BRYOPHYTE AND LICHEN FLORA IN RELATION TO HABITAT CHARACTERISTICS IN MORICSALA NATURE RESERVE, LATVIA

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Information on 166 bryophyte and 147 lichen species recorded for Moricsala Island, Moricsala Reserve in previous studies and recently was compiled in the present article to produce checklists. Epiphytic bryophytes and lichens, and also epixylic and epigeic bryophytes were studied in relation to substrate characteristics. Factors explained bryohyte and lichen species richness were analysed using CCA ordination. Epiphytic bryophyte and lichen species distributions were affected mostly by tree species; epixylic bryophyte species distribution was affected mostly by log decay stage. Forest type, soil pH as well as organic content of soil were significant for epigeic species distribution.

Keywords: bryophytes, lichens, Moricsala Nature Reserve, Latvia.

INTRODUCTION

Moricsala Nature Reserve was established in 1912 and is one of the oldest Nature Reserves in the Baltic countries. Of the various habitat types forests dominate (95% coverage), among which old-growth broad leaved forests (*Quercus robur* and *Tilia cordata*, *Quercus robur-Pinus sylvestris*, deciduous-*Picea abies*, Eurosiberian alder swamp forests) are typical.

There has been a wide range of studies of the vegetation and habitat descriptions of Moricsala Island, of which the most important are K. Kupffer (1931), M. Laiviņš, S. Laiviņa (1980).

The first detailed bryophyte and lichen studies were carried out in the beginning of the 20th century by J. M. Mikotowicz, V. Grošinskis, A. Apinis, N. Malta and continued in the 1970-ties by Āboliņa and Piterāns (Kupffer 1931, Аболинь et al. 1979). A survey of the bryophyte and lichen species has been conducted on the whole Moricsala Island, in forests, grasslands and in anthropogenic landscape on various substrates – ground, logs and live tree stems (Kupffer 1931, Аболинь et al. 1979).

Lichens have little been studied. Records of 54 lichen species (mostly epiphytic and a few epigeic species) were published by K. Kupffer in 1931. K. Kupffer found also the rare species *Pertusaria multipuncta* and *Usnea florida*.

Although the bryophyte and lichen flora has been studied in the past, minimal information is available on the ecology of these organisms. However, bryophytes and lichens are valuable indicator organisms (indicator species or specialist species) in woodland key habitat (WKH) identification. Indicator species are more common compared with specialist species (Ek et al. 2002).

The aim of the present study is to characterize the bryophyte and lichen flora and to determine the main limiting factors on a substrate scale for bryophyte and lichen community (*sensu* Gleason 1939) distribution depend on substrate in Moricsala Nature Reserve.

METHODS

Moricsala Nature Reserve is located in the north-western part of Latvia (Fig.1). Moricsala Island is the second largest island (83 ha) in Usma lake with 10% of the total Moricsala Nature Reserve area (LRMK 2000a). The studied territory is located in the Littoral geobotanical region (Kabucis 1995) and in the Venta-Usma lowland sands region. Annual rainfall is 600-650 mm. Average air temperature in January is –4°C and +17.5°C in July (Klane 1975). Dominating tree species in forests of Moricsala Island are *Quercus robur, Tilia cordata and Acer platanoides.* In the understory *Padus avium, Corylus avellana* and *Sorbus aucuparia* are common.

Epiphytic lichens and bryophytes were studied in July 2006 and in July-September 2007. Sample plots were selected randomly in *Quercus robur-Tilia cordata* dominated woodland. Sample plots (20x20m) were established in each forest stand and epiphytic bryophyte and lichen species occurrences were described on randomly selected 16 deciduous trees (in *Tilia cordata* dominated forest stand) and 14 deciduous trees in broad-leaved forest (minimal tree diameter at breast height (DBH) – 0.10 m). Height, DBH at 1.2m height, bark pH (at 1.2 m height in north direction of exposure), inclination in degrees, bark crevice depth (in north direction of exposure at 1.2 height), age (after counting core rings) as well as tree species were measured for each studied tree.

