (Laasimer, 1946). In many cases the main species are mentioned in species lists when describing the alvar communities, but these do not include the bryophyte communities (Vilberg, 1927; Laasimer, 1965; Akkel, 1967, a.o.).

In the present paper an attempt is made to distinguish the main bryophyte species groups with the help of interspecific association and to compare the species composition of these groups with those described earlier in

[1] Authors' taxonomy is not changed.

Estonia.

STUDY AREA

Study sites (in total 18) are located in the coastal area of Saaremaa and Vilsandi islands (Fig. 1). They were chosen to represent typical alvar habitats on Silurian limestones or dolomites, which are often covered by gravel-shingle deposits. All the sites chosen were

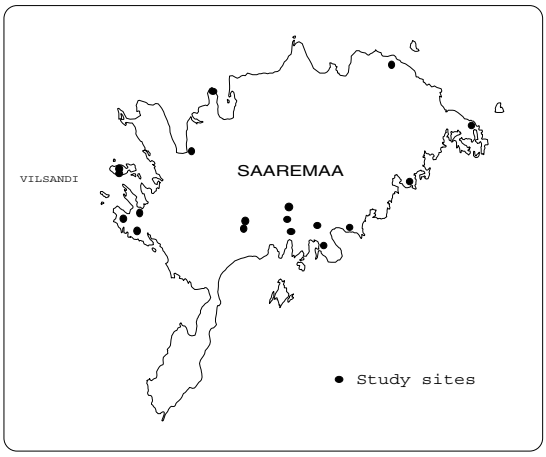

Fig. 1. Location of the study sites.

subjected to moderate anthropogenic influence (grazing). The minimum area of the study sites was about 2 ha.

Study sites include grasslands with single shrubs and juniper shrublands. The majority of the study sites are situated on the rendzic leptosols on coastal deposits (gravel and shingle). The rest are on the rendzic leptosols on limestone. The soils are thin (up to 20 cm) and characterised by a high content of humus, carbonates and microelements (Rooma, 1976; Rooma & Sepp, 1972). In A horizon of soils pH_{KCl} varies between 6.7–8.0.

The microclimatic conditions are rather severe. The soil water is mostly accumulated in spring. In summer during the vegetation period the soil is often extremely dry when the thin soil layer cannot retain moisture. Frequent are great diurnal temperature fluctuations, late colds in spring and a thin snow cover in winter.

MATERIAL AND METHODS

The releves of bryophyte vegetation were made on 1x1 m^2 sample plots laid out along the transects across the study sites (total number of releves is 202). Per cent cover of all bryophyte species as well as the total cover of vascular plants was estimated visually. Identification of bryophyte specimens was checked in the laboratory when necessary. Nomenclature follows Ingerpuu et al. (1994).

Statistical analysis of interspecific association is used for the recognition of plant communities. It is well known that certain species tend to grow together in certain locations, while others never coexist. This idea is represented by the concepts of positive and negative associations. If two species are positively associated, it means that they are growing together more often than would be expected by chance or random events. Conversely, a negative association means that one species is found growing without the other more often than would be expected by chance. The different types of interspecific association pattern may reflect similarity or dissimilarity of ecological conditions, but factors like plant strategies, competition and interaction are important too (Greig-Smith, 1969; Bates, 1982; Kent & Coker, 1992).

For the association analyses all rare species with constancy of less than 5 % were excluded and the percentage scale used in the field was transferred into presence/absence data. 22 from all 50 species identified were used for the analyses. From these data 2x2 contingency tables were constructed and the data were analysed following Greig-Smith (1969). Chi-square values for interspecific associations were calculated using Yate's correction. All associations with the expected value in any one cell of the contingency table less than 5 were rejected (Greig-Smith, 1969).

RESULTS AND DISCUSSION

The results of the association analysis are shown in Table 1. In all 18 species show statistically significant associations. Three species, *Scleropodium purum, Bryum caespiticum* and *Climacium dendroides,* show a statistically significant association (positive or negative) with one other species. Two central species are *Ditrichum flexicaule* and *Dicranum scoparium*, showing interspecific associations with eleven and ten other species, respectively. The other

Table 1. The significant interspecific associations detected by chi-square analysis; + positive, - negative (+ - $p<0.05$; ++ — $p<0.01$; +++ — $p<0.001$)

Gr.		Species	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
I	1.	*Ditrichum flexicaule*	x	+++	+++	+++	++	+	++	++					+			---	--	---
	2.	*Tortella tortuosa*		x	+++	+++			+++		+++					-		--	---	---
	3.	*Barbula convoluta*			x	+									-					
	4.	*Weissia brachycarpa*				x										-			---	--
	5.	*Campylium chrysophyllum*					x													---
	6.	*Tortella fragilis*						x		++									-	
	7.	*Encalypta streptocarpa*							x											
	8.	*Fissidens dubius*								x	+	++	+		--					
	9.	*Bryum pallens*									x									
	10.	*Bryum caespiticum*										x								
	11.	*Scleropodium purum*											x							
	12.	*Ctenidium molluscum*												x					--	--
	13.	*Thuidium abietinum*													x	+++				-
	14.	*Homalothecium lutescens*														x				-
II	15.	*Climacium dendroides*															x			++
	16.	*Hylocomium splendens*																x		+++
	17.	*Hypnum cupressiforme*																	x	+++
	18.	*Dicranum scoparium*																		x

species occupy an intermediate position in this range.

After the rearrangement of species, two clear species groups emerge. The first includes the species from 1–11. The smaller second group includes four species (15–18). Both groups are characterised by several positive associations within the group and negative associations between the groups. The space between those two groups is occupied by the species *Thuidium abietinum* and *Homalothecium lutescens*, which show negative associations with the species of both groups, but are positively associated with each other. *Ctenidium molluscum* has no positive associations at all, because it occupies a special habitat. It is known to grow in wet places, in the areas, which are temporarily flooded.

However, the underlying processes that cause positive and negative associations are not easy to determine from a description of pattern alone. Because the competitive interactions are thought to be less important among the bryophytes (and lichens) than among vascular plants (Grime, 1977; During, 1992), the associations reflect a similar response to the ecological conditions.

The division of bryophytes into the two groups is obviously derived from the different ecological conditions occurring on the grassland. The first group is distributed in the open places with thin soil and a scarce grass layer, and the second between the shrubs were the grass layer is dense and, as compared to the first habitat, the soil is thicker. The mosaic structure of open areas with a scarce grass layer and the hummocks with a dense grass layer is mainly created by the sheep grazing. Among the species of the first group the distribution of *Barbula convoluta, Weissia brachycarpa* and *Bryum* spp. is known to be restricted to the open spots and they show a strong preference for sheep paths and occasional hoof prints (During & Willems, 1986). *Tortella* spp. are reported to be sensitive to the changes in light and moisture regime resulting from a dense summer herb layer (Watson 1960). These species are the most sensitive to the cessation of grazing. Other species can take advantage of slightly moister conditions and shelter provided by the grass layer.

The species composition of *Ditrichum flexicaule* community[2] (group I) corresponds with the *Thuidium abietinum-Ditrichum flexicaul*e union of Lippmaa (1933), a helophilous community distributed on the ryhk (thin stony soils developed on Silurian outcrops). The common species beside the characteristic species are

[2] Here the term community is used in general meaning without assessing its exact position in the hierarchy of phytosociological systems.

Tortella tortuosa, Encalypta streptocarpa, Homalothecium lutescens, Bryum spp., *Ceratodon purpureus* (Lippmaa 1933), beside those *Fissidens dubius* and *Dicranum brevifolium* (Laasimer. 1946). Obviously the *Ditrichum flexicaule* union by Trass (1949) is the *Ditrichum flexicaule*-rich fragment of the above named union. Similarly, the *Tortelletum* union (Albertson, 1946, 1950) on the exposed bedrock where small amounts of soil occur in patches locally, is the initial stage of the *Thuidium abietinum-Ditrichum flexicaule* union. *Thuidium abietinum* is present in the mature stage of the union (Lippmaa 1933). According to the association analysis the most important species of the community is *Ditrichum flexicaule*, together with *Tortella tortuosa* and *Fissidens dubius*.

The *Dicranum scoparium* community (group II) has common species with the *Pleurozium schreberi-Hylocomium proliferum* union (Lippmaa, 1933; Laasimer, 1946), e.g. *Dicranum scoparium* and *Hylocomium splendens*. But there exist also differences. *Hypnum cupressiforme,* common on the grassland, is not found on the ground in the forest. It is sensitive to the substrate moisture conditions, and in the forest it grows on the boulders or tree trunks. *Pleurozium schreberi* is rarely found on the grassland (according to our data it is a rare species with constancy less than 5 %). This group is better to be considered as a separate community, not as a fragment of the above named union. Further studies are needed to describe the structure of the community and its different development stages.

On Abruka Island Lippmaa (1940) has described the *Stereodon-Camptothecium-Thuidium* union, which is distributed on the limestone covered with glacial and postglacial deposits, such as loam, sand, gravel, stones and erratic blocks. Albertson (1950) has mentioned the *Camptothecium lutescens-Thuidium abietinum* union on the gravelly deposits in calcium-rich places. *Camptothecium* synusia are described also on chalk grasslands. Van Harperen (1972), who studied Dutch chalk grasslands, has mentioned the occurrence of *Camptothecium* synusia on the driest spots with highly calcareous soil, mainly on open grassland, but also occasionally below shrubs. In the present data this community is not represented well enough to be distinguished, although strong positive association is found between *Homalothecium lutescens* and *Thuidium abietinum*.

It may be concluded that the method used separates well two bryophyte groups, which can be distinguished also by ecological preferences. Obviously it is possible to find one more - dominated by *Homalothecium lutescens* and *Thuidium abietinum*, but this is not represented well enough in the present dataset to be distinguished with the interspecific association analysis.

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Bryophytes on small islands in four nature reserves of Estonia

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Abstract: The bryophyte flora on the small islands of four nature reserves off the coast of Estonia (total area of islands about 32 km^2) contains 246 species (37 liverworts, 209 mosses), i e. 48% of Estonian bryophyte flora. Of these 166 have been found on the small islands of the Vilsandi National Park, 126 species on the islets of the Hiiumaa Islets Landscape Reserve (West-Estonian Archipelago), 146 species in the Naissaar Nature Park and 109 species on the islets of the Kolga Bay Islets Reserve (islands of the Gulf of Finland). 27 species found on the four nature reserves are rare or very rare in Estonia.

Kokkuvõte: L. Kannukene. Nelja Eesti looduskaitseala väikesaarte samblad.

Eesti väikesaarte samblafloora on liigirikas. Nelja kaitseala koosseisu jäävatelt väikesaartelt (kogupindala ca 32 km^2) on leitud 246 liiki (37 helvik- ja 209 lehtsamblaliiki) ehk 48 % Eesti samblaliikidest. Nendest 27 liiki kuuluvad Eestis haruldaste ja väga haruldaste samblaliikide hulka. Vilsandi rahvuspargi saartelt on teada 166, Hiiumaa laidude maastike kaitseala laidudelt 125, Naissaare looduspargist 146 ja Kolga lahe laidude kaitseala laidudelt 109 samblaliiki.

INTRODUCTION

The bryophyte flora on the small islands (area less than 40 km^2) of four nature reserves off the coast of Estonia (Fig. 1) was investigated. The Vilsandi National Park (VNP) on the western coast of Saaremaa Island includes about 160 small islands and islets (area less than 5 km^2) and has a total area of 12.9 km^2. The largest of the islands is Vilsandi (8.75 km^2). The Hiiumaa Islets Landscape Reserve (HILR), SE from Hiiumaa Island, includes 16 islets. The largest of them are Saarnaki (1.5 km^2) and Hanikatsi (0.9 km^2). The Naissaar Nature

Fig. 1. Map of study sites.

Park (NNP), about 9 km NW of Tallinn, is 18.6 km^2 in area. Ten small islets belong to the Kolga Bay Islets Reserve (KBIR), approximately 60 km E of Tallinn. The largest islets are Rammu (1.0 km^2), Pedassaar (0.9 km^2) and Koipse (0.3 km^2) (Loopmann, 1982).

The West-Estonian small islands are characterised by outcrops of Silurian and Ordovician limestone. The layer of Quaternary deposits is sometimes very thin. The soils are rich in carbonates. Naissaar Island and Kolga Bay islets, belonging to the landscape region of the North-Estonian coastal lowland, are different from the West-Estonian islands. The bedrock is non-calcareous, the surronding sea is deeper, and the climate is more continental than on the western islands (Ratas et al., 1995).

The moss flora of the small islands of the Vilsandi National Park (Vilsandi and Vesiloo islands, Ülemine Vaika and Alumine Vaika, Kalarahu and Matu islets) has been studied since 1981 by Kannukene (1981, 1984, 1988a, 1988b, Vilsandi püsivaatlusalade ... 1991, 1993), by Tamm in 1979–1981 and by Leis in 1985, and the liverworts flora was studied by Krall in 1990 (Ingerpuu et al., 1994). The bryoflora of Saarnaki, Hanikatsi, Palgirahu, Kajakarahu and Säinarahu islets, belonging to the Hiiumaa Islets Landscape Reserve, was explored in 1987–1992. The bryofloristical studies on the islets of the Kolga Bay Islets Reserve (Rammu, Koipse, Pedassaar, Rohusi, Allu, Põhja- and Lõuna-Malusi and Vahekaare) were carried out in 1991–1992 (Kannukene, 1993; Ratas et al., 1995) and on Naissaar Island in 1993. In 1995 Leis and Vellak visited Naissaar Island. In the list, the species found by them as new for Naissaar Island, are marked with an asterisk (*).

The liverworts (ca 100 specimens) were identified by Ingerpuu and Krall and are kept in the Herbarium of the Institute of Zoology and Botany (TAA). The mosses (ca 2400 specimens) are stored in the Herbarium of the Tallinn Botanical Garden (TBA) and in the Herbarium of the Estonian Nature Museum (TAL).

Earlier published data (Russow, 1864; Malta, 1933; Lippmaa, 1935; Häyrén, 1936/1937) are also included in the list below. The species, recorded only in the first half of this century, are marked by **. Nomenclature follows Ingerpuu et al. (1994).

LIST OF BRYOPHYTES

MARCHANTIOPSIDA

AYTONIACEAE

REBOULIA HEMISPHAERICA (L.) Raddi – VNP

MARCHANTIACEAE

MARCHANTIA POLYMORPHA L. – HILR; NNP

PREISSIA QUADRATA (Scop.) Nees – VNP

METZGERIACEAE

METZGERIA FURGATA (L.) Dum. – VNP; HILR

PELLIACEAE (PELLIALISED)

PELLIA EPIPHYLLA (L.) Corda – NNP

P. NEESIANA (Gott.) Limpr. – NNP

LOPHOZIACEAE

BARBILOPHOZIA ATTENUATA (Mårt.) Loeske – NNP

B. BARBATA (Schmid.) Loeske – VNP; HILR; NNP; KBIR

B. HATCHERI (Evans) Loeske – KBIR

B. LYCOPODIOIDES (Wallr.) Loeske – HILR; *NNP

LOPHOZIA BICRENATA (Schmid. ex Hoffm.) Dum. – KBIR

L. EXISA (Dicks.) Dum. – NNP

L. INCISA (Schrad.) Dum. – *NNP

L. VENTRICOSA (Dicks.) Dum. – NNP; KBIR

TRITOMARIA EXSECTIFORMIS (Breidl.) Loeske – *NNP

PLAGIOCHILACEAE

PLAGIOCHILA ASPLENIOIDES (L. emend. Tayl.) Dum. – NNP

GEOCALYACEAE

CHILOSCYPHUS PALLESCENS (Ehrh. ex Hoffm.) Dum. – NNP

LOPHOCOLEA BIDENTATA (L.) Dum. – VNP; HILR; KBIR

L. HETEROPHYLLA (Schrad.) Dum. – VNP; NNP; KBIR

L. MINOR Nees – VNP; HILR

CEPHALOZIELLACEAE

CEPHALOZIELLA HAMPEANA (Nees) Schiffn. – HILR

C. DIVARICATA (Sm.) Schiffn. – KBIR

CEPHALOZIACEAE

CEPHALOZIA BICUSPIDATA (L.) Dum. – NNP

C. LUNULIFOLIA (Dum.) Dum. – *NNP

NOWELLIA CURVIFOLIA (Dicks.) Mitt. – VNP; NNP

LEPIDOZIACEAE

BAZZANIA TRILOBATA (L.) S. Grey – NNP

LEPIDOZIA REPTANS (L.) Dum. – NNP

CALYPOGEIACEAE

CALYPOGEIA INTEGRISTIPULA Steph. – NNP

Scapaniaceae

Scapania calcicola (H. Arn. & J. Persss.) Ingham. – VNP

S. irrigua (Nees) Nees – *NNP

S. lingulata Buch – VNP

Pseudolepicoleaceae

Blepharostoma trichophylla (L.) Dum. – *NNP

Ptilidiacea

Ptilidium ciliare (L.) Hampe – VNP; HILR; NNP; KBIR

P. pulcherrimum (G. Veb.) Vaino – VNP; HILR; NNP; KBIR

Radulaceae

Radula complanata (L.) Dum. – VNP; HILR; NNP**;** KBIR

Porellaceae

Porella cordeana (Hüb.) Moore – VNP; HILR

P. platyphylla (L.) Pfeiff. – VNP

Bryopsida

Sphagnaceae

S. capillifolium (Ehrh.) Hedw. – NNP*;* KBIR

S. cuspidatum Ehrh. ex Hoffm. – NNP

S. fallax (Klinggr.) Klinggr. – NNP

S. fimbriatum Wils. – KBIR

S. flexuosum Dozy & Molk. – NNP; KBIR

S. fuscum (Schimp.) Klinggr. – NNP

S. girgensohnii Russ. – VNP; NNP

S. imbricatum Hornsch. ex Russ. – KBIR

S. magellanicum Brid. – NNP; KBIR

S..palustre L. – NNP; KBIR

S. riparium Ångstr. – *NNP

S. rubellum Wils. – NNP; KBIR

S. subnitens Russ. – KBIR

S. squarrosum Crome – *NNP; KBIR

S. teres (Schimp.) Ångstr. – KBIR

Andreaeaceae

Andreaea rupestris Hedw. – NNP

Tetraphidaceae

Tetraphis pellucida Hedw. – NNP; KBIR

Polytrichaceae

Atrichum tenellum (Röhl.) B. & S. – VNP

A. undulatum (Hedw.) P. Beauv. – VNP; NNP

Polytrichum commune Hedw. – VNP; HILR; NNP; KBIR

var. perigonale (Michx.) Hampe – NNP; KBIR

P. formosum Hedw. – VNP; NNP; KBIR

P. longisetum Sw. ex Brid. – **VNP; HILR; NNP; KBIR

P. juniperinum Hedw. – VNP; HILR; NNP; KBIR

P. piliferum Hedw. – VNP; NNP; KBIR

P. strictum Brid. – VNP; NNP; KBIR

Fissidentaceae

Fissidens adianthoides Hedw. – VNP; HILR; NNP

F. gracilifolius Brugg.-Nann. – VNP

F. dubius P. Beauv. – VNP**;** HILR;

var. mucronatus (Limpr.) Waldh. – VNP**;** HILR

F. exilis Hedw. – VNP

F. pusillus (Wils.) Milde – HILR

F. taxifolius Hedw. – VNP; HILR

Dicranaceae

Ceratodon purpureus (Hedw.) Brid. – VNP; HILR; NNP; KBIR

Cynodontium strumiferum (Hedw.) Lindb. – VNP; NNP

Dicranella cerviculata (Hedw.**)** Schimp. – NNP

Dicranum bonjeanii De Not. – VNP**;** HILR; KBIR

D. brevifolium (Lindb.) Lindb. – VNP; HILR

D. drummondii C. Müll. – NNP; KBIR

D. flagellare Hedw. – NNP

D. fuscescens Sm. – NNP; KBIR

D. majus Sm. – NNP

D. montanum Hedw. – VNP; HILR; NNP; KBIR

var. truncicolum (De Not.) Podp. – VNP; NNP

D. scoparium Hedw. – VNP; HILR; NNP; KBIR

var. orthophyllum (Brid.) Mönkem. – VNP; KBIR

D. spurium Hedw. – NNP; KBIR

D. polysetum Sw. – VNP; NNP; KBIR

Distichum capillaceum (Hedw.) B., S. & G. – VNP; NNP

D. inclinatum (Hedw.) B,.S. & G. – **VNP

Ditrichum flexicaule (Schwaegr.) Hampe – VNP; HILR; NNP

Leucobryum glaucum (Hedw.) Ångstr. – VNP

Paraleucobryum longifolium (Hedw.) Loeske – VNP; HILR; NNP

Encalyptaceae

Encalypta rhabtocarpa Schwaegr. – VNP

E. streptocarpa Hedw. – VNP; HILR; NNP

E. vulgaris Hedw. – VNP

Pottiaceae

Barbula convoluta Hedw. – VNP; HILR; NNP; KBIR

B. unguiculata Hedw. – VNP; KBIR

Bryoerythrophyllum recurvirostre (Hedw.) Chen – VNP; NNP

Desmatodon heimii – VNP; HILR; KBIR

Didymodon fallax (Hedw.) Zander – VNP; HILR

D. insulanus (De Not.) M. Hill. – VNP; KBIR

D. rigidulus Hedw. – VNP; NNP; KBIR

Gymnostomum calcareum Nees & Hornsch. –

VNP
Phascum cuspidatum Hedw. – VNP
Pottia bryoides (Dicks.) Mitt. – VNP
P. davalliana (Sm.) C. Jens. – VNP
P. intermedia (Turn.) Fürnr. – VNP
Pseudocrossidium hornschuchianum (K. F. Schultz) Zander - VNP; HILR
Tortella fragilis (Drumm.) Limpr. – VNP; HILR
T. inclinata (Hedw. f.) Limpr. – VNP; HILR
T. tortuosa (Hedw.) Limpr. – VNP; HILR
Tortula muralis Hedw. – VNP; HILR; NNP; KBIR
T. ruraliformis (Besch.) Grout – VNP; HILR
T. ruralis (Hedw.) Gaertn., Meyer & Schreb – VNP; HILR; NNP; KBIR
var. calcicola Grebe – VNP; NNP
T. subulata Hedw. – VNP; HILR
Weissia brachycarpa (Nees & Hornsch.) Jur. – VNP
W. controversa Hedw. – VNP

Grimmiaceae

Grimmia pulvinata (Hedw.) Smith – VNP; NNR
G. trichophylla Grev. – VNP; HILR; NNP; KBIR
Racomitrium canescens (Hedw.) Brid. – VNP; NNP; KBIR
R. elongatum Frish. – NNP
R. ericoides (Hedw.) Brid. – KBIR
R. heterostichum (Hedw.) Brid. – VNP; NNP; KBIR
R. lanuginosum (Hedw.) Brid. – NNP
R. microcarpon (Hedw.) Brid. – NNP; HILR; KBIR
Schistidium apocarpum (Hedw.) B. & S. – VNP; HILR; NNP; KBIR
S. maritimum (Turn.) B. & S. – KBIR
S. strictum (Turn.) Loeske &, Mårt. – VNP; NNP
S. rivulare *var.* latifolium (J. E. Zett.) Crum & Anders. – KBIR

Seligeriaceae

Seligeria recurvata (Hedw.) B., S. & G. – HILR

Funariaceae

Funaria hygrometrica Hedw. – VNP; HILR; NNP; KBIR
Physcomitrium pyriforme (Hedw.) Brid. – **VNP

Bryaceae

Bryum algovicum Sendt. ex C. Müll. – VNP; HILR; NNP
Bryum argenteum Hedw. – VNP; NNP; KBIR
B. blindii B., S. & G. – VNP
B. caespiticum Hedw. - VNP; HILR; NNP; KBIR
B. capillare Hedw. – VNP; HILR; NNP
B. imbricatum (Schwaegr.) B. & S. – KBIR
B. intermedium (Brid.) Bland. – **VNP; NNP
Bryum pallescens Schleich. ex Schwaegr. – NNP; KBLR
B. pallens Sw. – VNP; HILR; NNP
B. pseudotriquetrum (Hedw.) Gaertn., Meyer & Schreb. – VNP; HILR; NNP; KBIR
B. uliginosum Brid., B. & G. – NNP
B. warneum Bland. – VNP
Leptobryum pyriforme (Hedw.) Wils. – VNP; *NNP; KBIR
Pohlia cruda (Hedw.) Lindb. – HILR
P. nutans (Hedw.) Lindb. – VNP; NNP; KBIR.
var. longiseta (Brid.) Delog. – **VNP; KBIR
Rhodobryum ontariense (Kindb.) Kindb. – VNP; HILR
R. roseum (Hedw.) Limpr. – VNP; HILR; NNP

Mniaceae

Mnium hornum Hedw. – VNP; HILR; NNP; KBIR
M. stellare Hedw. – HILR; NNP; KBIR
Plagiomnium affine (Bland.) T. Kop. – VNP; HILR; NNP**;** KBIR
P. cuspidatum (Hedw.) T. Kop. – VNP**;** HILR; NNP; KBIR
P. elatum (B. & S.) T. Kop. – VNP; HILR; NNP
P. ellipticum (Brid.) T. Kop. – VNP; HILR; NNP
P. medium (B. & S.) T. Kop. – VNP
P. undalatum (Hedw.) T. Kop. – VNP; NNP; KBIR
Rhizomnium punctatum (Hedw.) T. Kop. – HILR; NNP; KBIR

Aulacomniaceae

Aulacomnium androgynum (Hedw.) Schwaegr. – VNP; NNP
A. palustre (Hedw.) Schwaegr. – VNP; HILR; NNP; KBIR

Bartramiaceae

Philonotis fontana (Hedw.) Brid. – HILR

Orthotrichaceae

Orthotrichum affine Brid. – VNP; HILR; NNP; KBIR
O. anomalum Hedw. – VNP; HILR; NNP; KBIR
O. cupulatum Brid. – VNP
O. diaphanum Brid. – KBIR
O. obtusifolium Brid. – NNP
O. pallens Bruch – VNP; HILR; NNP
O. pumilum Sw. – KBIR
O. rupestre Schleich. ex Schwaegr. – VNP; HILR; KBIR
O. speciosum Nees – VNP; HILR; NNP; KBIR
U. coarctata (P. Beauv.) Hammar – VNP

U. crispa (Hedw.) Brid. – HILR; NNP
Zygodon viridissimus (Dicks.) Brid. – VNP
Hedwigiaceae
Hedwigia ciliata (Hedw.) P. Beauv. – VNP; HILR; NNP; KBIR
Climaciaceae
Climacium dendroides (Hedw.) Wils. & Mohr – VNP; HILR; NNP; KBIR
Leucodontaceae
Antitrichia curtipendula (Hedw.) Brid. – **VNP; HILR
Leucodon sciuroides (Hedw.) Schwaegr. – VNP; HILR; NNP
Pterogonium gracile (Hedw.) Sm. – HILR
Neckeraceae
Neckera crispa Hedw. – VNP
Theliaceae
Myurella julacea (Schwaegr.) B., S. & G. – VNP
Leskeaceae
Pseudoleskeella nervosa (Brid.) Nyh. – VNP; HILR
Pterigynandrum filiforme Hedw. – HILR
Thuidiaceae
Anomodon longifolius (Brid.) Hartm. – VNP; HILR
Helodium blandowii (Web. & Mohr) Warnst. – KBIR
Thuidium abietinum (Hedw.) B., S. & G. – VNP**;** HILR; NNP**;** KBIR
T. delicatulum (Hedw.) Mitt. – VNP
T. philibertii Limpr. – VNP; HILR
T. recognitum (Hedw.) Lindb. – VNP
Amblystegiaceae
Amblystegium compactum (C. Müll.) Aust. – **VNP
A. serpens (Hedw.) B., S. & G. – VNP; HILR; NNP; KBIR
var. juratzkanum (Schimp.) Rau & Herv. – VNP; NNP; KBIR
A. subtile (Hedw.) B., S. & G. – VNP
A. riparium (Hedw.) B., S. & G. – HILR; NNP; KBIR
A. varium (Hedw.) Lindb. – VNP; NNP
Calliergon cordifolium (Hedw.) Kindb. – NNP*;* KBIR
C. giganteum (Schimp.) Kindb. – HILR; KBIR
C. stramineum (Brid.) Kindb. – KBIR
Calliergonella cuspidate (Hedw.) Loeske – VNP; HILR; NNP; KBIR
Campylium chrysophyllum (Brid.) Lange – VNP; HILR
C. elodes (Lindb.) Kindb. – VNP; HILR
C. polygamum (B., S. & G.) J. Lange & C. Jens. – VNP; HILR
C. sommerfeltii (Myr.) J. Lange – VNP; HILR
C. stellatum (Hedw.) J. Lange – VNP; HILR; NNP; KBLR
var. protensum (Brid.) Bryhn ex Grout – VNP; HILR
Cratoneuron filicinum (Hedw.) Spruce – VNP; HILR;–NNP
Drepanocladus aduncus (Hedw.) Warnst. – VNP; HILR; KBIR
D. cossoni (Schimp.) Loeske – VNP; HILR
D. lycopodioides (Brid.) Warnst. – VNP; HILR
D. sendtneri (Schimp. ex C. Müll.) Warnst. – VNP; HILR
Sanionia uncinata (Hedw.) Loeske – VNP; HILR; NNP; KBIR
Palustriella commutata (Hedw.) Ochyra – HILR
Scorpidium scorpidioides (Hedw.) Limpr. – VNP; HILR
S. turgescens (T. Jens.) Loeske – VNP; HILR
Warnstorfia exannulata (B., S. & G.) Loeske – VNP; HILR; NNP; KBIR
W. fluitans (Hedw.) Loeske – VNP; HILR; NNP; KBIR
Brachytheciaceae
Brachythecium albicans (Hedw.) B., S. & G. – VNP; HILR; NNP; KBIR
B. erythrorrhizon B., S. & G. – VNP; NNP
B. glareosum (Spruce) B., S. & G. – VNP; HILR
B. mildeanum (Schimp.) Schimp. – NNP; KBIR
B. oedipodium (Mitt.) Jaeg. – VNP; NNP; KBIR
B. populeum (Hedw.) B., S. & G. - VNP; HILR; NNP; KBIR
B. reflexum (Starke) B., S. & G. – HILR; NNP; KBIR
B. rivulare B., S. & G. – NNP
B. rutabulum (Hedw.) B., S. & G. – VNP; HILR; NNP; KBIR
B. salebrosum (Web. & Mohr) B., S. & G. – VNP; HILR; NNP; KBIR
B. starkei (Brid.) B., S. & G. – VNP; NNP
B. velutinum (Hedw.) B., S. & G. – VNP; HILR; NNP; KBIR
Cirriphyllum piliferum (Hedw.) Grout – VNP; NNP; KBIR
Eurhynchium angustirete (Broth.) T. Kop. – NNP; KBIR
E. praelongum (Hedw.) B., S. & G. – VNP
E. pulchellum (Hedw.) Jenn. – VNP; HILR
Homalothecium lutescens (Hedw.) Robins. –

VNP; HILR
H. SERICEUM (Hedw.) B., S. & G. – VNP;, HILR; NNP; KBIR
ISOTHECIUM ALOPECURIOIDES (Dubois) Isov. – NNP
SCLEROPODIUM PURUM (Hedw.) Limpr. – VNP; HILR

PLAGIOTHECIACEAE

HERZOGIELLA SELIGERI (Brid.) Iwats. – VNP; HILR; NNP; KBIR
PLAGIOTHECIUM CAVIFOLIUM (Brid.) Iwats. – NNP
P. CURVIFOLIUM Schlieph. – VNP; NNP; KBIR
P. DENTICULATUM B., S. & G. – VNF; HILR; NNP; KBIR
P. LAETUM B., S. & G. – VNP; NNP; KBIR
P. SUCCULENTUM (Wils.) Lindb. – VNP; KBIR

SEMATOPHYLLASCEAE

CALLICLADIUM HALDANIANUM (Grev.) Crum – VNP

HYPNACEAE

CTENIDIUM MOLLUSCUM (Hedw.) Mitt. – VNP
HYLOCOMIUM SPLENDENS (Hedw.) B., S. & G. – VNP; HILR; NNP; KBIR
HYPNUM CUPRESSIFORME Hedw. – VNP; HILR; NNP; KBIR
var. FILIFORME Brid. – VNP; HILR; NNP; KBIR
var. LACUNOSUM Brid. – VNP
H. PALLESCENS (Hedw.) P. Beauv. – VNP; KBIR
PLATYGYRIUM REPENS (Brid.) B., S. & G. – NNP
PLEUROZIUM SCHREBERI (Brid.) Mitt. – VNP, HILR; NNP; KBIR
PTILIUM CRISTA-CASTRENSIS (Hedw.) De Not. – NNP; KBIR
PYLAISIA POLYANTHA (Hedw.) Schimp. – VNP; NNP; KBIR
RHYTIDIADELPHUS SUBPINNATUS (Lindb.) T. Kop. – VNP
R. SQUARROSUS (Hedw.) Warnst. – VNP; HILR; NNP; KBIR
R. TRIQUETRUS (Hedw.) Warnst. – VNP; HILR; NNP; KBIR

SUMMARY

The small islands of four Estonian nature reserves are characterised by 246 bryophyte species (37 liverworts and 209 mosses), i.e. 48 % of Estonian bryophyte flora. Of them 166 species (15 liverworts, 151 mosses) have been found on small islands belonging to the Vilsandi National Park, 126 species (12 liverworts, 104 mosses) on islands of the Hiiumaa Islets Landscape Reserve, 146 species (24 liverworts, 122 mosses) on the Naissaar Nature Park and 109 species (10 liverworts, 99 mosses) in the Kolga Bay Islets Reserve.

Thirteen of the species reported are very rare for Estonia (1–3 localities): the liverworts *Bazzania trilobata* (NNP, Naissaar) and *Scapania calcicola* (VNP, Vilsandi) and the mosses *Amblystegium compactum, Fissidens gracilifolius*, *Neckera crispa, Pottia bryoides, P. davalliana, Ulota coarctata* (VNP, Vilsandi), *Bryum blindii* (VNP, Kalarahu), *Pseudocrossidium hornschuchianum* (VNP, Vilsandi; HILR, Saarnaki), *Pterogonium gracile* (HILR, Saarnaki), *Orthotrichum diaphanum* (KBIR, Koipse) and *Schistidium maritimum* (KBIR, Rohusi).

Fourteen of the species reported are rare (4–7 localities) in Estonia: the liverworts *Porella platyphylla, Reboulia hemisphaerica, Scapania lingulata* (VNP, Vilsandi), *Cephaloziella divaricata* (KBIR, Pedassaar and Koipse), *C. hampeana* (HILR, Saarnaki) and *Porella cordeana* (VNP, Vilsandi; HILR, Saarnaki) and the mosses *Bryum warneum, Didymodon insulanus*, *Fissidens exilis* (VNP, Vilsandi), *F. pusillus, Seligeria recurvata* (HILR, Hanikatsi)), *Rhodobryum ontariense* (VNP, Vilsandi; HILR, Saarnaki) *Brachythecium starkei* (VNP, Vilsandi; NNP, Naissaar) and *Schistidium rivulare* var. *latifolium* (KBIR, Rammu).

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Lichens of Naissaar Island (Gulf of Finland, Estonia)

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Abstract: This is the first study of the lichen flora of Naissaar Island, situated on the northern coast of Estonia. The materials for the present survey were collected on Naissaar during 1993–1996. The list of lichens found on Naissaar Island includes 165 species; one of them (*Bryoria furcellata*) is new to Estonia. Some lichens collected on the island (*Acarospora veronensis, Cladonia cervicornis, Dimerella pineti, Melanelia stygia, Parmelia omphalodes, Peltigera hymenina, Polychidium muscicola, Rinodina cacuminum, Umbilicaria torrefacta*) are rare in Estonia. *Melanelia hepatizon* was earlier considered to be lost in Estonia. The lichen flora of Naissaar is comparatively rich in species and of special interest due to the occurence of some rare lichens.

Kokkuvõte: T. Randlane, I. Jüriado, J. Martin, L. Martin, E. Nilson ja M. Temina. Naissaare (Soome laht, Eesti) samblikud.

Käesolev ülevaade Naissaare samblikest on esimene selle piirkonna lihhenofloorat käsitlev töö. Uurimuse aluseks on aastatel 1993–1996 kogutud herbaareksemplarid, mida säilitatakse Tartu Ülikooli (TU), Ökoloogia Instituudi (IE) ja Rahvusvahelise Keskkonnabioloogia Keskuse (ICEB) herbaariumites. Esitatakse Naissaare samblike nimekiri; see sisaldab 165 liiki, neist üks (*Bryoria furcellata*) on Eestile uus. Mitmeid Naissaarelt leitud samblikuliike (*Acarospora veronensis, Cladonia cervicornis, Dimerella pineti, Melanelia stygia, Parmelia omphalodes, Peltigera hymenina, Polychidium muscicola, Rinodina cacuminum, Umbilicaria torrefacta*) on Eestis varem kogutud vaid mõnel korral. Viimastest on huvipakkuvaim *Melanelia hepatizon*, mida eelnevalt oli meie alal teada vaid ühest leiukohast käesoleva sajandi alguses ning mida seni peeti Eesti lihhenofloorast hävinuks. Naissaare lihhenofloorat võib hinnata suhteliselt liigirikkaks, see pakub huvi haruldaste samblike ja mitmete Lääne- ja Loode-Eestile iseloomulike liikide esinemise poolest.

INTRODUCTION

The island of Naissaar (*Nargen* in German, *Nargö* in Swedish), with an area of 18,6 km^2, is situated in the Gulf of Finland, on the northern coast of Estonia (59'N 24'E), about 9 km NW of Tallinn (Fig. 1 on p. 13); administratively it belongs to the municipality of Viimsi, Harjumaa County. The island has been botanically poorly investigated except for the last few years: due to the presence of a Soviet military base on the island it has been closed to visitors and also to the scientific research for the last 50 years. Lichenologically it has been studied only very occasionally before the Soviet period. Räsänen (1931) in his synopsis of Estonian lichens mentions six species which have been collected on Naissaar. These species are (original nomenclature by Räsänen in brackets): *Bryoria capillaris (Alectoria implexa), Evernia divaricata (Letharia divaricata), Hypogymnia physodes (Parmelia physodes), Parmelia saxatilis, Ramalina thrausta* and *R. farinacea (R. f.* var. *normalis)*. Räsänen did not visit the island himself, the collectors were according to him P. Wasmuth and W. Sokolow. Most of the specimens cited by Räsänen are kept in Tartu (TU), besides a few specimens collected there in 1938 by H. Aasamaa. The species that were verified from the earlier herbarium materials are also included in the present list.

The present paper is the first special review of the lichen flora of Naissaar Island.

MATERIAL AND METHODS

The materials for the present survey were collected on Naissaar by E. Nilson in June and August 1993 (in IE), by I. Jüriado, T. Randlane, A. Roosma and A. Saag in August 1995 (in TU) and by J. Martin, L. Martin and M. Temina

during the summer of 1996 (in ICEB). Lichens were collected from different substrata in various habitats throughout the island; a transect with ecological analyses through the central part of the island was also carried out by E. Nilson. The taxa were identified using the routine morphological, anatomical and chemical methods [incl. hand-made cross-sections of fruit-bodies and colour tests with 10% KOH, sodium hypochlorite and p-phenylenediamine in ethanol].

RESULTS

A total of 165 lichen species and two subspecies have been identified on Naissaar Island. A comparison with numbers of lichen species found on other Estonian islands of medium size (Kassari – 105, Ruhnu – 115, Osmussaar – 143) (Randlane, 1993; Randlane & Jüriado, in press) allows us to evaluate the lichen flora of Naissaar as comparatively rich in species. This is due to the great variation in habitats: coniferous and mixed forests, wooded meadows, sand dunes, both siliceous boulders (but not bedrock outcrops) and calcareous substrata are all present on the island. The ruins of several houses and old military buildings also serve as suitable localities for lichens.

The majority of lichen species found on Naissaar are common inhabitants of Estonia. Still, a number of species, e.g. *Caloplaca scopularis, Cladonia cervicornis, Flavocetraria nivalis, Parmelia omphalodes, Polychidium muscicola, Tremolecia atrata, Umbilicaria torrefacta* are characteristic of the north-western area or western islands of Estonia only and most of these species are rare even there. In addition, some lichens collected on Naissaar are of special interest. *Bryoria furcellata* is new to Estonia; *Melanelia hepatizon* has been found in Estonia earlier only once – at the beginning of this century in Tallinn by Paul Wasmuth and this locality is considered to be destroyed (Trass & Randlane, 1994); *Acarospora veronensis, Dimerella pineti, Melanelia stygia, Peltigera hymenina, Rinodina cacuminum* have been collected in few localities in Estonia.

In conclusion, the lichen flora of the Island of Naissaar can be treated as rich in taxa and interesting due to several rare in Estonia species.