Additional data were collected about bryophytes on various substrates in September 2008. Sample plots were established in six forest stands – broad-leaved-*Alnus glutinosa* forest, broad-leaved *Picea abies* and *Populus tremula* forest. Location of forest stands was plotted on a forest-type map. Epiphytic bryophytes were described in each forest type on ten living trees. Species, DBH, bark pH were measured for living trees. Epiphytic bryophyte occurrence was evaluated up to 2-m height on tree stem, and epigeic bryophyte species on 31 1m x 1m soil sample plots. Distance to nearest living tree was measured for each 1m x 1m sample plot. Organic substance content and pH value were determined for each second soil sample plot.

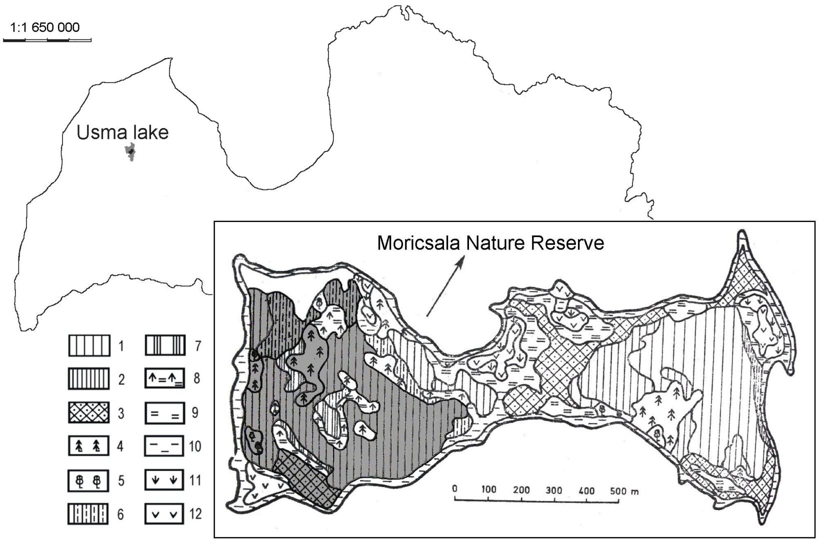


Figure 1. Studied territory (modified after Лайвиня 1983, http://www.lral.lv/latvkar.jpg

Explanations:

1 – *Quercus robur* forests; 2 – *Quercus robur* – *Tilia cordata* forests; 3 – *Quercus robur-Pinus sylvestris*; 4 – broad-leaved-*Picea abies* forest; 5 – *Populus tremula* forest; 6 – broad-leaved –*Alnus glutinosa* forest; 7 – *Picea abies-Alnus glutinosa* forest; 8 – *Betula* sp-*Picea abies* forest; 9 – *Betula* sp. forest; 10 – *Alnus glutinosa* forest; 11 – *Salix* sp. dominated habitat; 12 – *Carex* spp grassland.

In July and September 2007, two transects were established in broad-leaved forest. A total of 100 decayed logs (minimal diameter 0.10 m and minimal log length 1.5 m) were described. Occurrences of bryophyte species were determined on each decayed log. Decay stage, length, diameter and species of trees were described for each selected log.

Determination of decay stage was estimated as a five-point scale followed Pyle and Brown (1998): (1) wood cannot be penetrated with thumbnail, wood is sound, bark is intact, smaller to medium branches are present; (2) thumbnail penetrates in the bark till three centimeters, bark may or may not be attached, wood is sound, bark is decaying; (3) thumbnail penetrates till seven centimeters, bark may or may not be attached, wood is somewhat rotten, the biggest trunks and only larger stubs are present; (4) thumbnail penetrates readily, bark is lightly attached, sloughing off or detached, wood texture is soft, decayed log may assume oval shape; (5) all wood texture is squashy and powdered, bark is detached or absent, can be decayed in pieces, wood is indistinguishable from ground.

Each log was assigned one decay stage. If different parts of log were in several decay stages, the predominant stage was chosen.