List of species

The following list is presented in alphabetical order. In nomenclature of macrolichens Trass and Randlane (1994) and in that of microlichens Santesson (1993) is mainly followed. The substrata are mentioned for each species; the exact localities on the island are presented only in a few occasions – for rare species (less than 10 localities in Estonia). For the latter purpose the main quarter of the compass is mentioned at first; the forest squares arrangement are according to the latest map, prepared in 1994. The herbaria where the specimens are kept are the following:

- International Center for Environmental Biology (ICEB), Tallinn;
- Institute of Ecology (IE), Tallinn;
- Institute of Botany & Ecology, University of Tartu (TU).

1. Acarospora fuscata (Schrad.) Th. Fr. – SW coast, forest sq. no. 212, on siliceous boulder (ICEB).
2. Anaptychia ciliaris (L.) Körb. – on *Populus tremula* (IE, TU).
3. Aspicilia cinerea (L.) Körb. – on a big siliceous rock (IE, TU).
4. Baeomyces rufus (Huds.) Rebent. – dunes, on sand (IE).
5. Bryoria capillaris (Ach.) Brodo & D. Hawksw. – on *Picea abies,* on *Betula pendula*, on a fallen birch (ICEB, IE, TU).
6. **B. furcellata** (Fr.) Brodo & D. Hawksw. – N, forest sq. no. 199, on a trunk of *Pinus sylvestris* (ICEB). New to Estonia.
7. B. fuscescens (Gyeln.) Brodo & D. Hawksw. – on *Betula pendula* and *Picea abies* (ICEB, IE, TU).
8. B. nadvornikiana (Gyeln.) Brodo & D. Hawksw. – on dry lower branches of *Pinus sylvestris*, on branches of *Picea abies*, on siliceous boulders (ICEB, TU).
9. B. subcana (Nyl. ex Stizenb.) Brodo & D. Hawksw. – on *Pinus sylvestris*, *Picea abies*, *Betula pendula* (ICEB, TU).
10. Buellia punctata (Hoffm.) A. Massal. – on twig of a dead *Sorbus aucuparia,* on a dead tree (IE, TU).
11. B. schaereri De Not. – S, on a dead tree (TU).
12. Calicium glaucellum Ach. – on wood (TU).

13. C. QUERCINUM Pers. – an old stump, on wood (TU).
14. C. VIRIDE Pers. – on trunks of *Betula pendula, Picea abies* and *Acer platanoides*, on a dead *Sorbus aucuparia* and on a fallen *Betula pendula* (ICEB, IE, TU).
15. CALOPLACA CERINA (Ehrh. ex Hedw.) Th. Fr. – on *Populus tremula* (IE, TU).
16. C. CITRINA (Hoffm.) Th. Fr. – on calcareous rock on shore (TU).
17. C. FLAVORUBESCENS (Huds.) J. R. Laundon – on *Populus tremula* (IE, TU).
18. C. SAXICOLA (Hoffm.) Nordin – on siliceous boulder, on calcareous rock on shore (TU).
19. C. SCOPULARIS (Nyl.) Lett. – on siliceous boulder on shore (TU).
20. CANDELARIELLA AURELLA (Hoffm.) Zahlbr. – on basement of an old house, on mortar, in an old heap of roof cover (TU).
21. C. CORALLIZA (Nyl.) H. Magn. – on siliceous boulder (TU).
22. C. VITELLINA (Hoffm.) Müll. Arg. – on wood, on a brick in the heap, on siliceous rock (ICEB, TU).
23. C. XANTHOSTIGMA (Ach.) Lettau – on *Acer platanoides* (TU).
24. CETRARIA ACULEATA (Schreb.) Fr. – on sand dunes (ICEB, IE, TU).
25. C. ERICETORUM Opiz – on sand (ICEB, IE, TU).
26. C. ISLANDICA (L.) Ach. *ssp.* ISLANDICA – on sand dunes, on soil in pine forest (ICEB, IE, TU).
27. C. MURICATA (Ach.) Eckfelt – on sand (ICEB, IE, TU).
28. CHAENOTHECA CHRYSOCEPHALA (Turner ex Ach.) Th. Fr. – on *Betula pendula*, *Picea abies* (ICEB, IE, TU).
29. C. FERRUGINEA (Turner ex Ach.) Mig. – on trunks of *Pinus sylvestris* (IE).
30. C. FURFURACEA (L.) Tibell – on trunk of *Tilia cordata* (ICEB).
31. CLADINA ARBUSCULA (Wallr.) Hale & W. Culb. – pine forest and heath, on ground and on sand (ICEB, IE, TU).
32. C. MITIS (Sandst.) Hustich – heath, on sand (IE, TU).
33. C. RANGIFERINA (L.) Nyl. – pine forest, on soil and on sand (ICEB, IE, TU).
34. C. STELLARIS (Opiz) Brodo – pine forest and heath, on soil and on sand (ICEB, IE, TU).
35. CLADONIA BACILLARIS Nyl. – on sand, on an old stump, on wood (ICEB, IE, TU).
36. C. BOREALIS S. Stenroos – heath, on ground (TU).
37. C. BOTRYTES (K. G. Hagen) Willd. – on a stump (IE, TU).
38. C. CENOTEA (Ach.) Schaer. – on old wood, on a stump and on ground (IE, TU).
39. C. CERVICORNIS (Ach.) Flot. – heath, on ground (TU).
40. C. CHLOROPHAEA (Flörke ex Sommerf.) Spreng. – leg. H. Aasamaa 1938 (TU); on soil, on basement of an old house covered with mosses (IE, TU).
41. C. CONIOCRAEA (Flörke) Spreng. – on foot of *Pinus sylvestris*, on foot and stump of *Picea abies*, on decaying wood, on basement of an old house covered with mosses (ICEB, IE, TU).
42. C. CORNUTA (L.) Hoffm. – on soil, on an old stump, on sand (ICEB, IE, TU).
43. C. CRISPATA (Ach.) Flot. – pine forest, on old wood and on ground (IE, TU).
44. C. DEFORMIS (L.) Hoffm. – pine forest, on sand (ICEB, IE).
45. C. DIGITATA (L.) Hoffm. – on foot of an old *Pinus sylvestris,* on old wood (ICEB, IE, TU).
46. C. FIMBRIATA (L.) Fr. – on soil (IE, TU).
47. C. FLOERKEANA (Fr.) Flörke – on sand and mosses (ICEB, IE, TU).
48. C. FURCATA (Huds.) Schrad. – on sandy soil and on an old stump (ICEB, IE, TU).
49. C. GRACILIS (L.) Willd. *ssp.* GRACILIS – on soil (ICEB, IE, TU).
    C. G. *ssp.* TURBINATA (Ach.) Ahti – on sand dunes (TU).
50. C. INCRASSATA Flörke – on driftwood and sand (ICEB).
51. C. PHYLLOPHORA Hoffm. – pine forest and heath, on sand (ICEB, TU).
52. C. PYXIDATA (L.) Hoffm. – on old pieces of concrete (IE, TU).
53. C. SCABRIUSCULA (Delise in Duby) Nyl. – heath forest, on ground; pine forest, on soil between mosses, on a basement covered with mosses (ICEB, IE, TU).
54. C. SQUAMOSA Hoffm. – heath forest, on ground (IE, TU).
55. C. SUBULATA (L.) Weber – on ground and on an old stump (TU).
56. C. SULPHURINA (Michx.) Fr. – on ground and on an old wood (TU).
57. C. UNCIALIS (L.) Weber ex F. H. Wigg. *ssp.* UNCIALIS – heath, on sand (ICEB, IE, TU).

C. u. *ssp.* BIUNCIALIS (Hoffm.) M. Choisy – pine forest, on a stump and on sand (ICEB).

58. C. VERTICILLATA (Hoffm.) Schaer. – pine forest, on sand (ICEB, IE).
59. COLLEMA FUSCOVIRENS (With.) J. R. Laundon – heath, on the top of a concrete fortress (IE).
60. DIMERELLA PINETI (Ach.) Vezda – N coast, on trunk of *Pinus sylvestris* (IE).
61. EVERNIA DIVARICATA (L.) Ach. – on base of *Pinus sylvestris*, 1909, Herb. Wasmuthii (TU).
62. E. PRUNASTRI (L.) Ach. – on *Acer platanoides*, *Alnus glutinosa, Betula pendula, Picea abies, Salix* sp., on a dry *Sorbus aucuparia* (ICEB, IE, TU).
63. FLAVOCETRARIA NIVALIS (L.) Kärnefelt & Thell – on sand (ICEB, IE).
64. HYPOCENOMYCE SCALARIS (Ach.) M. Choisy – on *Betula pendula*, *Pinus sylvestris* (ICEB, IE, TU).
65. HYPOGYMNIA FARINACEA Zopf – in many localities, always on *Pinus sylvestris* (ICEB).
66. HYPOGYMNIA PHYSODES (L.) Nyl. – common all over the island, mainly epiphytic both on coniferous and deciduous trees, but occasionally also on sand dunes and siliceous boulders (ICEB, IE, TU incl. Herb. Wasmuthii).
67. H. TUBULOSA (Schaer.) Hav. – on *Alnus glutinosa, Picea abies*, *Sorbus aucuparia*, on siliceous boulders (ICEB, IE, TU).
68. IMSHAUGIA ALEURITES (Ach.) S. L. F. Meyer – on *Pinus sylvestris*, on decaying wood (ICEB,IE, TU).
69. LASALLIA PUSTULATA (L.) Mérat – pine forest, on siliceous boulder (ICEB).
70. LECANACTIS ABIETINA (Ach.) Körb. – in a few localities (SE, forest sq. no. 238; S, forest sq. no. 237; SW, forest sq. no. 228), always on trunks of old *Picea abies* (ICEB, IE).
71. LECANORA ALBESCENS (Hoffm.) Branth & Rostrup – in an old heap of roof cover, on calcareous rocks on shore (IE, TU).
72. L. ARGENTATA (Ach.) Malme - on *Tilia cordata* (TU).
73. L. CARPINEA (L.) Vain. – on a young *Sorbus aucuparia* (ICEB, IE, TU).
74. L. CENISIA Ach. – on brick in the site of an old house (TU).
75. L. CHLAROTERA Nyl. – on *Sorbus aucuparia*, on a dead tree (TU).
76. L. CRENULATA Hook. – in an old heap of roof cover (TU).
77. L. DISPERSA (Pers.) Sommerf. – on calcareous stones of old fortress, in an old heap of roof cover, on concrete on the basement of an old house, on calcareous rocks (ICEB, IE, TU).
78. L. LEPTYRODES (Nyl.) Degel. - on a dead tree (TU).
79. L. POLYTROPA (Hoffm.) Rabenh. – on siliceous pebbles (TU).
80. L. PULICARIS (Pers.) Ach. – on *Padus avium*, *Pinus sylvestris*, on a dead tree, on wood (IE, TU).
81. L. RUGOSELLA Zahlbr. – on *Populus tremula* (TU).
82. L. SALIGNA (Schrad.) Zahlbr. - on a dead tree (TU).
83. L. SYMMICTA Ach. – on *Betula pendula, Pinus sylvestris*, on wood (ICEB, IE, TU).
84. L. VARIA (Hoffm.) Ach. – on *Pinus sylvestris,* on wood (IE, TU).
85. LECIDEA FUSCOATRA (L.) Ach. - on siliceous rocks (IE).
86. L. LAPICIDA (Ach.) Ach. VAR PANTHERINA Ach. - on siliceous rocks (IE).
87. LECIDELLA ELAEOCHROMA (Ach.) M. Choisy – on *Acer platanoides*, on twigs of a dead *Sorbus aucuparia* (IE, TU).
88. L. STIGMATEA (Ach.) Hertel & Leuckert – in an old heap of roof cover (TU).
89. LEPRARIA INCANA (L.) Ach. s. lat. – widely all over the island, on *Picea abies, Pinus sylvestris,* old stumps, on foot of a dead *Sorbus aucuparia* etc. (ICEB, IE, TU).
90. LOBARIA PULMONARIA (L.) Hoffm. – E, forest sq. no. 211, "Garden of Danish King", on *Tilia cordata* (ICEB).
91. MELANELIA EXASPERATA (De Not.) Essl. – on *Betula pendula*, *Sorbus aucuparia* (ICEB, IE).
92. M. EXASPERATULA (Nyl.) Essl. – on *Pinus sylvestris* (TU).
93. M. FULIGINOSA (Fr. ex Duby) Essl. – on siliceous rocks and on a big siliceous boulder (ICEB, TU).
94. M. HEPATIZON (Ach.) Thell – NE, forest sq. no. 189, near the ruins of old military buildings; forest sq. no. 220, on the territory of storehouse of mines; SE coast, forest sq. no. 232; central part of W coast, always on siliceous boulders (ICEB, IE).
95. M. OLIVACEA (L.) Essl. – on *Betula pendula*

(ICEB, IE).

96. M. SOREDIATA (Ach.) Goward & Ahti – on siliceous rocks (ICEB).
97. M. STYGIA (L.) Essl. – NE, forest sq. no. 187, on siliceous boulder (ICEB).
98. M. SUBARGENTIFERA (Nyl.) Essl. – on *Acer platanoides* (TU).
99. M. SUBAURIFERA (Nyl.) Essl. – on *Acer platanoides, Betula pendula, Rhamnus cathartica* (ICEB, TU).
100. MYCOBLASTUS SANGUINARIUS (L.) Norman – on *Alnus glutinosa, Pinus sylvestris* (ICEB, IE).
101. NEOFUSCELIA PULLA (Ach.) Essl. – on siliceous rock (TU).
102. OCHROLECHIA ANDROGYNA (Hoffm.) Arnold – on a fallen *Betula* (TU).
103. PARMELIA OMPHALODES (L.) Ach. – on siliceous boulders on shore (ICEB, IE).
104. P. SAXATILIS (L.) Ach. – on erratic stones, 1909, Herb. Wasmuthii; in many localities, always on siliceous boulders (ICEB, IE, TU).
105. P. SULCATA Taylor – on *Betula pendula, Picea abies* and on decaying wood (ICEB, IE, TU).
106. PARMELIOPSIS AMBIGUA (Wulfen) Nyl. – on *Betula pendula*, *Pinus sylvestris* and on decaying wood (ICEB, IE, TU).
107. P. HYPEROPTA (Ach.) Arnold – on *Pinus sylvestris* (ICEB, IE, TU).
108. PELTIGERA APHTHOSA (L.) Willd. – on mosses on the ground (ICEB, IE).
109. P. CANINA (L.) Willd. – in many localities all over the island, on mosses and on ground (ICEB, IE, TU).
110. P. DIDACTYLA (With.) J. R. Laundon – on an old fortress, on basement of an old house among mosses (ICEB, IE, TU).
111. P. HYMENINA (Ach.) Delise – E, forest sq. no. 211, "Garden of Danish King", mixed forest, on sandy soil; S, Southern Village, near the big barracks, pine forest, on ground; west from Southern Village, ride of forest sq. no. 50/49, on ground; on foot of *Alnus glutinosa* (IE, TU).
112. P. MEMBRANACEA (Ach.) Nyl. – on ground (TU).
113. P. POLYDACTYLON (Neck.) Hoffm. – on sandy soil among mosses (TU).
114. P. RUFESCENS (Weiss) Humb. – on trunk of *Tilia cordata*, on sandy soil, on sand and pebbles (ICEB, IE, TU).
115. PERTUSARIA AMARA (Ach.) Nyl. – on *Acer platanoides, Pinus sylvestris, Populus tremula, Sorbus aucuparia* (ICEB, IE, TU).
116. P. COCCODES (Ach.) Nyl. – on *Malus sylvestris* (TU).
117. P. LEIOPLACA DC. – on trunk of a young *Sorbus aucuparia* (IE, TU).
118. PHAEOPHYSCIA ORBICULARIS (Neck.) Moberg – on a piece of concrete (TU, IE).
119. P. NIGRICANS (Flörke) Moberg – in an old heap of roof cover (ICEB).
120. PHLYCTIS ARGENA (Spreng.) Flot. – on *Acer platanoides* and *Tilia cordata*, on a dead *Sorbus* (ICEB, IE, TU).
121. PHYSCIA ADSCENDENS (Fr.) H. Olivier – on concrete, on a dead tree, on *Alnus glutinosa* (ICEB, IE, TU).
122. P. AIPOLIA (Ehrh. ex Humb.) Fürnr. – on *Sorbus aucuparia* (IE).
123. P. DUBIA (Hoffm.) Lettau – on *Alnus glutinosa, Sorbus aucuparia*, *Tilia cordata* (ICEB, IE).
124. P. CAESIA (Hoffm.) Fürnr. – on concrete and on siliceous stone on the basement of an old house (IE, TU).
125. P. TENELLA (Scop.) DC. – on *Betula pendula, Populus tremula, Sorbus aucuparia*; on a dead tree (IE, TU).
126. PHYSCONIA DISTORTA (With.) J. R. Laundon – on *Acer platanoides* (TU).
127. P. ENTEROXANTHA (Nyl.) Poelt – on *Acer platanoides* (TU).
128. PLACYNTHIELLA ICMALEA (Ach.) Coppins & P. James – on wood and on soil, on foot of *Pinus sylvestris*, on an old piece of leather on ground (IE, TU).
129. PLACYNTHIUM NIGRUM (Huds.) Gray – on mosses and soil, on calcarous stones of old fortress (ICEB, IE).
130. PLATISMATIA GLAUCA (L.) W. L. Culb. & C. F. Culb. – in many localities all over the island, epiphytic on *Betula pendula, Pinus sylvestris, Picea abies, Tilia cordata* etc. but also on sandy soil and siliceous stones (ICEB, IE, TU).
131. POLYCHIDIUM MUSCICOLA (Sw.) Gray – SW coast, forest sq. no. 212, on mosses (ICEB).
132. PORPIDIA CRUSTULATA (Ach.) Hertel & Knoph - on siliceous stones (IE, TU).
133. PSEUDEVERNIA FURFURACEA (L.) Zopf – in many localities all over the island, epiphytic on *Betula pendula*, *Picea abies* and *Pinus sylvestris*, occasionally also on decaying wood and siliceous boulders (ICEB, IE, TU).
134. RAMALINA FARINACEA (L.) Ach. – on *Alnus glutinosa, Betula pendula, Pinus sylvestris, Salix* sp., *Tilia cordata*, on a dead *Sorbus* sp.

(ICEB, IE, TU incl. Herb. Wasmuthii).

135. R. FASTIGIATA (Pers.) Ach. – on *Acer platanoides, Betula pendula, Sorbus aucuparia* (IE, TU).
136. R. FRAXINEA (L.) Ach. – on *Acer platanoides*, *Sorbus aucuparia* (ICEB, IE, TU).
137. R. THRAUSTA (Ach.) Nyl. – on *Picea abies*, leg. W. Sokolow 1908, Herb. Wasmuthii (TU).
138. RHIZOCARPON GEOGRAPHICUM (L.) DC. – on siliceous boulders (IE, TU).
139. R. DISTINCTUM Th. Fr. – on siliceous boulders (ICEB).
140. R. OBSCURATUM (Ach.) A. Massal. – on siliceous boulder, on old bricks, on granite pebbles (TU).
141. RINODINA CACUMINUM (Th. Fr.) Malme – S, sandy shore, on granite pebbles (TU).
142. SCOLICIOSPORUM CHLOROCOCCUM (Graewe ex Stenh.) Vezda – on several trees of *Pinus sylvestris* (IE).
143. STEREOCAULON CONDENSATUM Hoffm. – sand dunes, on sand (IE).
144. S. DACTYLOPHYLLUM Flörke – on siliceous boulders (IE).
145. S. TOMENTOSUM Fr. – on soil, on sand and on old bricks (IE, TU).
146. TEPHROMELA ATRA (Huds.) Hafellner – on siliceous rock (IE, TU).
147. TRAPELIOPSIS FLEXUOSA (Fr.) Coppins & P. James – on old stump, on wood (TU).
148. T. GRANULOSA (Hoffm.) Lumbsch – on sandy soil and on an old piece of leather (IE, TU).
149. TREMOLECIA ATRATA (Ach.) Hertel - on siliceous pebbles (IE).
150. TUCKERMANNOPSIS CHLOROPHYLLA (Willd.) Hale – in many localities all over the island, epiphytic on *Betula pendula*, *Pinus sylvestris, Picea abies* (ICEB, IE, TU).
151. T. SEPINCOLA (Ehrh.) Hale – on a fallen *Betula*, on a dead tree (IE, TU).
152. UMBILICARIA DEUSTA (L.) Baumg. – in many localities, always on siliceous boulders (ICEB, IE, TU).
153. U. POLYPHYLLA (L.) Baumg. – on siliceous boulders (ICEB, IE, TU).
154. U. TORREFACTA (Light.) Schrad. – SE coast, forest sq. no. 224, 232; SW coast, forest sq. no. 212; NW coast, forest sq. no. 187, on siliceous boulders (ICEB, IE, TU).
155. USNEA FILIPENDULA Stirt. – on *Picea abies, Pinus sylvestris*, on a fallen *Betula* (ICEB, IE, TU).
156. U. FULVOREAGENS (Räsänen) Räsänen – on *Picea abies* (ICEB).
157. U. HIRTA (L.) Weber ex F. H. Wigg. – in many localities all over the island, epiphytic on *Picea abies, Pinus sylvestris, Betula pendula,* occasionally on *Sorbus aucuparia* (ICEB, IE, TU).
158. U. SUBFLORIDANA Stirt. – in many localities all over the island, epiphytic on *Picea abies, Pinus sylvestris, Betula pendula,* occasionally on *Padus avium* (ICEB, IE, TU).
159. VERRUCARIA MURALIS Ach. – on calcareous stones of an old fortress (ICEB).
160. VULPICIDA PINASTRI (Scop.) J.-E. Mattsson & M. J. Lai – on *Picea abies*, *Pinus sylvestris* and on decaying wood (ICEB, IE, TU).
161. XANTHOPARMELIA CONSPERSA (Ach.) Hale – in many localities, always on siliceous boulders (ICEB, IE, TU).
162. X. SOMLOËNSIS (Gyeln.) Hale – on siliceous boulders (ICEB, IE, TU).
163. XANTHORIA CANDELARIA (L.) Th. Fr. – on siliceous boulders (ICEB, TU).
164. X. PARIETINA (L.) Th. Fr. – on *Betula pendula, Populus tremula*, on mosses (ICEB, IE, TU).
165. X. POLYCARPA (Hoffm.) Th. Fr. ex Rieber – on twigs of *Betula pendula* and *Rosa* sp., on *Tilia cordata* and on a dead tree (ICEB, IE, TU).

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Epilithic species of the lichen genera *Lecanora*, *Protoparmelia* and *Tephromela* in Estonia

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Abstract: In a checklist of Estonian lichens of 1970, 46 *Lecanora* species were reported, 18 of them epilithic. After the revision of herbarium materials and taking into consideration the changes in systematics, we can today list 18 epilithic *Lecanora* species, 3 *Protoparmelia* and 1 *Tephromela* species in Estonia. Additions to the fomer list are the following taxa: *Lecanora argopholis* (Ach.) Ach., *L. caesiosora* Poelt, *L. macrocyclos* (H. Magn.) Degel, *L. perpruinosa* Fröberg, *L. swartzii* (Ach.) Ach., *Protoparmelia atriseda* (Fr.) R. Sant. & V. Wirth and *P. picea* auct.

Kokkuvõte: I. Jüriado. Samblikuperekondade *Lecanora*, *Protoparmelia* ja *Tephromela* epiliitsed liigid Eestis.

Eesti samblikuliikide nimekirjas (Trass 1970) oli 46 liiki perekonnast *Lecanora*, nendest epiliite 18. Herbaarmaterjalide läbitöötamisel ja süstemaatikas toimunud muutusi arvesse võttes, on Eestist tänaseks teada 18 epiliitset liiki perekonnast *Lecanora*, 3 liiki perekonnast *Protoparmelia* ja 1 liik perekonnast *Tephromela*. Võrreldes Trassi 1970. aasta nimekirjaga on Eestile uued järgmised taksonid: *Lecanora argopholis* (Ach.) Ach., *L. swartzii* (Ach.) Ach., *Protoparmelia picea* auct. (vanema kirjanduse andmed), *Lecanora macrocyclos* (H. Magn.) Degel. (Ekman et al. 1991), *L. caesiosora* Poelt (määras I. Brodo), *L. perpruinosa* Fröberg (määras artikli autor) ja *Protoparmelia atriseda* (Fr.) R. Sant. & V. Wirth (S. Ekmani ja R. Mobergi andmed).

INTRODUCTION

The first list of Estonian lichens was compiled at the end of sixties (Trass, 1967, 1970). A new revision of Estonian macrolichens was published in 1994 (Trass & Randlane, 1994) but our knowledge of microlichens is still unsatisfactory and for that reason a project to compile a new and complete list of lichen species in Estonia has been started.

The aim of this study is to revise all the epilithic species of the genera *Lecanora* Ach., *Protoparmelia* M. Choisy and *Tephromela* M. Choisy in Estonia within the framework of this project.

MATERIALS AND METHODS

The study is based mainly on the herbarium materials of the Institute of Botany and Ecology at the University of Tartu (TU). Smaller collections are also kept in the Botanical Garden in Tallinn (TBA) and in the International Center for Environmental Biology (ICEB); altogether about 550 specimens have been studied. Additional field work was carried out to collect specimens in Central and South Estonia.

The morphology of the lichens was studied using stereomicroscopes MBS-9 and A. Krüss Optronic. The hand-made cross-sections of lichen fruitbodies were studied using light microscopes MBI-3 and A. Krüss Optronic.

The "spot tests" were made on the cortex of the thallus, on the medulla and on the discs of apothecia with 10% KOH, p-phenylenediamine in ethanol and sodium hypochlorite. The solubility of granules in the epithecium was tested with 10% KOH, and 50% nitric acid was used for hymenial colour tests.

The herbarium data were sorted using the computer program BRAHMS. Additional comparison material was received from Helsinki (H) and Lund (LD) herbaria. The nomenclature is according to Santesson (1993), the names and abbreviations of names of authors are according to Kirk & Ansell (1992).

RESULTS AND DISCUSSION

In the list of Estonian lichens (Trass, 1970) 46 *Lecanora* species were reported, 18 of them epilithic. After revision of herbarium materi-

als and taking into consideration the changes in systematics, we can today list 18 epilithic *Lecanora* species, 3 *Protoparmelia* and 1 *Tephromela* species in Estonia. Table 1 shows the number of localities of species in 1970 and in 1996, and it presents also the changes in generic disposition of the species. New to Estonia (compared with Trass, 1970) are the following taxa: *Lecanora argopholis*, *L. swartzii*, *Protoparmelia picea* (reported in older literature), *Lecanora macrocyclos* (reported by Ekman *et al.*, 1991), *L. caesiosora* (identified by Brodo), *L. perpruinosa* (identified by the author of the paper) and *Protoparmelia atriseda* (identified by Ekman & Moberg).

Lecanora albescens, *L. dispersa*, *L. muralis* and *Tephromela atra* are the most common of the studied species in Estonia (more than 60 localities). *L. cenisia*, *L. crenulata*, *L. polytropa*, *L. rupicola* and *L. sulphurea* are also widely distributed (20 and more than 20 localities). *L. campestris*, *L. helicopis*, *L. macrocyclos* have been found in more than 10 localities and *L. bicincta*, *L. intricata*, *L. perpruinosa* and *Protoparmelia badia* in more than 5 localities. *Lecanora achariana*, *L. argopholis*, *L. swartzii* and *L. caesiosora* are the rarest *Lecanora* species with only one locality recorded today. Other rare species in Estonia include *Protoparmelia atriseda* (2 localities) and *P. picea* (1 locality).

Table 1. The *Lecanora*, *Protoparmelia* and *Tephromela* epilithic species reported in Estonia and the numbers of their records in 1970 and 1996

Species as cited by Trass 1967 & 1970	The number of localities (1970)	Species according to modern taxonomy	The number of localities (1996)
Lecanora albescens (Hoffm.) Flk.	*5*	*L. albescens* (Hoffm.) Branth & Rostr.	> 60
L. atra (Huds.) Ach.	*7*	*Tephromela atra* (Huds.) Hafellner	> 60
L. atrynea (Ach.) Nyl.	1	incl. in *L. cenisia* Ach.	
L. atrynella Nyl.	3	incl. in *L. dispersa* (Pers.) Sommerf.	
L. badia (Hoffm.) Ach.	5	*Protoparmelia badia* (Hoffm.) Hafellner	9
L. bicincta Ram.	1	*L. bicincta* Ramond	5
L. campestris (Schrad.) Hue	1	*L. campestris* (Schaer.) Hue	12
L. cenisia Ach.	7	*L. cenisia* Ach.	26
L. conferta (Duby) Grogn. after Mereschkowski (1913)	1	*L. albescens* (Hoffm.) Branth & Rostr. ?	
L. crenulata (Dicks) Hook.	24	*L. crenulata* Hook.	20
L. dispersa (Pers.) Röhl.	10	*L. dispersa* (Pers.) Sommerf.	> 60
L. helicopis (Wahlenb.) Ach.	4	*L. helicopis* (Wahlenb.) Ach.	12
L. intricata (Schrad.) Ach.	2	*L. intricata* (Ach.) Ach.	9
L. lithophila (Wallr.) Oxn.	1	incl. in *L. dispersa* (Pers.) Sommerf.	
L. nephaea Sommerf. (*L. atriseda* (Fr.) Nyl. after Mereschkowski (1913))	1	*Protoparmelia atriseda* (Fr.) R. Sant. & V. Wirth	2
L. polytropa (Ehrh.) Rabenh.	4	*L. polytropa* (Ehrh. ex Hoffm.) Rabenh.	29
L. rupicola (L.) Zahlbr.	20	*L. rupicola* (L.) Zahlbr.	> 35
L. rupicola var. *glaucescens* (Sw.) Zahlbr. (*L. sordida* var. *swartzii* Ach. after Mereschkowski (1913))	1	*L. swartzii* (Ach.) Ach.	1
L. umbrina (Ehrh.) Massal.	13	incl. in *L. dispersa* (Pers.) Sommerf.	
Placodium achariana A. L. Sm.	1	*L. achariana* A. L. Sm.	1
P. murale (Schreb.) Frege.	54	*L. muralis* (Schreb.) Rabenh.	> 60
Lecidea sulphurea (Hoffm.) Wahlenb.	10	*L. sulphurea* (Hoffm.) Ach.	20
——		*L. argopholis* (Ach.) Ach.	1
——		*L. caesiosora* Poelt	1
——		*L. macrocyclos* (H. Magn.) Degel.	12
——		*L. perpruinosa* Fröberg	6
——		*Protoparmelia picea* auct.	1

Epilithic species of the genus *Lecanora*

L. caesiosora was identified as new to Estonia by Brodo in 1993, the specimen being collected on the islet of Saarnaki in West Estonia by Sander in 1974. *L. caesiosora* is distributed in central and northern Europe, Fennoscandia and Scotland (Brodo *et al.*, 1994), therefore the discovery of this species in Estonia was expected.

The occurrence of *Lecanora argopholis* and *L. swartzii* in Estonia was mentioned by Mereschkowski (1913). Unfortunately, the records he referred to were not precisely located ("in the vicinity of the city of Tallinn"), and we do not have any new collections. However, both species are distributed in South Finland (Leuckert & Poelt, 1989; Vänskä, 1984) and thus it is very probable that they will be found here again. Today we still include these species in the check list of Estonian lichens but consider them doubtful.

L. macrocyclos was reported for the first time in Estonia by Ekman *et al.* (1991) from 2 localities in western Estonia. After critical revision of herbarium collections of *L. muralis,* 9 specimens were re-identified as *L. macrocyclos.* Now, after additional field work we can say that the species is frequent in western Estonia. The general distribution of *L. macrocyclos* is poorly studied – it is known only from Finland, Scandinavia and Hungary (Clauzade & Roux, 1985; Poelt & Vezda, 1977; Vitikainen, 1989).

L. bicincta was included in the list of Estonian lichens (1970) on the basis of old data (Mereschkowski, 1913). Today we know 5 localities of *L. bicincta* in North and West Estonia. These specimens were earlier identified as *L. rupicola*.

L. helicopis is quite frequent in West and North Estonia. According to several authors (Clauzade & Roux, 1985; Makarevicz, 1971; Purvis *et al.*, 1992; Wirth, 1995) *L. helicopis* grows only on siliceous maritime rocks. Still, also maritime calcareous cliffs may sometimes be inhabited by *L. helicopis* (Degelius, 1982; Fletcher, 1975), and this has been observed in West Estonia as well.

Revision of herbarium specimens of the *L. dispersa* group showed that the characters of *L. dispersa* and *L. crenulata* had ealier been misunderstood. Most of the specimens were re-identified, and still more radical investigation is needed. *L. albescens* was known only from 5 localities in West Estonia in 1970. The revision of herbarium specimens and further field work showed that *L. albescens* is very frequent in West Estonia, where it grows mainly on calcareous rocks. In inland it often grows on anthropogenous substrates. *L. perpruinosa* also belongs to the *L. dispersa* group. It was described by Fröberg (1989) and only a few localities in Sweden and Switzerland were known until Poelt and Leuckert (1995) reported it for Austria, Germany and Italy. The author of this study identified *L. perpruinosa* for the first time for Estonia in 1996, the determination was verified by Fröberg.

Species of the genera *Protoparmelia* and *Tephromela*

Two *Lecanora* species in the list of Estonian lichens (Trass, 1970) – *L. badia* and *L. nephaea* – are now referred to the genus *Protoparmelia. Protoparmelia badia* is known only in West and North Estonia from 9 localities. *P. nephaea* has been reported in older literature only and we have no herbarium specimens of it from Estonia today. After checking the synonyms it seems most likely that the original material belonged not to *P. nephaea* but *P. atriseda,* and therefore we exclude *P. nephaea* from the current list of Estonian lichens. *P. atriseda* and *P. picea* were both mentioned by Mereschkowski (1913) from Tallinn (North Estonia). There are no new collections of *P. picea* but *P. atriseda* was found from the island of Saaremaa (Sõrve Peninsula, Lõo alvar) in 1989 by Randlane and identified by Ekman and later also by Moberg (1992). So, we have 3 species of the genus *Protoparmelia* in Estonia: *P. atriseda* and *P. badia* as certain members of our lichen flora, and *P. picea* as a doubtful, one.

Only one species of the genus *Tephromela* is known from Estonia – *T. atra*. According to Trass (1970) *T. atra* was quite a rare species in Estonia (7 localities). Now it is known to be a very frequent lichen on maritime rocks in West and North Estonia, in more than 60 localities. In a few localities (4) the species is known also as epiphytic, growing on *Fraxinus*

excelsior and *Sorbus aucuparia*.

L. atra var. *grumosa* Ach. (syn. *T. grumosa* (Pers.) Hafellner & Roux) is mentioned by Mereschkowski (1913) but without an exact locality from Estonia. Therefore this species cannot be included in the list of Estonian lichens.

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The species of the genus *Rinodina* (Physciaceae, Lecanorales) in Estonia

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Abstract: Seventeen species of the genus *Rinodina* are known in Estonia. Five of them are new to the territory, viz. *R. confragosa, R. interpolata, R. milvina, R. parasitica* and *R. turfacea*. A list of the species with ecological and distributional data of all taxa is presented. A key to the known and expected species in Estonia is included.

Kokkuvõte: M. Sarv. Perekonna *Rinodina* liigid Eestis.

H. Trassi poolt 1970. aastal koostatud Eesti samblike nimekirjas on perekonnas *Rinodina* üheksa liiki, lisaks veel sünonüümi *Buellia occulta* all käsitletud *Rinodina occulta*. Pärast olemasoleva herbaarmaterjali ja käesoleva töö autori poolt kogutud täiendava materjali läbitöötamist on lisandunud perekonda *Rinodina* veel 5 liiki: *R. confragosa, R. interpolata, R. milvina, R. parasitica* ja *R. turfacea*. Praegusel ajal on teada uuritavas perekonnas 17 liigi esinemine Eestis. Käesolevas töös on esitatud nende liikide nimekiri, ökoloogia ja leiukohtade andmed. Lisatud on Eestis esinevaid ja tõenäoliselt leiduvaid liike käsitlev määramistabel.

INTRODUCTION

A checklist of lichens occuring in Estonia was presented by Trass in 1970. According to this, *Rinodina* was represented by ten species (incl. *R. occulta*, which was treated as *Buellia occulta*) (Trass, 1970). No microlichens have been revised since then. The present study is a part of the collective project of revising all lichen genera and composing a second, updated list of Estonian lichens. The aims of this study are the following: 1) to examine all herbarium specimens of *Rinodina*; 2) to collect additional material from the poorly studied parts of Estonia (mainly Middle and South Estonia); 3) to compose a list of the species of *Rinodina*; 4) to prepare a key to the known and expected species and 5) to present the data of their distribution in Estonia.

MATERIALS AND METHODS

The study is based mainly on material from the following herbaria: University of Tartu (TU), Botanical Garden of Tallinn (TBA) and the Institute of Ecology in Tallinn (IE). The total number of specimens examined was 162, of which 41 specimens were collected by the author during field works within the last two years.

Stereomicroscopes MBS-9 and A. Krüss Optronic were used for examination of morphological characters. "Spot test" colour reactions were made on the cortex of the thallus using the following chemical reagents: 10% KOH (K), p-phenylenediamine in ethanol (PD) and sodium hypochlorite (C). Anatomical characters (apothecial margin, ascus structure, ascospore type, hypothecial structure etc.) were studied using light microscopes MBI-3 and A. Krüss Optronic. Cross sections were made by hand and mounted in water, in 10% KOH or in Lugol's solution. 10% KOH was used for identification of the swelling of ascospore septa; Lugol's solution was used for identification of the iodine colouration of the hymenium and the hypothecium.

Chemical analyses were carried out according to the standardized TLC methods (Culberson & Kristinsson, 1970; Culberson, 1972) on 11 specimens. The acetone extracts were run in solvent system sodium hypochlorite (Culberson et al., 1981).

Additional comparison material from UPS was used. The terminology for the ascospore types (Fig. 1) follows Mayrhofer (1982, 1984). Nomenclature is used according to Santesson (1993). The following key books and papers were used for the identification of the specimens and for compiling the key to the species: Foucard (1990), Giralt & Barbero (1995), Giralt & Mayrhofer (1995), Mayrhofer (1984), Mayrhofer & Leuckert (1985), Mayrhofer & Poelt (1979), Mayrhofer et al. (1990, 1992), Purvis et al. (1992), Ropin & Mayrhofer (1995), Sheard (1967) and Wirth (1995).

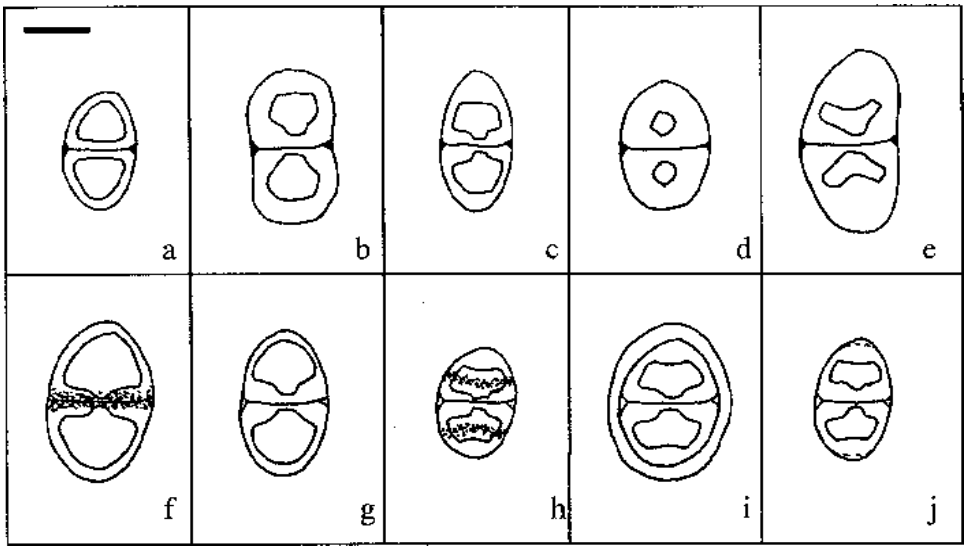

Fig. 1. The ascospore-types of the genus *Rinodina*. a) *Beltraminia*-type; b) *Milvina*-type; c) *Physcia*-type; d) *Pachysporaria*-type; e) *Mischoblastia*-type; f) *Bischoffii*-type; g) *Physconia*-type; h) *Bicincta*-type; i) *Tunicata*-type; j) *Dirinaria*-type. Bar 10 µm.