Bark pH value were determined in laboratory. Tree bark and soil samples were dried at room temperature, weighed (0.50 g), put into flasks, shaken with 20 ml 1MKCl for 2 h. Bark pH value was determined with a pH-meter (GPH 014, Greisinger Electronic).

Lichen and bryophyte species that could not be identified in the field were collected for identification in the laboratory. Species nomenclature follows (Smith 1996, Hallingbäck, Holmåsen 2000, Āboliņa 2002, Piterāns 2001, Игнатов, Игнатова 2003, Игнатов, Игнатова 2004, Smith 2004). Data were analysed with Canoco for Windows 4.5. programme package using CCA ordination: 49 trees and 36 bryophyte species (species data file) and tree height, age, inclination, bark pH, DBH, *Acer platanoides*, *Alnus glutinosa*, *Tilia cordata*, *Populus tremula*, *Quercus robur*, (environmental data file) for epiphytic bryophyte community analysis,; 30 trees and 20 epiphytic lichen species (species data file) tree height, age, inclination, bark pH, DBH, *Acer platanoides*, *Tilia cordata*, *Quercus robur*, (environmental data file) for epiphytic lichen communities; 38 epixylic bryophyte species and 100 sample plots (species data file), tree species *Quercus robur*, *Alnus glutinosa*, *Picea abies*, *Pinus sylvestris*, *Betula* sp., *Tilia cordata*, decay stage, DBH (environmental file) for decayed logs. Data on 35 epigeic bryophyte species in 31 soil sample plots (species data file) were also investigated in relation to pH, distance to tree, and organic substance composition (environmental data file)

RESULTS AND DISCUSSION

Bryophyte and lichen checklists are presented in Apppendix 1 and in Appendix 2, which includes all pupblished and new results. The number of species may give insight into changes of bryophyte and lichen species communities over time (Apppendix 1, Appendix 2).

Overall 166 bryophyte species were found in Moricsala Nature Reserve from 1912 to 2008 (Apppendix 1), which represents 1/3 of the Latvian bryoflora and thus indicates high bryophyte species diversity. Bryophyte species were divided into six groups depending on habitat characteristics. Most of species were found in dry or moist forest or in several habitat groups (generalist species). Less bryophyte species were found in moist grasslands and in anthropogenic habitats (Apppendix 1).

After the first detailed study in Moricsala Island K. Kupffers found 119 bryophyte species. In the next detailed study, the highest bryophyte species richness was found by A. Āboliņa (149 species) who found 34 bryophyte species new to Moricsala Island. Authors of the present study found 92 bryophyte species, of which 13 were new to Moricsala Island, including *Dicranum viride* - European Habitat Directive bryophyte species. The study methods differed for the mentioned studies, which may be the cause of differences in bryophyte species richness (Apppendix 1). The authors of the present study studied bryophyte ecology in forest habitats, while K.Kupffers and A. Āboliņa were more interested in bryophyte taxonomy. However, after more detailed bryophyte species richness investigations, it might be possible to assess more objectively differences in bryophyte flora during time.

Differences in bryophyte species richness are not high among the authors in dry forests (Apppendix 1). The authors of the present article studied in more detail this habitat type. Some bryophyte species such as *Chiloscyphus polyanthos, Homomallium incurvatum, Jamesoniella autumnalis*, *Thuidium philibertii* have not been found in recent years. Probably, *Thuidium philibertii* has vanished as the last record was in the beginning of the 20th century. On the other hand, *Chiloscyphus polyanthos, Homomallium incurvatum, Jamesoniella autumnalis* have been mentioned as rare or relatively rare after Āboliņa (2002) and the authors of the present study might have missed them. New records of epiphytic bryophytes like *Brachythecium populeum, Dicranum viride, Mnium stellare, Pseudoleskeella nervosa* were found recently in Moricsala Island. Increased epiphytic species richness in recent years could be due to increased tree DBH and shading ensuring continuity and higher humidity compared to earlier forest structure when woodland meadows were common. *Sphagnum* and *Drepanocladus* species were not found in recent years. This can be exlained by a changed misture regime or due to insufficient survey of all habitats. Also, the differences in species richness in grassland habitats is probably due to insufficient recent survey of this habitat (Apppendix 1).