Key to the known and expected species (*) of the genus *Rinodina* in Estonia

1 On rocks 2
– On other substrata 17

2 On siliceous rocks 3
– On calcareous rocks 13

3 Thallus sorediate ..... *R. aspersa**
– Thallus not sorediate 4

4 Apothecia lecideine 5
– Apothecia lecanorine 6

5 Thallus thin. Apothecia small, up to 0,3 mm diam., sessile; disc convex. Ascospores 11–15 (16) x 6–8 (10) µm ..... *R. occulta*
– Thallus thick. Apothecia up to 1 mm diam., immersed at first, becoming sessile; disc plane. Ascospores (13)15–18 x 7–10 µm ..... *R. rinodinoides**

6 Thallus C+ red ..... *R. atrocinerea**
– Thallus C- 7

7 Ascospores with equally thin walls ..... *R. cacuminum*
– Ascospores with thickened walls 8

8 Ascospores of *Mischoblastia*-type ..... *R. oxydata**
– Ascospores of another type 9

9 Ascospores of *Pachysporaria*-type ..... *R. badiella**
– Ascospores of another type 10

10 Ascospores of *Physcia*-type 11
– Ascospores of another type 12

11 Thallus K+ yellow (sometimes very weak), PD+ yellow. Hymenium more than 90 µm high ..... *R. confragosa*
– Thallus K-, PD-. Hymenium up to 80 µm high ..... *R. interpolata*

12 Ascospores of *Dirinaria*-type;
swollen around the septum in K ..... *R. gennarii*
– Ascospores of *Milvina*-type;
not swollen around the septum in K ..... *R. milvina*

13 Ascospores with 1–2 dark pigmented band 14
– Ascospores without a dark pigmented band 16

14 Ascospores of *Bicincta*-type ..... *R. lecanorina*
– Ascospores of *Bischoffii*-type 15

15 Apothecia immersed. Hymenium without oil droplets ..... *R. immersa*
– Apothecia sessile. Hymenium with oil droplets ..... *R. bischoffii*

16 Ascospores of *Tunicata*-type. Hymenium 90–130 µm high ..... *R. calcarea**
– Ascospores of *Dirinaria*-type. Hymenium 70–95 µm high ..... *R. gennarii*

17 On bark or wood 18
– On soil, mosses, lichens or decaying wood 29

18 Thallus sorediate ..... *R. efflorescens**
– Thallus not sorediate 19

19 Thallus grey-blue. Epithecium blue-green.
Ascospores of *Tunicata*-type ..... *R. colobina**
– Thallus not grey-blue. Epithecium brown. Ascospores of another type .. 20

20 Asci 10–12-spored ..... *R. polyspora**
– Asci 8-spored 21

21 Ascospores 3-septate at maturity ..... *R. conradii*
– Ascospores 1-septate at maturity 22

22 Ascospores with thin walls at maturity; slightly curved ..... *R. pyrina*
– Ascospores with unequally thickened walls and septum; mostly straight . 23

23 Ascospores more than 25 µm long, septum 5.5–8 µm,
the apical wall 5–7 µm ..... *R. turfacea*
– Ascospores up to 25 µm long, septum and the apical wall thinner 24

24 Ascospores of *Dirinaria*-type; swollen around the septum in K ..... *R. gennarii*
– Ascospores of another type; not swollen around the septum in K..... 25

25 Ascospores of *Physcia*-type 26
– Ascospores of another type 28

26 Thallus K+ yellow ..... *R. exigua*
– Thallus K- 27

27 Thallus thin, verrucose, pale grey to pale brown, areolate... *R. septentrionalis*
– Thallus evanescent, granulose, brown to dark brown,
or completely absent ..... *R. laevigata**

28 Ascospores of *Milvina*-type; 13–19 x 6.5–9 µm ..... *R. sophodes*
– Ascospores of *Physconia*-type; 17–24 x 8–10 µm ..... *R. archaea*

29 On crustose lichens 30
– Not on other lichens 31

30 Ascospores of *Milvina*-type;
constricted at the septum at maturity ..... *R. milvina*
– Ascospores of *Physcia*-type;
not constricted at the septum at maturity ..... *R. parasitica*

31 Ascospores 3-septate at maturity, 24–35 x 10–15 µm ..... *R. conradii*
– Ascospores 1-septate at maturity 32

32 Thallus grey to brown, granular 33
– Thallus whitish grey, indistinct ..... *R. roscida**
33 Apothecia plane becoming convex. Thalline exciple thin ..... *R. mniarea**
– Apothecia persistently plane. Thalline exciple thick ..... *R. turfacea*

Ecological and distributional data of *Rinodina* species in Estonia

R. ARCHAEA (Ach.) Arnold
On rough and smooth bark of coniferous and deciduous trees and also on wood. Rare; known only from three localities in Estonia: 1. Harjumaa Co., Tallinn, K. Mereschkowski (Trass, 1967); 2. Lääne-Virumaa Co., Esku, leg. E. Nilson, det. M. Sarv (TU); 3. Järvamaa Co., Paluküla, M. Sarv (TU).

R. BISCHOFFII (Hepp) A. Massal.
On calcareous substrata, particularly hard limestones. Local; mainly in coastal areas of Estonia: 1. Saaremaa Co., Muhu Is., A. Bruttan (TU); 2. Harjumaa Co., Tallinn, L. Kari (Trass, 1967); 3. Läänemaa Co., Osmussaar Is., T. Randlane (TU); 4. Saaremaa Co., Saaremaa Is., Sõrve peninsula, Lõo, T. Randlane (TU); 5. Läänemaa Co., Vormsi Is., Rumpo peninsula, R. Allmäe & T. Piin (TU; TBA); 6. Saaremaa Co., Vilsandi Nature Reserve, Vilsandi Is., T. Randlane (TU); 7. Harjumaa Co., Pakri peninsula, M. Sarv (TU).

R. CACUMINUM (Th. Fr.) Malme
On siliceous rocks, in coastal areas (especially on nutrient-rich substrata) and in mountains. Local; found only in West and North Estonia: 1. Lääne-Virumaa Co., Kunda, V. Räsänen (Trass, 1967); 2. Saaremaa Co., Vilsandi Is., V. Räsänen (Trass, 1967); 3. Saaremaa Co., Saaremaa Is., Kuressaare, V. Räsänen (Trass, 1967); 4. Harjumaa Co., Naissaar Is., leg. T. Randlane, det. M. Sarv (TU); 5. Harjumaa Co., Rammu Is., leg. T. Piin, det. M. Sarv (TBA).

R. CONFRAGOSA (Ach.) Körb.
On coastal, siliceous rocks, also on overhanging rocks at high altitudes. Rare, found at three localities in coastal areas of Estonia: 1. Saaremaa Co., Saaremaa Is., Randvere, leg. H. Trass, det. M. Sarv (TU); 2. Pärnumaa Co., Ruhnu Is., leg. T. Piin, det. M. Sarv (TU); 3. Saaremaa Co., Vahase Is., leg. H. Trass, det. M. Sarv (TU).

R. CONRADII Körb.
On soil, mosses, bark or wood, particularly on decaying turf, especially on or near the coast. Very rare, known only from two localities in Estonia: 1. Saaremaa Co., Vilsandi Nature Reserve, Vesiloo Is., leg. E. Häyren, det. H. Magnusson (Trass, 1967); 2. Saaremaa Co., Saaremaa Is., Harilaid, R. Moberg (Moberg, 1992).

R. EXIGUA Gray
On the rough bark of old trees. Common in several parts of Estonia.

R. GENNARII Bagl.
On calcareous and siliceous nutrient-rich and -enriched substrata, on rocks, mortar, concrete, beton; more rarely on wood; particularly in coastal and urban sites. Local, found only on maritime rocks in the islands of West and North Estonia: 1. Saaremaa Co., Abruka Is., V. Räsänen (TU); 2. Pärnumaa Co., Ruhnu Is., T. Randlane (TU); 3. Saaremaa Co., Vilsandi Nature Reserve, Vilsandi Is., T. Randlane (TU); 4. Saaremaa Co., Vilsandi Nature Reserve, Alumine Vaika Is., T. Randlane (TU); 5. Harjumaa Co., Ülgase, M. Sarv (TU); 6. Saaremaa Co., Kõinastu Is., leg. T. Randlane, det. M. Sarv (TU); 7. Harjumaa Co., Umbloo Is., leg. T. Piin, det. M. Sarv (TBA).

R. IMMERSA (Körb.) Zahlbr.
On calcareous substrata, on hard limestone. Local, found in coastal areas of West and Northwest Estonia: 1. Läänemaa Co., Osmussaar Is., T. Randlane (TU); 2. Saaremaa Co., Saaremaa Is., Sõrve peninsula, T. Randlane (TU); 3. Saaremaa Co., Vilsandi Nature Reserve, Vilsandi Is., T. Randlane (TU); 4. Harjumaa Co., Pakri peninsula, M. Sarv (TU); 5. Läänemaa Co., Vormsi Is., Rumpo peninsula, T. Piin (TU); 6. Lääne-Virumaa Co., Kunda, V. Räsänen (Mayrhofer, 1984); 7. Saaremaa Co., Kõinastu Is. (Ekman *et al.*, 1991), 8. Saaremaa Co., Saaremaa Is., Harilaid, leg. H. Trass, det. M. Sarv (TU).

R. INTERPOLATA (Stirt.) Sheard
On siliceous rocks. Very rare, found only at one locality in West Estonia: Saaremaa Co., Vilsandi Nature Reserve, Vilsandi Is., leg. V. Räsänen, det. M. Sarv (TU).

R. LECANORINA (A. Massal.) A. Massal.

On calcareous rocks. Very rare, known only from one locality in North Estonia: Lääne-Virumaa Co., Kunda, V. Räsänen (Räsänen, 1931).

R. MILVINA (Wahlenb.) Th. Fr.

On siliceous, nutrient-rich rocks, rarely on other crustose lichens. Rare, known only from three localities in coastal areas of West and North Estonia: 1. Harjumaa Co., Tallinn, Merivälja, leg. J. Seim, det. M. Sarv (TU), 2. Saaremaa Co., Vilsandi Nature Reserve, Suur Kolme Kivi Rahu Is., leg. T. Randlane, det. M. Sarv (TU); 3. Harjumaa Co., Rammu Is., leg. T. Piin, det. M. Sarv (TBA).

R. OCCULTA (Körb.) Sheard

On hard siliceous rocks, preferably in shaded situations. Very rare, known only from one locality in West Estonia: Saaremaa Co., Saaremaa Is., alvar near to Kuressaare, L. Kari (Räsänen, 1931).

R. PARASITICA H. Mayrhofer & Poelt

Parasitic on other crustose lichens, especially on thalli of *Aspicilia caesiocinerea*. Very rare, found only in one locality in West Estonia: Saaremaa Co., Vilsandi Nature Reserve, Vilsandi Is., on the thallus of *Lecanora dispersa,* leg. T. Randlane, det. M. Sarv (TU).

R. PYRINA (Ach.) Arnold

On smooth or rough bark, also frequently on wood. Common in several parts of Estonia.

R. SEPTENTRIONALIS Malme

Mainly on smooth bark of young twigs of coniferous and deciduous trees. Rare, known only from two localities: 1. Saaremaa Co., Saaremaa Is., Sõrve peninsula, Lõo, R. Moberg (UPS); 2. Harjumaa Co., Pakri peninsula, Kersalu, M. Sarv (TU).

R. SOPHODES (Ach.) A. Massal.

Mainly on smooth bark of small twigs of deciduous trees, especially *Fraxinus*, an early colonizer, most common in hilly and exposed districts. Common in all parts of Estonia.

R. TURFACEA (Wahlenb.) Körb.

On soil, more or less dead mosses, also on decaying wood and rocks. Very rare, known only from one locality in Middle Estonia: Järvamaa Co., Paluküla, M. Sarv (TU).

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I am grateful to my supervisor T. Randlane and to A. Saag; I thank also T. Piin and E. Nilson for the loan of specimens (TBA, IE), A. Nordin for revising the manuscript and determining some specimens, and R. Moberg for the opportunity to work in the Botanical Museum, Uppsala University.

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Folia Cryptog. Estonica, Fasc. 31: 36–37 (1997)

Phaeophyscia chloantha and *Solorina bispora* new to Estonia

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Abstract: The two species *Phaeophyscia chloantha* and *Solorina bispora* are reported for the first time from Estonia. A map of the known distribution of *Phaeophyscia chloantha* in Europe is presented.

Kokkkuvõte: R. Moberg. *Phaeophyscia chloantha* ja *Solorina bispora* esmasleiud Eestis.

Esmakordselt teatatakse kahe samblikuliigi – *Phaeophyscia chloantha* ja *Solorina bispora* – leidmisest Eestis. Esitatakse kaart *Phaeophyscia chloantha* levikust Euroopas.

In preparation of an Estonian lichen flora Tiina Randlane informed me that some of my collections and redeterminations represent species not earlier known to Estonia. I thus formally report the two species – *Phaeophyscia chloantha* (Ach.) Moberg and *Solorina bispora* Nyl.– as new to Estonia. The former species was among my redeterminations of material in UPS and latter species was collected during a lichen excursion to westerm Estonia in 1991 (Moberg, 1992) together with the late Professor Gunnar Degelius.

Phaeophyscia chloantha (Ach.) Moberg

This species is easily recognized by the lip-shaped soralia, the pale lower side and a prosoplectenchymatous lower cortex. The upper side is brownish like all *Phaeophyscia* species, but it is usually paler than for instance *P. orbicularis* (Neck.) Moberg, which is one of the species it might be confused with. However, the white colour of the lower side and the prosoplectenchymatous lower cortex makes it easy to identify as all the other

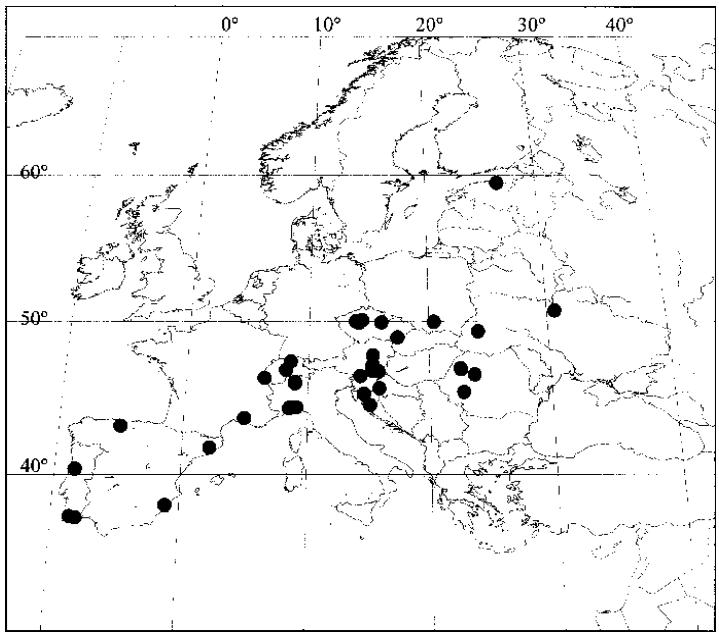

Fig.1. Distribution of *Phaeophyscia chloantha* in Europe.

Phaeophyscia species in Europe have black lower side and paraplectenchymatous lower cortex. A more detailed description is given by Moberg (1978).

The material from Estonia is collected in Kunda (59°29'N 26°32'E) by Räsänen 1927 on bark of *Fraxinus* (UPS).

In Europe *P. chloantha* has a southern distribution (Fig. 1). Thus the record from Estonia is far north of the main distribution in Europe. It might be overlooked in northeastern Europe and should be looked for on deciduous trees in open situations. Very often it is found growing mixed with several other species of *Phaeophyscia*.

Solorina bispora Nyl.

Solorina bispora is separated from related species by the presence of a thallus around the apothecia and the number and size of the spores. As the name indicates, the number of spores is two per ascus and the length is usually more than 60 µm. The material from Muhu Island, Üügu cliffs (58°40'N 23°15'E) collected by me in 1991 (UPS) is not well developed, but it has typical spores. The distribution of *S. bispora* is mainly mountainous in Europe and the record in Estonia was quite unexpected. However, the habitat is calcareous, northexposed rocks which might have conditions similar to mountaneous areas.

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Lignicolous Aphyllophorales of old and primeval forests in Estonia. 1. The forests of northern Central Estonia with a preliminary list of indicator species

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Abstract: A list of 141 species of aphyllophoroid wood-rotting fungi collected in 13 forest plots in 1995 is presented; seven species are mentioned as new to Estonia. Since 1993, in North Europe several species of wood-rotting fungi have been used as indicators for selection of old and primeval forests of high biodiversity worth to be protected. The *old forest indicator fungi* may be defined as more or less easily recognizable macrofungi distributed mainly or only in old forests minimally affected by forest management. Presence of these species in a forest indicate, that ecosystems have been persisting there without major disturbance during a long period of time. The indicator species proposed as suitable for the Estonian forests are listed on pages 44–45.

Kokkuvõte: E. Parmasto ja I. Parmasto. Eesti vanade ja ürgmetsade puitulagundavad seened seltsist Aphyllophorales. 1. Kesk-Eesti põhjaosa metsad koos indikaatorliikide esialgse nimestikuga.

1995. a. uurimiste alusel esitatakse 141 liiki hõlmav nimestik 13 metsa-alalt leitud puitulagundava seene kohta; neist seitset mainitakse Eestist esmakordselt. Alates 1993. aastast on Põhja-Euroopas mitmeid puitulagundavaid seeni kasutatud indikaatorliikidena selliste kaitset vajavate vanade ja ürgmetsade selekteerimiseks, mida iseloomustab suur elusolendite liigiline mitmekesidus. Käesoleva kirjutise autorid esitavad definitsiooni: *Vanade metsade indikaatorliikideks on sellised makroseened, mis on levinud peamiselt või ainult sellistes vanades metsades, mida vaid minimaalselt on mõjustatud metsa majandamisega.* Need liigid näitavad metsa ökosüsteemide pikaajalist oluliste häireteta püsimist antud paigas. Eesti metsadele sobivaks peetava 43 indikaatorliigi nimestik on toodud lk. 44-45.

INTRODUCTION

Northern part of Central Estonia (southern half of the Järvamaa Co., southeastern part of the Harjumaa Co. and eastern part of the Raplamaa Co.) is the mycologically least explored region of Estonia. As a part of the project "Old Forest Inventory in Estonia" organized by the Estonian Nature Foundation, several forest plots of this region were studied by the mycologists of the Institute of Zoology and Botany in September, 1995. The forest plots were selected by the leaders of the project as possible nature protection areas to be studied by taxonomists of several different groups of organisms. Altogether, 13 localities in this region were studied and 141 species recorded.

Lignicolous Aphyllophorales were collected by the authors of this paper, in some areas also by Dr. Urmas Kõljalg; field notes by Prof. Kuulo Kalamees and Ms. Mall Vaasma were also used.

The study area is located mainly in the northern half of the *Estonia Intermedia* geobotanical district of the West Baltic Subprovince of the Baltic geobotanical Province. According to Laasimer (1965), this region belongs to the Conifer–Hardwood Zone; however, the forests in the study area are close to typical Southern Taiga Zone forests. The district is characterized by oligotrophic ("raised") bogs and swampy forests; however, (sub)nemoral spruce forest "islands" are scattered in the bogs and swampy pine forests. The area covered with forests ready for harvesting is smaller than expected.

Forest management has been quite intensive in most Estonian forests; as a rule, almost all ripe forests have been clearcut in due time; thinning and sanitary cuts as means of forest management have been regular and intensive during the last 30–40 years. The number of fallen, rotten, thick tree trunks (logs) is low in most forests. The climate is less favourable for fungal growth here than in most other regions of Estonia. In the study area and east of it, the period with a mean daily temperature above 10 C° is the shortest

in Estonia (up to 120 days), the sum of the mean daily air temperature during this period is the lowest (below 1700). The combined effect of these factors is that the number of aphyllophoraceous lignicolous fungi is lower than may be expected, and remarkably smaller than in the forests of Finland or Sweden which have been well studied from this aspect.

The weather was dry and sunny in Estonia in 1995, and thus an unfavourable period for a study of species diversity of wood-rotting fungi. The results of our study may be called preliminary; only 141 species of Aphyllophorales (and their anamorphs) are indicated in the list below. However, the forest plots studied are small and well delimited, and this enables similar inventorial studies in the same plots to be continued in the future.

In the species list, localities are indicated by their numbers; after this, substrata are listed. If not indicated, the fungal species are found on logs, fallen branches and on other non-living parts of trees and bushes. After this, in several cases remarks on the distribution of the species in Estonia in general are added.

STUDY PLOTS

Approximate geographical coordinates are for the midpoint of a plot.

1. Järvamaa Co., Lepametsa near Retla (Forestry Türi, forest sq. no. 262); 58°44.2' N, 25°40.9' E. – Spruce, aspen and birch forests of *Aegopodium* and *Filipendula* types. 20 Sept. 1995.
2. Järvamaa Co., Pätsavere near Päinurme (Forestry Huuksi, sq. nos 100 and 101); 58°50.5' N, 25°52.6' E. – Spruce forest of *Aegopodium* type. 20 Sept. 1995.
3. Järvamaa Co., Lepametsa near Retla (Forestry Türi, sq. no. 258); 58°44.2' N, 25°39.6' E. – Aspen forests of *Aegopodium* (partly *Filipendula*) types. 21 Sept. 1995.
4. Järvamaa Co., near Retla (Forestry Türi, sq. no. 252); 58°45' N, 25°40.9' E. – Spruce forest of *Aegopodium* type. 21 Sept. 1995.
5. Järvamaa Co., near Tammeküla (Forestry Türi, sq. no. 249); 58°46.5' N, 25°41' E. – Aspen forest of *Aegopodium* type. 21 Sept. 1995.
6. Järvamaa Co., Kuusiku near Laimetsa (Forestry Huuksi, sq. no. 73); 58°47.6' N, 25°38.7' E. – Spruce forests of *Aegopodium* and *Filipendula* types. 22 Sept. 1995.
7. Järvamaa Co., partly periodically flooded forests at Prandi river near Laimetsa (Forestry Huuksi, sq. no. 30); 58°49.2' N, 25°36.8' E. – Spruce forest of *Aegopodium* type, boggy in some places. 22 Sept. 1995.
8. Järvamaa Co., NE of Vahastu (Forestry Väätsa, sq. no. 87); 58°58.8' N, 25°18' E. – Pine forest on elevated bog (peatland). 23 Sept. 1995.
9. Järvamaa Co., near Põllika (Forestry Vahastu, sq. no. 57); 58°59.5' N, 25°16' E. – Spruce forest of *Vaccinium myrtillus* and *Aegopodium* types. 23 Sept. 1995.
10. Järvamaa Co., Virla (Forestry Väätsa, sq. no. 25); 59°02.3' N, 25°15' E. –Spruce-pine forest of *Vaccinium myrtillus* type. 23 Sept. 1995.
11. Järvamaa Co., near Kolu (Forestry Kolu, sq. no. 99); 58°48.6' N, 25°16.5' E. – Pine-spruce forest of *Vaccinium myrtillus–Polytrichum* type. 24 Sept. 1995.
12. Järvamaa Co., close to locality no. 11 (sq. no. 93). – Boggy spruce-pine forest of *Vaccinium myrtillus* and *Vaccinium uliginosum* type. 24 Sept. 1995.
13. Harjumaa Co., Saarnakõrve near Paimetsa (Forestry Nõmme, sq. no. 75); 59°01' N, 25°21' E. – Boggy spruce forest. 25 Sept. 1995.

LIST OF SPECIES FOUND

After species name, nos. of localities and substrata are indicated.

TELEOMORPHS

ALEURODISCUS AMORPHUS (Pers.: Fr.) J. Schröt. – 4, 7, 13 – *Picea abies* (TAA 162233, 162265, 162295). – Very rare in Estonia but possibly overlooked (cf. I. Parmasto, 1990). In the locality no. 7, **TREMELLA SIMPLEX** Jacks. & Martin was found parasitizing on *A. amorphus*; this is the first and only collection of this species in Estonia.

AMPHINEMA BYSSOIDES (Pers.: Fr.) J. Erikss. – 1, 2, 4, 6, 7, 9 – *Alnus incana, Athyrium* sp., *Betula pubescens, Juniperus communis,*

Picea abies, Populus tremula. – Very common in Estonia in almost all forest types.

Amylocorticium subincarnatum (Peck) Pouzar – 10 – *Picea abies*.

Amylostereum chailletii (Pers.) Boidin – 2 – *Picea abies*. – In Estonia uncommon but not rare.

A. laevigatum (Fr.) Boidin – 3, 7 – *Juniperus communis*. – The species is fairly common in Estonia at base of dead *Juniperus* stems. In western Estonia where *Peniophora junipericola* is common (cf. E. & I. Parmasto, 1992) these two species are ecological vicariants and only rarely grow on the same bush or tree.

Antrodia serialis (Fr.: Fr.) Donk – 1, 2, 4, 6, 11 – *Picea abies*. – Very common in Estonia.

A. sinuosa (Fr.: Fr.) P. Karst. – 2, 7, 10, 13 – *Picea abies, Pinus sylvestris*. – Very common in Estonia.

A. xantha (Fr.: Fr.) Ryvarden – 1, 10, 11 – *Picea abies, Pinus sylvestris*. – Common in Estonia.

Antrodiella semisupina (Berk. & M.A. Curtis) Ryvarden – 6 – *Betula pendula*. – The numerous localities of this fungus in Estonia are mainly in secondary forests (*Alnus incana* stands, in partly destroyed stands, etc.).

Bjerkandera adusta (Willd.: Fr.) P. Karst. – 7, 9, 10 – *Corylus avellana, Populus tremula*. – Common in Estonia.

Botryobasidium candicans J. Erikss. – 1 – *Alnus incana*.

B. intertextum (Schwein.) Jülich & Stalpers – 5, 7, 9, 13 – *Picea abies* (TAA 162264, 164809, 164745), *Tilia cordata* (TAA 164676). – New to Estonia but possibly overlooked.

B. laeve (J. Erikss.) Parmasto – 2, 9 – *Phellinus tremulae, Picea abies, Populus tremula*.

B. obtusisporum J. Erikss. – 10 – *Pinus sylvestris* (TAA 164756). – New to Estonia but possibly overlooked.

B. pruinatum (Bres.) J. Erikss. – 1 – *Picea abies*.

B. subcoronatum (Höhn. & Litsch.) Donk – 1, 2, 3, 4, 5, 6, 7, 9, 10, 13 – *Alnus glutinosa, A. incana, Betula pubescens, Juniperus communis, Picea abies, Populus tremula*. – One of the most common species on fallen logs in many forest types in Estonia.

Cantharellus cibarius Fr.: Fr. – 1, 2, 10.

C. tubaeformis Fr.: Fr. – 11.

Ceraceomyces serpens (Tode.: Fr.) Ginns – 10 – *Populus tremula*.

C. sublaevis (Bres.) Jülich – 2, 5, 7, 8 – *Alnus incana, Betula pubescens, Picea abies, Populus tremula*.

C. violascens (Fr.: Fr.) Jülich – 8 – *Pinus sylvestris*. – Rather rare in Estonia.

Ceriporia subreticulata Ryvarden (det. T. Niemelä) – 1 – *Populus tremula* (TAA 164580). – This is the only European locality of this species described from Thailand; very closely related if not identical with *C. alachuana* (Murrill) Hallenb. found in USA, Germany and Italy. – Found in a flooded "wild" forest.

C. reticulata (Hoffm.: Fr.) Domanski – 3 – *Betula pubescens*.

Chondrostereum purpureum (Pers.: Fr.) Pouzar – 1, 7 – *Betula pendula, Populus tremula*.

Clavicorona pyxidata (Pers.: Fr.) Doty – 2, 4, 7, 9 – *Populus tremula*.

Coltricia perennis (Fr.: Fr.) Murrill – 10 – The species is common in Estonia, mainly in dry pine forests (not visited for this study).

Coniophora puteana (Schum.: Fr.) P. Karst. – 1 – *Picea abies, Populus tremula*.

Corticium roseum Pers.: Fr. – 1, 7 – *Betula* sp., *Populus tremula*. – The species is common in Estonia, mainly on dead *Salix* branches but also on fallen logs of *Populus tremula*.

Cylindrobasidium evolvens (Fr.: Fr.) Jülich – 1, 6 – *Betula pendula, Betula pubescens*.

Cytidia salicina (Fr.: Fr.) Burt – 7 – *Salix* sp. – Common in Estonia on dead branches of *Salix* ssp.

Daedaleopsis confragosa (Bolton: Fr.) J. Schröt. – 2 – *Salix caprea*. – In Estonia mainly on dead *Salix* trunks and fallen branches, usually in secondary communities near ditches and rivulets.

Datronia mollis (Sommerf.: Fr.) Donk – 1, 2, 7, 13 – *Populus tremula*.

Fomes fomentarius (L.: Fr.) Fr. – 1, 3, 5, 6, 8, 12, 13 – *Betula pendula, B. pubescens*. – Very common everywhere in Estonia.

Fomitopsis pinicola (Sw.: Fr.) P. Karst. – 1, 2, 3, 5, 6, 7, 10, 11, 12, 13 – *Alnus incana, Betula pendula, B. pubescens, Picea abies, Populus tremula*; at base of a living trunk of *Tilia cordata*. – Very common everywhere

in Estonia; of living trees, only *T. cordata* is rarely infected.

Galzinia pedicellata Bourdot – 1 – *Picea abies* (TAA 162217). – First locality in Estonia.

Ganoderma applanatum (Pers.) Pat. – 1, 2 – *Alnus incana, Populus tremula*. – Common in Estonian forests, mainly on fallen logs of *Populus tremula*.

G. lucidum (Fr.) P. Karst. – 6 – a deciduous tree.

Gloeocystidiellum convolvens (P. Karst.) Donk – 1, 3, 6 – *Alnus incana, Betula pubescens, Fomes fomentarius*.

G. ochraceum (Fr.: Fr.) Donk – 12 – *Picea abies*.

Gloeophyllum odoratum (Wulfen: Fr.) Imazeki – 2, 4 – *Picea abies*.

G. sepiarium (Wulfen: Fr.) P. Karst. – 4, 5, 7 – *Picea abies*. – Common on clear-cut areas of coniferous forests in Estonia; not numerous in "natural" forests.

Hapalopilus nidulans (Fr.) P. Karst. – 11 – *Betula pubescens*.

Heterobasidion annosum (Fr.) Bref. – 2 – *Picea abies*.

Hydnum repandum L.: Fr. – 2, 3, 4, 6.

Hymenochaete cinnamomea (Pers.: Fr.) Bres. – 1, 7 – *Alnus incana, Quercus robur*. – Found everywhere in Estonia, but nowhere numerous.

H. tabacina (Sowerby: Fr.) Lév. – 3, 7, 9 – *Alnus incana, Corylus avellana, Salix* sp. – Most finds of this species in Estonia are from secondary stands, on dead branches of *Salix* sp. a.o. at ditches, rivulets, etc.

Hyphoderma argillaceum (Bres.) Donk – 1, 3, 5, 7, 9 – *Alnus incana, Picea abies, Populus tremula*.

H. puberum (Fr.: Fr.) Wallr. – 13 – *Populus tremula*.

H. setigerum (Fr.: Fr.) Donk – 1, 8 – *Alnus incana, Betula pubescens, Populus tremula*. – The species is common in Estonia but not numerous in "natural" forests (except in oak stands).

Hyphodontia abieticola (Bourdot & Galzin) J. Erikss. – 6 – *Picea abies*.

H. alutacea (Fr.: Fr.) J. Eriksson – 10 – *Pinus sylvestris*.

H. aspera (Fr.) J. Erikss. – 3, 7, 8, 10. 12 – *Betula pubescens, Picea abies, Pinus sylvestris*. – Common in Estonia.

H. barba-jovis (Fr.: Fr.) J. Erikss. – 5, 7, 8 – *Betula pubescens, Pinus sylvestris*.

H. breviseta (P. Karst.) J. Erikss. – 2, 3, 8, 13 – *Juniperus communis, Picea abies, Pinus sylvestris*. – Common in Estonia.

H. cineracea (Bourdot & Galzin) J. Erikss. & Hjortstam – 7, 8 – *Juniperus communis*.

H. crustosa (Fr.: Fr.) J. Erikss. – 2 – *Juniperus communis, Populus tremula, Sorbus aucuparia*.

H. pallidula (Bres.) J. Erikss. – 3 – *Sorbus aucuparia, Picea abies*.

H. subalutacea (P. Karst.) J. Erikss. – 4, 8 – *Betula pubescens, Pinus sylvestris*.

Hypochnicium bombycinum (Sommerf.: Fr.) J. Erikss. – 1 – *Populus tremula*.

H. lundellii (Bourdot) J. Erikss. – 2 – *Picea abies*.

Inonotus obliquus (Fr.: Fr.) Pilát – 1, 3, 7 – *Alnus incana* (rare), *Betula pendula, B. pubescens*. – Very common in Estonia; basidiomes are short-living and usually one can find only old remnants of these, and sterile conks.

I. radiatus (Sowerby: Fr.) P. Karst. – 1, 3, 4, 6, 7, 13 – *Alnus glutinosa, A. incana*. – Very common in Estonia, mainly on *Alnus* wood.

I. tomentosus (Fr.) Teng – 1, 2, 4 – *Picea abies*. – The species has been found in Estonia mainly in spruce stands which have been thinned or othervise influenced by human activities.

Junghuhnia nitida (Pers.: Fr.) Ryvarden – 1, 4 – *Populus tremula*.

J. pseudozilingiana (Parmasto) Ryvarden – 7 – *Phellinus tremulae*. – The species is very rare in Estonia; it has not been found for tens of years after it was described, but in the last three or four years several new localities have been observed. It may be called an indicator of old forests: all *Populus tremula* trees with this fungus are old or very old.

Mucronella calva (Alb. & Schwein.: Fr.) Fr. – 8 – *Picea abies*.

Oligoporus caesius (Schrad.: Fr.) Gilb. & Ryvarden – 1, 2, 3, 9 – *Picea abies*. – Common in Estonia; frequent on thin spruce trunks felled for thinning.

O. leucomallellus (Murrill) Gilb. & Ryvarden – 7 – *Picea abies*.

O. subcaesius (A. David) Ryvarden & Gilb. – 2, 7 – *Salix caprea* and a rotten deciduous

trunk.

Oxyporus corticola (Fr.: Fr.) Ryvarden – 2, 5 – *Populus tremula*.

O. populinus (Schumach.: Fr.) Donk – 7 – *Alnus incana* (!).

Paullicorticium ansatum Liberta – 11 – *Pinus sylvestris* (TAA 164767). – First locality in Estonia.

Peniophora cinerea (Fr.: Fr.) Cooke – 7 – *Tilia cordata*.

P. pithya (Pers.) J. Erikss. – 7 – *Picea abies* (TAA 164722).

P. polygonia (Pers.: Fr.) Bourdot & Galzin – 4, 7 – *Populus tremula*.

P. violaceolivida (Sommerf.) Massee – 10 – *Betula pendula*.

Phanerochaete laevis (Fr.: Fr.) J. Erikss. & Ryvarden – 13 – *Betula pubescens*.

Ph. sanguinea (Fr.: Fr.) Pouzar – 8 – *Picea abies, Pinus sylvestris*.

Ph. sordida (P. Karst.) J. Erikss. & Ryvarden – 7, 10 – *Pinus sylvestris, Populus tremula*.

Ph. velutina (DC.: Fr.) P. Karst. – 5, 6 – *Betula pendula, Picea abies*.

Phellinus alni (Bondartsev) Parmasto – 1, 2, 3, 4, 8, 9, 13 – *Alnus glutinosa, A. incana, Betula pubescens*.

Ph. chrysoloma (Fr.) Donk – 2, 6, 12 – *Picea abies*. – Scattered but not rare in Estonia.

Ph. conchatus (Pers.: Fr.) Quél. – 2, 4, 7, 11 – *Salix caprea*.

Ph. ferruginosus (Schrad.: Fr.) Bourdot & Galzin – 5 – *Alnus incana*. – In Estonia not seldom in nemoral or mixed spruce forests, mainly on fallen twigs and trunks of *Corylus avellana*.

Ph. igniarius (L.: Fr.) Quél. (s. str.) – 2 – *Salix caprea*.

Ph. laevigatus (Fr.) Bourdot & Galzin – 3, 5 – *Betula pubescens*. – In Estonia rather seldom.

Ph. nigricans (Fr.: Fr.) P. Karst. – 3, 5, 6, 7, 8, 11, 13 – *Alnus incana, Betula pendula, B. pubescens, Sorbus aucuparia*.

Ph. nigrolimitatus (Romell) Bourdot & Galzin – 7 – *Picea abies* (TAA 164654). – Very rare in Estonia, found in old forests undisturbed by forest management.

Ph. populicola Niemelä – 1, 4 – *Populus tremula*, on living trunks. – In Estonia scattered, on old living aspen trees.

Ph. punctatus (Fr.) Pilát – 3, 7 – *Alnus incana, Populus tremula* (?).

Ph. tremulae (Bondartsev & Borissov) Bondartsev – 1, 2, 3, 4, 12, 13 – *Populus tremula*. – Very common everywhere in Estonia.

Phlebia livida (Pers.: Fr.) Bres. – 6, 10 – *Picea abies, Pinus sylvestris*.

Ph. rufa (Pers.: Fr.) M. P. Christ. – 9, 10 – *Alnus incana, Betula pendula*.

Ph. serialis (Fr.: Fr.) Donk – 8 – *Pinus sylvestris*.

Ph. tremellosa (Schrad.: Fr.) Nakasone & Burds. – 1, 2, 6 – *Alnus incana*, on a log of a deciduous tree.

Phlebiella sulphurea (Pers.: Fr.) Ginns & Lefebvre – 2, 3, 8, 9, 10, 13 – *Betula pubescens, Picea abies, Pinus sylvestris, Populus tremula*. – One of the most common corticioid species on fallen trunks and branches of coniferous trees in Estonia.

Ph. tulasnelloidea (Höhn. & Litsch.) Oberwinkler – 3 – *Sorbus aucuparia*.

Physisporinus vitreus (Pers.: Fr.) P. Karst. – 9, 11 – on rotten logs of deciduous trees (TAA 162287). – In Estonia rare, most collections are from old moist (flooded) *Alnus glutinosa–Picea abies* forests.

Piloderma bicolor (Peck) Jülich – 2, 3, 10, 11 – *Betula pubescens, Pinus sylvestris, Populus tremula*. – One of the most common litter (mycorrhizal) fungi in coniferous forests in Estonia.

P. byssinum (P. Karst.) Jülich – 2, 10 – *Picea abies*. – Common in Estonia.

Piptoporus betulinus (Bull.: Fr.) P. Karst. – 1, 3, 4, 5, 7, 8, 11 – *Betula pendula, B. pubescens*.

Phyllotopsis nidulans (Pers.) Singer – 1 – *Betula pubescens*.

Plicatura nivea (Sommerf.: Fr.) P. Karst. – 1, 9 – *Alnus incana*.

Polyporus varius Fr.: Fr. – 1, 2, 3, 5, 7, 13. – *Alnus incana, Salix caprea*.

Porotheleum fimbriatum (Pers.: Fr.) Fr. – 6, 9, 12, 13 – *Alnus incana, Juniperus communis, Picea abies, Populus tremula*.

Pseudomerulius aureus (Fr.: Fr.) Jülich – 8, 10 – *Pinus sylvestris*. – In Estonia not common.

Pycnoporellus fulgens (Fr.) Donk – 1, 3 – *Picea abies*. – Infrequent in Estonia.

Radulomyces confluens (Fr.: Fr.) M. P. Christ. – 7.

Resinicium bicolor (Alb. & Schwein.: Fr.)

Parmasto – 1, 4, 5, 13 – *Juniperus communis, Picea abies, Salix caprea*. – Very common in Estonia.

SCOPULOIDES HYDNOIDES (Cooke & Massee) Hjortstam & Ryvarden – 3, 6, 8 – *Betula pendula, Betula pubescens, Picea abies*.

SCYTINOSTROMA ODORATUM (Fr.: Fr.) Donk – 5, 10 – *Betula pendula, Picea abies, Populus tremula*.

S. PORTENTOSUM (Berk. & M. A. Curtis) Donk – 1 – *Populus tremula*.

SISTOTREMA BRINKMANNII (Bres.) J. Erikss. – 6 – *Fomitopsis pinicola*.

S. SERNANDERI (Litsch.) Donk – 1 – on a dead basidiome of *Ganoderma applanatum*.

SKELETOCUTIS AMORPHA (Fr.) Kotl. & Pouzar – 1, 4, 10 – *Picea abies, Pinus sylvestris*.

S. CARNEOGRISEA A. David – 5 – *Picea abies*. – In Estonia found in many localities on dead basidiomata of *Trichaptum abietinum* and on rotten spruce wood.

S. STELLAE (Pilát) Jean Keller – 4, 12 – *Picea abies* (TAA 164673, 164777). – In Estonia rare.

S. SUBINCARNATA (Peck) Jean Keller – 1 – *Picea abies*.

STECCHERINUM FIMBRIATUM (Pers.: Fr.) J. Erikss. – 1, 7, 8, 13 – *Alnus incana, Betula pubescens, Populus tremula*.

S. OCHRACEUM (Pers.: Fr.) Gray – 1, 13 – *Alnus glutinosa, A. incana, Phellinus tremulae*.

STEREUM HIRSUTUM (Willd.: Fr.) Gray – 1, 5, 7, 8 – *Alnus incana, Betula pendula, B. pubescens*.