Of the recorded species, under protection (specially protected or microhabitat species in Latvia) are nine bryophyte species, 11 bryophyte species are red-listed in Latvia, ten WKH indicator species, two WKH specialist species.

A. Piterāns studied lichens in Moricsala Island in 1973. He found 64 lichen species, including rare species such as *Melanelia elegantula, Pertusaria pertusa, Opegrapha viridis,* and *Usnea florida*. He found also 28 species new to the Island. S. Hultengren in 2001 found 28 lichen species and 24 new to Moricsala Island and 10 species new to Latvia – *Anisomerideum nyssaegenum, Arthonia arthonioides, Bacidia fraxinea*, *Bactrospora dryina, Biatora ocelliformis, Biatoridium monasteriense, Buellia violaceofusca, Chaenotheca brachypoda, Ch. hispida,* and *Sclerophora coniophaea.*

Overall 147 lichen species have been recorded for Moricsala Nature Reserve (Appendix 2). Data in Appendix 2 provide insight into lichen species changes during 70 years. Overall 13 lichen species are under protection (specially protected or microhabitat species in Latvia), five lichen species are red-listed in Latvia, nine are WKH indicator species, 14 are WKH specialist species (Appendix 2).

There is little suitable habitat for epigeic lichen species in Moricsala Island due to intensive shading in the forest. Epiphytic lichens are more common. Epixylic lichens were also found on walls of old buildings.

The highest total epiphytic (in average 11.56±2.22, Fig. 2), bryophyte (8.1±1.52) and bryophyte signal (average 2.44±1.07) species richness was found on *Acer platanoides*. Overall lichen (average 3.66±1.15), lichen signal (average 0.44±0.50) species richness was higher on *Quercus robur* (Fig. 2). Only significant factors ($p<0.05$) explaining bryophyte and species ordination were included in

CCA ordination analysis. Significant factors explaining epiphytic bryophyte species distribution (Fig. 3) were *Alnus glutinosa* on CCA axis 1 (r=0.80) and *Quercus robur* on CCA axis 2 (r=-0.75). *Rhizomnium punctatum, Mnium hornum,* and *Lophocolea heterophylla* are bryophyte species thet were related with *Alnus glutinosa* as a substrate. Bryophyte species common on *Quercus robur* were *Rhodobryum roseum, Pseudoleskeella nervosa, Mnium stellare, Dicranum viride,* and *Plagiomnium affine* (Fig. 3a).

Tree species is significant factor influencing epiphytic community distribution and *Acer platanoides* is associated with high epiphytic bryophyte species richness (Barkman 1958, Snäll et al. 2004, Löbel et al. 2006). However, according to the CCA ordination (Fig. 3a) *Alnus glutinosa* and *Quercus robur* were the most important factors affecting species distribution. *Quercus robur* is one of the most important substrate trees for epiphyte distribution also in other forest stands in Latvia (Mežaka et al. 2008a).