S. RUGOSUM (Pers.: Fr.) Fr. – 2, 5, 9, 11 – *Alnus incana, Corylus avellana, Salix caprea*.

S. SANGUINOLENTUM (Alb. & Schwein.: Fr.) Fr. – 6, 7 – *Picea abies*.

S. SUBTOMENTOSUM Pouzar – 1, 3, 5, 6 – *Alnus incana, Betula pubescens* (rarely). – Not rare in Estonia, mainly on fallen trunks and branches of *Alnus glutinosa* and *A. incana*, rarely also of other deciduous trees.

TOMENTELLA BRYOPHILA (Pers.) M. J. Larsen – 2 – *Populus tremula*.

T. CINERASCENS (P. Karst.) Höhn. & Litsch. – 13 – *Alnus glutinosa*.

T. ELLISII (Sacc.) Jülich & Stalpers – 1 – *Populus tremula*.

T. FERRUGINEA (Pers.: Fr.) Pat. – 4 – *Alnus glutinosa*.

T. UMBRINOSPORA M. J. Larsen – 6 – *Betula pubescens*.

TRAMETES HIRSUTA (Wulfen: Fr.) Pilát – 1, 4 – *Alnus incana*.

T. OCHRACEA (Pers.) Gilb. & Ryvarden – 1, 4, 7, 13 – *Betula pubescens, Populus tremula*.

TRECHISPORA FARINACEA (Pers.: Fr.) Liberta – 1, 2, 3, 4, 5, 6, 8, 13 – *Picea abies, Pinus sylvestris*; log of a deciduous tree. – Common in coniferous and mixed forests in Estonia.

T. MOLLUSCA (Pers.: Fr.) Liberta – 5, 7 – *Sorbus aucuparia*; log of a deciduous tree.

TRICHAPTUM ABIETINUM (Dicks.: Fr.) Ryvarden – 1, 2, 3, 4, 6, 7, 8, 13 – *Picea abies, Pinus sylvestris*. – One of the most common species on fallen trunks and branches of coniferous trees (*Picea abies, Pinus sylvestris*) in Estonia.

TUBULICRINIS PROPINQUUS (Bourdot & Galzin) Donk – 12 – *Picea abies*.

UTHATOBASIDIUM FUSISPORUM (J. Schröt.) Donk – 1 – *Populus tremula* (TAA 164606). – First collection in Estonia.

VESICULOMYCES CITRINUS (Pers.) Hagström – 10 – *Picea abies*. – Common in Estonia.

VUILLEMINIA COMEDENS (Nees: Fr.) Maire – 6 – *Quercus robur*. – Common in Estonia.

ANAMORPHS

COSTANTINELLA ATHRIX Nannf. & J. Erikss. – 1, 4 – *Picea abies, Populus tremula*.

HAPLOTRICHUM CONSPERSUM (Link) Hol.–Jech. – 3, 8, 9 – *Betula pubescens*.

DISCUSSION AND CONCLUSIONS

Old forest indicator fungi

During the last decades, studies in biodiversity and projects on nature conservation have focussed on old and virgin, or pristine forests. Intensive forest management combined with air pollution ("acid rains") has caused impoverishment of forest flora and fauna in many countries. One of the ways to mitigate these undesirable changes is to take under nature conservation "islands" of old forests with their rich biodiversity and undisturbed interactions between all living organisms, including fungi.

The main criteria in selecting the protected "islands" of forest are the inclusion of all the main but also rare forest types in a region, and maximal biodiversity of the forest stands selected.

There are no really primeval (virgin) forests in Estonia except old *Pinus sylvestris* stands on high (elevated) bogs not usable for cutting. Of the other old forests, some have not been managed for decades; as a result, there are numerous fallen rotten tree trunks (logs) inhabited by many wood-rotting fungi. The presence of logs and other dead wood is important for maintaining high biodiversity in forests (Samuelsson et al., 1994). Such dead wood has been characterized as a "complex, meticulous recycling station that deposits minerals and humus on the ground" and is therefore "indispensable to forest food chains" (Deyrup, 1981).

In contrast to flowering plants, the species richness of fungi, many microorganisms and insects depends heavily on the forest management type and on the age of the forest. In boreal forests, the number of species of wood-rotting fungi is up to four times higher on old decomposed fallen trunks than on freshly fallen trunks (Niemelä, Renvall & Penttilä, 1995). In the final stages of wood decay, the trunks maintain "exceptionally diverse species combinations" of saprotrophic fungi (Renvall, 1995: 43). Tens of rare species of polypores and corticiaceous fungi have been found only in unmanaged old forests in Estonia. On the other hand, the presence of such species reflects the richness of the flora and fauna in forests, i.e. is an indicator of natural biodiversity.

In some papers mainly by Finnish and Swedish mycologists, there have been attempts to use aphyllophoroid (mainly polyporoid) fungi as indicators of old and/or primeval forests worthy of protection. The species are hopefully indicators of the long continuity of forest ecosystems (*ecological continuity*).

The selection of indicator species has been mainly based on intuitial observations not verified by quantitative studies. 34 fungal species characteristic for old forests and 23 for virgin forests are listed by Kotiranta & Niemelä (1993, 1996), 45 indicator species by Karström (1993), and 10 species of polypores for one region of Latvia by Meiere (1996). Most of these species are indicators suitable for studies in Estonia, too. Some species have not yet been found in this country, or are too rare to be used in practice. Some species used as good indicators in Finland tolerate moderate forest management and other human interference in Estonia (i.e., *Phellinus chrysoloma*, *Pseudomerulius aureus*). To the list of species given by Kotiranta & Niemelä and Karström, several additional aphyllophoraceous fungi may be added in this country. During the last 45 years, the senior author has studied these fungi in Estonia, collecting mainly in old forests; the list given below is a result of these collections and field observations.

The *old forest indicator fungi* may be defined as more or less easily recognizable macrofungi distributed mainly or only in old forests minimally affected by forest management.

Preliminary list of Estonian old forest indicator fungi

Species also included in lists by Kotiranta and Niemelä are marked with an asterisk *, species in Karstöm's list with the sign @, and indicators mentioned by Meiere with the sign #.

Amylocorticium subincarnatum (Peck) Pouzar
* @ Amylocystis lapponica (Romell) Singer
* @ Anomoporia bombycina (Fr.: Fr.) Pouzar
* @ Antrodia crassa (P. Karst.) Ryvarden
* @ Asterodon ferruginosus Pat.
Boletopsis leucomelaena (Pers.) Fayod
Byssocorticium atrovirens (Fr.: Fr.) Bondartsev & Singer
Ceriporia excelsa (Lundell) Parmasto
Ceriporiopsis myceliosa (Peck) Ryvarden & Gilb.
Dentipellis fragilis (Pers.: Fr.) Donk
* @ Diplomitoporus crustulinus (Bres.) Domanski
* @ Fomitopsis rosea (Alb. & Schwein.: Fr.) P. Karst.
Ganoderma lucidum (W. Curt.: Fr.) P. Karst.
* @ Gloiodon strigosus (Sw.: Fr.) P. Karst.
Grifola frondosa (Dicks.: Fr.) S.F. Gray
Hapalopilus croceus (Pers.: Fr.) Bondartsev & Singer
@ H. salmonicolor (Berk. & M. A. Curtis) Pouzar
Haplotrichum aureum (Pers.) Hol.–Jech.
@ Hericium coralloides (Scop.: Fr.) S. F. Gray
* @ Junghuhnia collabens (Fr.) Ryvarden
@ J. luteoalba (P. Karst.) Ryvarden
J. pseudozilingiana (Parmasto) Ryvarden
* # Leptoporus mollis (Pers.: Fr.) Quél.
* # Oligoporus guttulatus (Peck) Gilb. & Ryvarden
* @ O. placentus (Fr.) Gilb. & Ryvarden
@ Perenniporia medulla-panis (Jacq.: Fr.) Donk
* @ P. subacida (Peck) Donk
* Phaeolus schweinitzii (Fr.: Fr.) Pat.
* @ Phellinus ferrugineofuscus (P. Karst.) Bourdot
* @ Ph. nigrolimitatus (Romell) Bourdot & Galzin
* @ Phlebia centrifuga P. Karst.

PHYSISPORINUS SANGUINOLENTUS (Alb. & Schwein.) Pilát
PH. VITREUS (Pers.: Fr.) P. Karst.
* # PYCNOPORELLUS FULGENS (Fr.) Donk
RIGIDOPORUS CROCATUS (Pat.) Ryvarden
SERPULA HIMANTIOIDES (Fr.: Fr.) Bondartsev
SISTOTREMA RADULOIDES (P. Karst.) Donk
SKELETOCUTIS VULGARIS (Fr.) Niemelä & Y. C. Dai (comb. ined.)
* SKELETOCUTIS ODORA (Sacc.) Ginns
* S. STELLAE (Pilát) Jean Keller
STECCHERINUM ROBUSTIUS (J. Erikss. & Lundell) J. Erikss.
TOMENTELLA CRINALIS (Fr.) M. J. Larsen

Evaluation of old forests studied

The list of indicator species given above was used for preliminary estimation of the conservational value of old forests studied by us in 1995 and 1996. In the Central Estonian forests studied in 1995, only 7 of the 43 indicator species were found. This small number does not mean that the list is too "strict" including only very rare species. In 1996, when weather conditions were equally unfavourable for most aphyllophoraceous fungi, forests of the Alam-Pedja Nature Reserve were studied preliminarily. Among 180 species of wood-rotting aphyllophoraceous fungi, 16 indicators of old forests were found, including 11 species on a small (sub)nemoral spruce forest "island" Vtivik.

Of the 13 study plots in Central Estonia, in 8 only one indicator species was found, and in one forest two species. The last mentioned plot, periodically flooded spruce forest at Prandi River (locality no. 7) is rich in wood rotting fungi. Indicator species *Junghuhnia pseudozilingiana* and *Phellinus nigrolimitatus* have been found there, as well as an in Europe very rare resupinate polyporaceous fungus *Ceriporia subreticulata*, an in Estonia rare species *Aleurodiscus amorphus* and *Tremella simplex*, which is new to Estonia, and parasitizes *A. amorphus*. Physiognomically, this plot is a "typical" almost undisturbed old forest worth to be protected.

Another physiognomically as well as mycologically valuable forest is the Lepametsa mixed spruce forest (locality no. 1). Of the indicator species, *Pycnoporellus fulgens* has been found there; first Estonian localities of the very rare in Europe corticioid fungi *Galzinia pedicellata* and *Uthatobasidium fusisporum* were detected by us, too.

Fungi are an important component of biodiversity in old forests. There are only few cases when a forest deserves protection because of the richness of its fungal "flora". Nevertheless, in a forest stand protected for other reasons, numerous rare fungal species may survive, especially now when forest management will continue to be intensified in Estonia.

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On the powdery mildews (Erysiphaceae) of Yakutia

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Kokkuvõte: H. Karis ja J. Elliku. Jakuutia jahukastelised (Erysiphaceae).

1983. a. Jakuutia ekspeditsioonil kogutud herbaareksemplaride alusel esitatakse 36 peremeestaimel parasiteeriva 22 jahukaste liigi nimestik. See on esimene artikkel, kus esitatakse andmed jahukasteliste levikust Jakuutias 60° põhjalaiusest lõunasse jääval alal.

This is the first report on the distribution of powdery mildews (Erysiphaceae Lév.) in Yakutia south of 60°N. The report is based on material collected by the authors during an expedition from September 12 to 19, 1983 in the Aldan River basin along the river from Aldan to Chagda.

The area investigated belongs to the Middle Taiga Vegetational Zone. According to a climatic atlas, the sum of effective temperatures in this area is 800°– 1200°, and the rainfall during the summer is 350–400 mm.

Collected specimens were identified by H. Karis using Braun's monograph (1987), names of the host species are based on Czerepanov's handbook (1981).

The authors found 22 species of powdery mildew fungi parasitizing on 36 host species. Among these, two species of fungi (*Microsphaera lonicerae*, *Podosphaera tridactyla*) and 11 host species (*Alnus hirsuta*, *A. sibirica*, *Betula fruticosa*, *Inula salicina*, *Lonicera edulis*, *Padus avium*, *Polemonium racemosum*, *Populus tremula*, *Potentilla multifida*, *Salix caprea*, *S. viminalis*) were not earlier known in the northern part of Yakutia (Karis, 1980).

Phyllactinia guttata, rather rare on the species of *Salix* in Eastern Europe and Asia (Fig. 1), was found on leaves of *Salix viminalis* in a riverside brushwood near the mouth of the Chaga River.

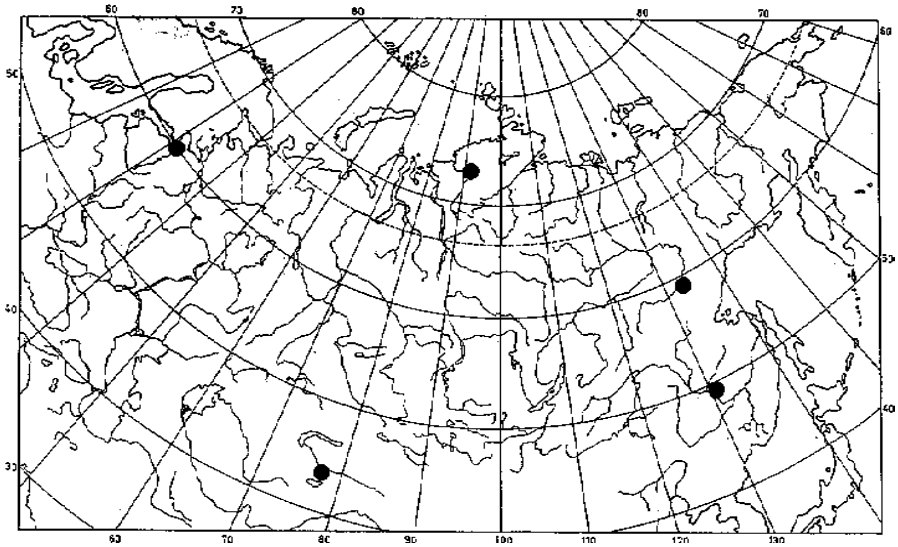

Fig.1. Localities of *Phyllactinia guttata* on *Salix* species in Eastern Europe, North and Central Asia.

List of the species collected in 1983

BLUMERIA GRAMINIS (DC.) Speer – Yakokit, on *Beckmannia syzigache* (Stend.) Fernand; Tommot, on *Elytrigia repens* (L.) Nevski

ERYSIPHE AQUILEGIAE DC. – Chagda, on *Atragene sibirica* L.; Tommot, on *A. sibirica*; Yakokit, on *A. sibirica*; Chagda, on *Ranunculus repens* L.; Tommot, on *R. repens*; Yakokit, on *R. repens*; Chagda, on *Thalictrum minus* L.; Tommot, on *T. minus*; Yakokit, on *T. minus*; Chagda, on *Thalictrum* sp.; Yakokit, on *Thalictrum* sp.

ERYSIPHE ARTEMISIAE Grev. – Chagda, on *Artemisia* sp.; Tommot, on *Artemisia* sp.; Yakokit, on *Artemisia* sp.

ERYSIPHE CICHORACEARUM DC. – Tommot, on *Achillea millefolium* L.; Yakokit, on *A. millefolium*; Yakokit, on *Hieracium umbellatum* L.; Tommot, on *Inula salicina* L.; Chagda, on *Tanacetum vulgare* L.; Tommot, on *T. vulgare*; Yakokit, on *T. vulgare*.

ERYSIPHE PISI DC. – Chagda, on *Vicia cracca* L.; Yakokit, on *V. cracca*; Chagda, on *Vicia* sp.; Tommot, on *Vicia* sp.

MICROSPHAERA HEDYSARI U. Braun – Chagda, on *Hedysarum* sp.

MICROSPHAERA LONICERAE (DC.) Wint. – Chagda, on *Lonicera edulis* Turcz. ex Freyn; Yakokit, on *L. edulis*.

MICROSPHAERA ORNATA U. Braun – Tommot, on *Betula fruticosa* Pall.

MICROSPHAERA PENICILLATA (Wallr.: Fr.) Lév. – Chagda, on *Alnus hirsuta* (Spach) Turcz. ex Rupr.; Yakokit, on *A. hirsuta* and on *A. sibirica* (Spach) Turcz. ex Kom.; Chagda, on *Duschekia fruticosa* (Rupr.) Pouzar; Tommot, on *D. fruticosa*.

MICROSPHAERA TRIFOLII (Grev.) U. Braun – Chagda, on *Trifolium lupinaster* L.; Tommot, on *T. lupinaster*; Tommot, on *Trifolium* sp.; Yakokit, on *Trifolium* sp.

PHYLLACTINIA GUTTATA (Wallr.: Fr.) Lév. – Chagda, on *Alnus hirsuta*; Chagda, on *Duschekia fruticosa*; Chagda, on *Betula platyphylla* Sukacz.; Chagda, on *Salix viminalis* L.

PODOSPHAERA CLANDESTINA (Wallr.: Fr.) Lév. – Chagda, on *Spiraea media* Franz Schmidt; Chagda, on *Spiraea salicifolia* L.

PODOSPHAERA MYRTILLINA (Schub.: Fr.) Kunze – Aldan, on *Vaccinium uliginosum* L.; Tommot, on *V. uliginosum*.

PODOSPHAERA TRIDACTYLA (Wallr.) de Bary – Aldan, on *Padus avium* Mill.; Yakokit, on *P. avium*.

SPHAEROTHECA APHANIS (Wallr.) U. Braun – Tommot, on *Pentaphylloides fruticosa* (L.) O. Schwarz; Chagda, on *Potentilla multifida* L.; Chagda, on *Potentilla* sp.

SPHAEROTHECA FULIGINEA (Schlecht.: Fr.) Poll – Chagda, on *Veronica longifolia* L.; Aldan, on *V. longifolia*.

SPHAEROTHECA FUSCA (Fr.) S. Blumer – Chagda, on *Taraxacum* sp.

SPHAEROTHECA PANNOSA (Wallr.: Fr.) Lév. – Chagda, on *Rosa acicularis* Lindl.; Tommot, on *R. acicularis*; Yakokit, on *R. acicularis*.

SPHAEROTHECA PLANTAGINIS (Cast.) L. Junell – Tommot, on *Plantago media* L.

SPHAEROTHECA POLEMONII L. Junell – Aldan, on *Polemonium racemosum* (Regel) Kitam.

SPHAEROTHECA SPIRAEAE Sawada – Chagda, on *Filipendula palmata* (Pall.) Maxim.

UNCINULA ADUNCA (Wallr.: Fr.) Lév. – Chagda, on *Populus tremula* L.; Chagda, on *Salix* sp.; Aldan, on *Salix* sp.; Yakokit, on *Salix* sp.

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Explosion of *Melampsoridium* sp. on *Alnus incana*

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Kokkuvõte: K. Põldmaa. Roosteseene *Melampsoridium* liigi massiline puhang hallil lepal.
1996. a. augustis märgati roosteseene suvieoslaid halli lepa (*Alnus incana*) lehtedel kahes Eesti maakonnas. Edasised vaatlused näitasid, et tegu on massilise puhanguga üle kogu Eesti. Sanglepa (*A. glutinosa*) nakatumist täheldati vaid ühes kohas. Samasugune oli olukord ka Lätis ning Leedus. Hiljutiste tööde kohaselt on Euroopas leppadel kohatava rooste puhul tegemist siin kaskedel laialdaselt levinud roosteseenega *Melampsoridium betulinum* Kleb. Mikroskoopiliste tunnuste osas on aga Eestist kogutud eksemplarid eristamatud liigist *M. hiratsukanum* S. Ito, mis parasiteerib leppadel Aasias. 1996. a. Baltikumis lepal esmakordselt leitud rooste massilise ning äkilise puhangu tekitaja taksonoomiline kuuluvus ning levik vajavad edasist selgitamist.

In the second half of August 1996, rust pustules on the lower surface of leaves of alder (*Alnus incana* (L.) Moench) were found in Tartumaa Co. and Valgamaa Co. in South-East Estonia. Further observations revealed that the rust occurred everywhere it was looked for, injuring most trees of alder. It was recorded in many counties from South Estonia up to the northern coast, on the roadside of the whole Tartu – Pärnu highway, and also on the isolated Ruhnu Island in the Gulf of Riga.