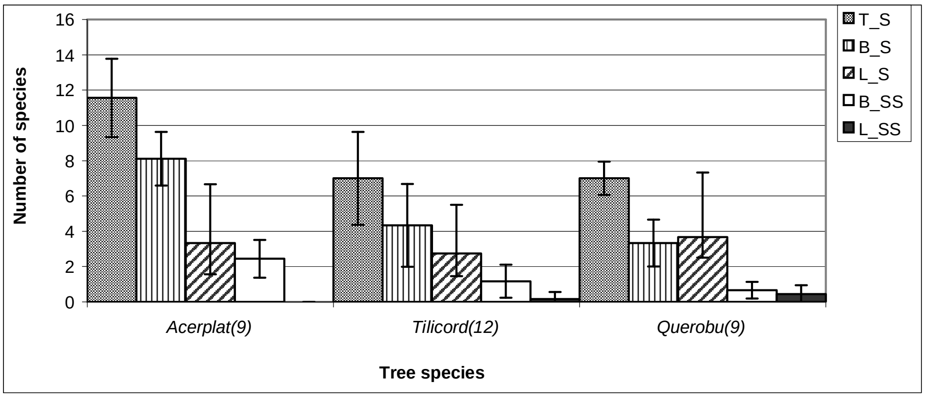
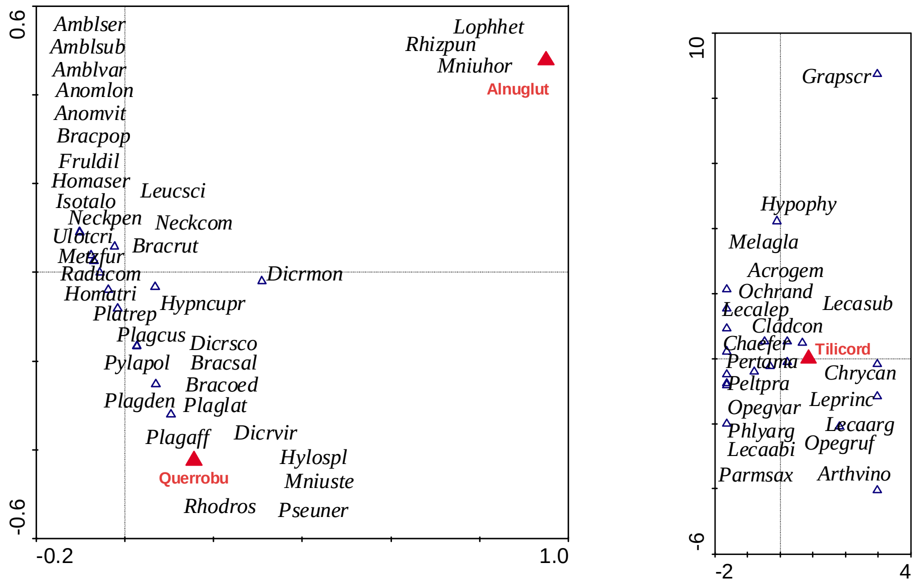


Figure. 2. Epiphytic bryophyte and lichen species on trees. Data includes 30 studied trees in each sample plot. Abbreviations: Acerplat – *Acer platanoides*, Tilicord – *Tilia cordata*, Querrobu – *Quercus robur*, T_S – total epiphytic species richness, B_S – bryophyte species richness, L_S – lichen species richness, B_SS – bryophyte signal species richness, L_SS – lichen species richness. Signal species richness include summarized specially protected, microhabitat, red-listed, EU Directive, WKH specialist and WKH indicator species richness.

A distinct epiphytic lichen community (Fig. 3b) was found on *Tilia cordata* - CCA axis 1 (r=0.85). Similar results were found by Mežaka et al. (2008b). Lichen species such as *Chrysotryx candelaris, Lepraria incana, Lecanora argentata, Opegrapha rufescens, Arthonia vinosa, Lecanora subrugosa, Graphis scripta* occurrence were related with *Tilia cordata* in the CCA ordination.



a. b.

Figure 3. Epiphytic bryophyte (a) and lichen (b) species CCA ordination.