In the middle of September leaves of *A. glutinosa* (L.) Gaertn. were also checked for the occurrence of the rust at several places in the western part of Viljandimaa (between Kõpu and Tipu) and in some other counties. Except for the scanty uredosori found on a few leaves of *A. glutinosa* in Alam-Pedja Nature Reserve (it grew together with *Microsphaera penicillata* (Wallr.) Lev., a powdery mildew, with very few known localities on that host species in Estonia (Karis, 1987)), no rust could be found on this possible host, usually growing among the totally infected trees of *A. incana*. Also in the other two Baltic countries the rust was abundant on *A. incana* and was only once found on *A. glutinosa* in Latvia (E. Vimba pers. comm.).

Rust fungi growing on the members of *Betulaceae* belong to the genus *Melampsoridium* (Melampsoraceae, Uredinales). The dikaryophase of the most common species, *M. betulinum* Kleb. grows on species of *Betula* and is distributed all over the temperate northern hemisphere (Farr et al., 1989). It is also reported to be the cause of rust infections of *Alnus* species in Europe and North America (Kaneko & Hiratsuka, 1981; Roll-Hansen & Roll-Hansen, 1981). In addition, two more species of this genus have been described to occur on species of *Alnus*. According to Kaneko & Hiratsuka (1981), *M. alni* (Thüm.) Diet. and *M. hiratsukanum* S. Ito occur on the species of *Alnus* subgenera *Alnaster* and *Gymnotharsus* respectively. Both species are known from Siberia, Russian Far East and Japan (Kuprevicz & Tranzshel, 1957), but also some European collections have been reported under these names (F. & H. Roll-Hansen, 1981). Their aecial stages occur on species of *Larix* but at least *M. betulinum* is known to persist also independently of host-alternation.

F. & H. Roll-Hansen (1981) studied microscopical characters of the uredospores from European collections on *Alnus cordata*, *A. incana* and *A. glutinosa,* and identified these as *M. betulinum*. They also compared these with two collections of *M. alni* from Siberia, carried out infection experiments, and concluded that *M. alni* is conspecific with *M. betulinum*. Still, all the mentioned authors recognize *M. hiratsukanum* as a distinct species, distinguishable from the other species by smaller uredospores which are echinulate over the whole surface.

In specimens collected from Estonia in August 1996, scanty uredosori were observed on the lower surface of the leaves of alders, which became almost totally covered with uredinia and telia during subsequent months. The infection was easily observable already

from distance as the leaves appeared brownish and their lower surface covered by powder of released uredospores. In the specimens studied the range of absolute values is 17–36 µm for uredospores length and 8.5–15 µm for width, and means vary between 22.5–28 µm and 10.5–12.5 µm respectively (30 spores measured per specimen). Uredospore wall is echinulate over the whole surface. Teliospores are in a densely palisade-like layer, measuring 30–50 x 11–16 µm. The rust on alders occurred on small as well as on high, over ten years old trees, while on birches *M. betulinum* causes severe damage only on young shoots in Estonia (Põldmaa, 1967; pers. obs.).

In our collections uredospores tend to measure less than given for *M. betulinum* and *M. alni* and lack the smooth area without wall ornamentation at the upper end, characteristic of these species, resembling thus *M. hiratsukanum.* Distribution of this species in Europe is still considered in doubt (Kaneko & Hiratsuka, 1981), although these features have also been noted in some European collections on *Alnus* spp., as reported by F. & H. Roll-Hansen (1981). In Europe the occurrence of rust on the species of *Alnus* (named *as Melampsoridium alni, M. betulinum* or *M. hiratsukanum*) has been recorded from Finland, Ireland, Italy, Norway and Scotland. The closest findings are from Helsinki in 1953 (Jørstad & Nannfeldt, 1958) and a nursery at the Agricultural University of Norway at Ås in 1972 (F. & H. Roll-Hansen, 1981). These are both single collections on *A. glutinosa*. Despite of the years-long search (including the fall of 1996), the fungus has not been found any more in Finland (Yrjö Mäkinen, pers. comm.). Although *M. betulinum* is very common on birches in the Baltic countries, no rusts have been earlier collected here on *Alnus* spp. (Minkevicius & Ignataviciute, 1991).

In *M. betulinum* special forms have been recognized which differ in their ability to infect different species of *Betula* (Gäumann, 1959) and presumably also species of *Alnus* (F. & H. Roll-Hansen, 1981). It leads to assume that in the Baltics we might have a form of the same species, restricted to *A. incana*, and that host specialization has been accompanied by morphological divergence. Yet the spread of rust spores of the Asian species *M. hiratsukanum* cannot also be ruled out, moreover if relying upon morphology. It is possible that the rust had infected alders to some extent already in previous years but remained unnoticed. Only favourable climatic conditions might have been responsible for its explosion and discovering in 1996. The origin of the explosive spread of the rust on *Alnus incana* in the Baltics and its taxonomic identity remains until unknown. Because of the very few morphological characters available, studies on other characters and infection experiments will be needed to prove its conspecifity with the known species of *Melampsoridium.*

Specimens examined (all collected in 1996):

(* marks the occurrence of *Microsphaera penicillata* (Wallr.) Lev. in addition to *Melampsoridium* sp.)

on *Alnus glutinosa* – ESTONIA. Jõgevamaa Co., Alam-Pedja Nature Reserve, near Nõmmeotsa, 10 Sept., K. Põldmaa (TAA 169570)*

on *Alnus incana* – ESTONIA. Tartumaa Co., Võnnu Distr., Terikeste, 18 Aug., K. Põldmaa (TAA 161957)*; Valgamaa Co., Otepää Landscape Reserve Area, Saare, 22 Aug., E. Parmasto (TAA 164883); Ida-Virumaa Co., 3 km SSW of Virunurme, Kaukvere Primeval forest, 3 Sept., K. Põldmaa (TAA 169538); Jõgevamaa Co., Alam-Pedja Nature Reserve, near Nõmmeotsa, 10 Sept., K. Põldmaa (TAA 169568); Harjumaa Co., Kanama, 15 Sept., E. Parmasto (TAA 154149); Raplamaa Co., Ruunavere, 15 Sept., E. Parmasto (TAA 154151); Pärnumaa Co., Nigula Nature Reserve, 17 Sept., E. Parmasto & K. Põldmaa (TAA 169598); Saaremaa Co., Ruhnu Island, Norkkeld, 18 Sept., E. Parmasto (TAA 154221); Lääne-Virumaa Co., S of Karula, 4 Oct., E. Parmasto, (TAA 154342)*; Võrumaa Co., Rõuge Distr., 3 km E of Kangsti, 11 Oct., E. Parmasto (TAA 154471); Lääne-Virumaa Co., Vaeküla, 27 Oct., T. Tärnov (TAA 169654); Lääne-Virumaa Co., Torma, Oct., T. Tärnov (TAA 169653)*; Tartumaa Co., Vara forestry, Alajõe, 8 Nov., M. Hanso;

LATVIA. Kemeri National Park, 24 Sept., K. Kalamees (TAA 146946).

ACKNOWLEDGEMENTS

For providing leaves of alder, infected with *Melampsoridium betulinum* or information about the infection localities, the author is indebted to many mycologists, especially to Prof. Erast Parmasto who also made many corrections to the manuscript. Thanks also to Dr. Edgars Vimba, Dr. M. Ignataviciute and Dr. Y. Mäkinen for the information concerning Latvia, Lithuania and Finland respectively.

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Milesina, a rust genus new for Estonia

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Kokkuvõte: E. Vimba ja K. Põldmaa. Uus roosteseente perekond Eestis.

Muhumaal Üügu pangal kasvava müür-raunjala (*Asplenium ruta-muraria* L.) lehtedelt 1983. a. kogutud roosteseen *Milesina murariae* P. & H. Sydow osutus selle perekonna esmasleiuks Eestis. Hiljem on samast kohast seene suvieoslaid valminud suvieostega kogutud veel kahel korral. Siiani ei ole täheldatud ühegi teise perekonna *Milesina* liigi esinemist ei Eestis ega ka mujal Baltimaades, kuigi võimalikeks peremeesteks on mitmed siin kasvavad sõnajalgtaimed.

In October 1988 brown pustules were found on leaves of the fern *Asplenium ruta-muraria* L. at Üügu Cliff, Muhu Island. Microscopical examination revealed that these were uredosori of the rust fungus *Milesina murariae* P. & H. Sydow, syn. *Milesia murariae* (P. Magn.) Faull (Pucciniastraceae, Uredinales). In September 1993 the same place was visited again. Although lots of leaves of *A. ruta-muraria* were examined, uredosori were found only on very few of them. Uredospores from these collections are oval or slightly angular, 22–40 x 14–25 µm, hyaline, with echinulate wall. Later, while the senior author was working on his herbarium material, a third collection became available. It contained also a conidial fungus, *Ramularia asplenii* Jaap, which was earlier not been recorded from Estonia but has been found once in Latvia (Vimba, 1970).

Milesina murariae has been known neither from Estonia (Järva & Parmasto, 1980) nor from Latvia, where its host also occurs (Minkevicius & Ignataviciute, 1991; Smarods, 1952). Its closest known localities are in Sweden (Gjærum, 1974) and on the Crimean Peninsula in the Ukraine (Kuprevicz & Tranzschel, 1957). While no other species from the genus *Milesina* have hitherto been found in the Baltics, six of them are known from the Nordic countries (Gjærum, 1974). Their hosts which are found also throughout the Baltics are *Dryopteris filix-mas* (L.) Schott and *Polypodium vulgare* L. Other possible hosts are very rare here with few localities in Estonia and Latvia (*Blechnum spicant* (L.) Roth, *Polystichum lonchitis* (L.) Roth) or only in Estonia (*Asplenium septentrionale* (L.) Hoffm.).

Specimens examined (all growing on *Asplenium ruta-muraria*): Saaremaa Co., Muhu Is., Üügu Cliff, 21 May 1983, leg. E. Vimba (TAA 169657); same locality, 6 Oct. 1988, leg. E. Vimba (TAA 160723); same locality, 17 Sept.1993, leg. K. Põldmaa (TAA 161054).

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List of new taxa and combinations published in FCE no. 1-30.

Compiled by Urmas Kõljalg

The number of fascicle and date of publication are given after taxon name.

Fungi (lichens are marked with an asterisk*)

AGARICUS BISPORUS (Lange) Imbach *var.* ALBIDUS (Lange) Singer *f.* MICROSPORA Kalamees - Fasc. 15, 1981.
A. LUTEOFLOCCULOSUS Kalamees - Fasc. 17, 1985.
A. SUBSQUAMULIFERUS Kalamees - Fasc. 27, 1989.
ALBOTRICHA KAMTSCHATICA (Raitv.) Raitv. - Fasc. 17, 1985.
A. KURILENSIS Raitv. - Fasc. 2, 4 Jan. 1973.
A. LONGISPORA Raitv. - Fasc. 2, 4 Jan. 1973.
A. MINUTA Raitv. - Fasc. 2, 4 Jan. 1973.
A. PALLIDA Raitv. - Fasc. 2, 4 Jan. 1973.
A. VANTSCHENSIS Raitv. - Fasc. 12, 1981.
* ASAHINEA CULBERSONIORUM Trass - Fasc. 29, 1992.

BELONIDIUM LITORALE Raitv. - Fasc. 13, 1981.
B. SACCHALINENSIS Raitv. - Fasc. 9, 1977.
B. TIANSCHANICUM Raitv. - Fasc. 12, 1981.
* BIATORELLA CONTIGUA N. S. Golubk. & Piin - Fasc. 7, 1977.

CAMAROPHYLLUS ALBIDOCINEREUS Kalamees - Fasc. 27, 1989.
CAPILLIPES KALAMEESII Raitv. - Fasc. 1, 15 April 1972.
CISTELLA ATRA Raitv. - Fasc. 12, 1981.
C. FLAVORUBENS Raitv. - Fasc. 12, 1981.
C. PEDIFORMIS Raitv. - Fasc. 12, 1981.
* CLADINA BERINGIANA (Ahti) Trass - Fasc. 1, 15 April 1972.
* C. CILIATA (Stirt.) Trass - Fasc. 11, 1978.
* C. MITIS (Sandst.) Hale & W. L. Culb. *f.* ARENICOLA Trass - Fasc. 11, 1978.
* C. OXNERI (Rass.) Trass - Fasc. 1, 15 April 1972.
* C. TENUIFORMIS (Ahti) Trass - Fasc. 1, 15 April 1972.
* CLADONIA ALINII Trass - Fasc. 11, 1978.
* C. GROENLANDICA (Å. E. Dahl) Trass - Fasc. 1, 15 April 1972.
* C. MACROCERAS (Flörke) Ahti *var.* NIGRIPES (Nyl.) Trass - Fasc. 11, 1978.
* C. NIGRIPES (Nyl.) Trass - Fasc. 1, 15 April 1972.
* C. SUBRANGIFORMIS Sandst. *f.* SPINULIFERA Trass - Fasc. 11, 1978.
CLITOCYBE SUBFESTIVA Kalamees - Fasc. 26, 1987.
COPRINUS VOŠOUSTII Pilát *var.* STEPPICOLA Kalamees - Fasc. 15, 1981.

DASYSCYPHUS ALNIFOLIUS Raitv. - Fasc. 9, 1977.
D. ALTAICUS Raitv. - Fasc. 9, 1977.
D. DASIPHORAE Raitv. - Fasc. 9, 1977.
D. LEDI Raitv. - Fasc. 9, 1977.
D. PSEUDOCANNABINUS Raitv. - Fasc. 9, 1977.
D. PUDICELLOIDES Raitv. - Fasc. 9, 1977.
D. VANTSCHENSIS Raitv. - Fasc. 12, 1981.

ENTOLOMA SUBGLOBISPORA Kalamees - Fasc. 27, 1989.

FAVOLASCHIA SACCHALINENSIS Parmasto - Fasc. 6, 1974.

GALERINA OVALISPORA Kalamees - Fasc. 15, 1981.
* GRACILES Trass - Fasc. 1, 15 April 1972.
GYROMITRA SPLENDIDA Raitv. - Fasc. 4, 1974.

* HETERODERMIA ALLARDII (Kurok.) Trass - Fasc. 29, 1992.
* H. CUBENSIS (Kurok.) Trass - Fasc. 29, 1992.
* H. FRAGILISSIMA (Kurok.) Trass - Fasc. 29, 1992.
* H. INTERMEDIA Trass - Fasc. 29, 1992.
* H. KUROKAWAE Trass - Fasc. 29, 1992.
* H. LAMELLIGERA (Taylor) Trass - Fasc. 29, 1992.
* H. MULTICILIATA (Kurok.) Trass - Fasc. 29, 1992.
* H. OBESA (Pers.) Trass - Fasc. 29, 1992.
* H. PALPEBRATA (Taylor) Trass - Fasc. 29, 1992.
* H. PANDURATA (Kurok.) Trass - Fasc. 29, 1992.
* H. RUGULOSA (Kurok.) Trass - Fasc. 29, 1992.
* H. SPINULOSA (Kurok.) Trass - Fasc. 29, 1992.
* H. SUBASCENDENS (Asahina) Trass - Fasc. 29, 1992.
* H. SUBCOMOSA (Nyl.) Trass - Fasc. 29, 1992.
* H. TRICHOPHORA (Kurok.) Trass - Fasc. 29, 1992.
HYALOPEZIZA ARCTICA Raitv. - Fasc. 23, 1985.
H. GLACIALIS Raitv. - Fasc. 12, 1981.
H. HEXAGONA (Fuckel) Raitv. - Fasc. 9, 1977.
H. LATISPORA Raitv. - Fasc. 12, 1981.
H. SCHACHDARICA Raitv. - Fasc. 12, 1981.
H. SCRUPULOSA (P.Karst.) Raitv. - Fasc. 9, 1977.
HYDROPUS FLOCCULINUS Kalamees - Fasc. 26, 1987.

INCRUPILA ALATAVICA Raitv. - Fasc. 12, 1981.
I. KONDARENSIS Raitv. - Fasc. 12, 1981.
I. NARYNICA Raitv. - Fasc. 12, 1981.

Inocybe ampullaceocystidiata Shtshukin - Fasc. 23, 1985.
I. hygrophoroides Shtshukin - Fasc. 23, 1985.
I. oblectabilis P. D. Orton *var.* odora Shtshukin - Fasc. 23, 1985.
I. ravaensis Kalamees & Shtshukin - Fasc. 23, 1985.
*I*nonotopsis Parmasto - Fasc. 2, 4 Jan. 1973.
Inonotopsis subiculosa (Peck) Parmasto - Fasc. 2, 4 Jan. 1973.

Lachnellula angustispora Raitv. - Fasc. 9, 1977.
L. minuscula Raitv. - Fasc. 9, 1977.
Lachnum alnifolium (Raitv.) Raitv. - Fasc. 20, 1986.
L. altaicum (Raitv.) Raitv. - Fasc. 20, 1986.
L. clavigerum (Svr ek) Raitv. - Fasc. 17, 1985.
L. dasiphorae (Raitv.) Raitv. - Fasc. 20, 1986.
L. fagicolum (W. Phillips) Raitv. - Fasc. 20, 1986.
L. fuscidulum (Cooke) Raitv. - Fasc. 20, 1986.
L. hissaricum (Raitv. & Faisova) Raitv. - Fasc. 20, 1986.
L. ledi (Raitv.) Raitv. - Fasc. 20, 1986.
L. lespedezae (Raitv.) Raitv. - Fasc. 20, 1986.
L. palearum (Desm.) Raitv. - Fasc 17, 1985.
L. perplexum (Boud.) Raitv. - Fasc. 20, 1986.
L. ponticum (Raitv.) Raitv. - Fasc. 20, 1986.
L. pseudocannabinum (Raitv.) Raitv. - Fasc. 17, 1985.
L. pudicelloides (Raitv.) Raitv. - Fasc. 17, 1985.
L. rubi (Bres.) Raitv. - Fasc. 17, 1985.
L. sinegoricum (Raitv.) Raitv. - Fasc. 17, 1985.
L. soppitii (Massee) Raitv. - Fasc. 20, 1986.
L. sulphurellum (Peck) Raitv. - Fasc. 20, 1986.
L. tenuissimum (Quél.) Raitv. - Fasc. 17, 1985.
L. turkestanicum (Raitv.) Raitv. - Fasc. 20, 1986.
L. vantschense (Raitv.) Raitv. - Fasc. 20, 1986.
L. virtembergensis (Matheis) Raitv. - Fasc. 17, 1985.
Lasiobelonium stipitatum Raitv. - Fasc. 12, 1981.
L. subfuscum Raitv. - Fasc. 12, 1981.
Lepista juniperi Kalamees - Fasc. 26, 1987.
L. saeva (Fr.) P. D. Orton *var.* anserina (Fr.) Kalamees & A. I. Ivanov - Fasc. 30, 1992.

Melanoleuca brunnea Kalamees - Fasc. 26, 1987.
M. zaaminensis Kalamees - Fasc. 26, 1987.
Mycena pura (Pers.: Fr.) P. Kumm. *f.* roseobrunnescens Kalamees - Fasc. 26, 1987.

Omphalina fuliginea Kalamees - Fasc. 26, 1987.
O. psammophila Shtshukin - Fasc. 18, 1985.

* Phaeophyscia primaria (Poelt) Trass - Fasc. 15, 1981.
* P. sulphurascens (Zahlbr.) Trass - Fasc. 15, 1981.
Phialina flaveola (Cooke) Raitv. - Fasc. 9, 1977.
P. montana Raitv. - Fasc. 23, 1985.
P. obscura Raitv. - Fasc. 23, 1985.
P. pseudopuberula (Graddon) Raitv. - Fasc. 9, 1977.
P. viridiflavescens (Rehm) Raitv. - Fasc. 9, 1977.
Phialoscypha Raitv. - Fasc. 8, 1977.
Phialoscypha lachnobrachya (Desm.) Raitv. - Fasc. 8, 1977.
P. lachnobrachyoides Raitv. - Fasc. 8, 1977.
P. spiraeaicola Raitv. - Fasc. 8, 1977.
Polyporus chozeniae (Vassilkov) Parmasto - Fasc. 5, 1974.
Psathyrella badhyzensis Kalamees - Fasc. 15, 1981.
P. gramina Kalamees - Fasc. 27, 1989.
* Pyxidatae Trass - Fasc. 1, 15 April 1972.

Scutellinia caucasica Kullman & Raitv. - Fasc. 10, 1978.
S. heterosculpturata Kullman & Raitv. - Fasc. 7, 1977.

Trichopezizella heteropilosa Raitv. - Fasc. 12, 1981.
T. paradoxa Raitv. - Fasc. 12, 1981.
T. vaasmae Raitv. - Fasc. 23, 1985.

Unguiculella lupini Raitv. - Fasc. 9, 1977.

* Verticillatae Trass - Fasc. 1, 15 April 1972.