Abbreviations: Bryophytes: Amblser – *Amblystegium serpens*, Amblsub – *Amblystegium subtile*, Amblvar – *Amblystegium varium*, Anomlon – *Anomodon longifolius*, Anomvit – *Anomodon viticulosus*, Bracoed – *Brachythecium oedipodium*, Bracpop – *Brachythecium populeum* Bracrut – *Brachythecium rutabulum*, Bracsal – *Brachythecium salebrosum*, Dicrmon – *Dicranum montanum*, Dicrsco – *Dicranum scoparium*, Dicrvir – *Dicranum viride*, Fruldil – *Frullania dilatata*, Homatri – *Homalia trichomanoides*, Homaser – *Homalothecium sericeum*, Hylospl – *Hylocomnium splendens*, Hypncup – *Hypnum cupressifome*, Isotalo – *Isothecium alopecuroides*, Metzfur – *Metzgeria furcata*, Mniuste – *Mnium stellare*, Mniuhor – *Mnium hornum*, Leucsci – *Leucodon sciuroides*, Lophhet – *Lophocolea heterophylla*, Neckcom – *Neckera complanata*, Neckpen – *Neckera pennata*, Plagaff – *Plagiomnium affine*, Plagcus – *Plagiomnium cuspidatum*, Plagden – *Plagiothecium denticulatum*, Plaglat – *Plagiothecium latebricola*, Platrep – *Platygyrium - repens*, Pylpoly – *Pylaisia polyantha*, Pseuner – *Pseudoleskeella nervosa*, Raducom – *Radula complanata*, Rhodros – *Rhodobryum roseum*, Rhizpun – *Rhizomnium punctatum*, Ulotcri – *Ulota crispa*. Lichens: Acrogem – *Acrocordia gemmata*, Arthvino – *Arthonia vinosa*, Chrycan – *Chrysotrix candelaris*, Cladcon – *Cladonia coniocraea*, Chaefer – *Chaenotheca ferruginea*, Grapscr – *Graphis scripta*, Hypophy – *Hypopgymnia physodes*, Ochrand – *Ochrolechia androgyna*, Lecaarg – *Lecanora argentata*, Lecaabi – *Lecanactis abietina*, Lecasub – *Lecanora subrugosa*, Lecalep – *Lecanora leptyrodes*, Melagla – *Melanelia glabratula*, Pertama – *Pertusaria amara*, Peltpra –

Peltigera praetextata, Leprinc – *Lepraria incana*, Opegvar - *Opegrapha varia*, Parmsax – *Parmelia saxatilis*, Phlyarg – *Phlyctis argena*.

Graphis scripta showed a preference for *Tilia cordata* in another study (Mežaka et al. 2008a). Other studied environmental variables were not significantly related to the epiphytic species communities (p>0.05).

In total 100 decayed logs were described, representing six tree species – *Betula sp., Picea abies, Pinus sylvestris, Quercus robur, Tilia cordata, Acer platanoides*. The highest bryophyte species richness (average 5 species per log) was found on logs in decay stages 3 and 5 (Fig. 4).

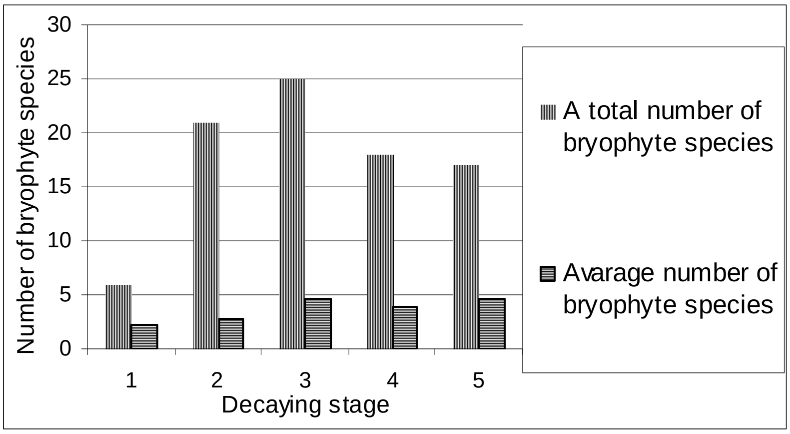


Figure 4. Epixylic bryophyte species richness related to log decay stage.
1 – wood cannot be penetrated with thumbnail, wood is sound, bark is intact, smaller to medium branches are present; 2 – thumbnail penetrates in the bark till three centimeters, bark may or may not be attached, wood is sound, bark is decaying; 3 – thumbnail penetrates till seven centimeters, bark may or may not be attached, wood is somewhat rotten, the biggest trunks and only larger stubs are present; 4 – thumbnail penetrates readily, bark is lightly attached, sloughing off or detached, wood texture is soft, decayed log may assume oval shape; 5 – all wood texture is squashy and powdered, bark is detached or absent, can be decayed in pieces, wood is indistinguishable from ground.

Epixylic bryophyte species composition was significantly (p<0.05) related to log decay stage (r=-0.64) explaining axis 1 and *Quercus robur* (r=0.66) explaining axis 2.

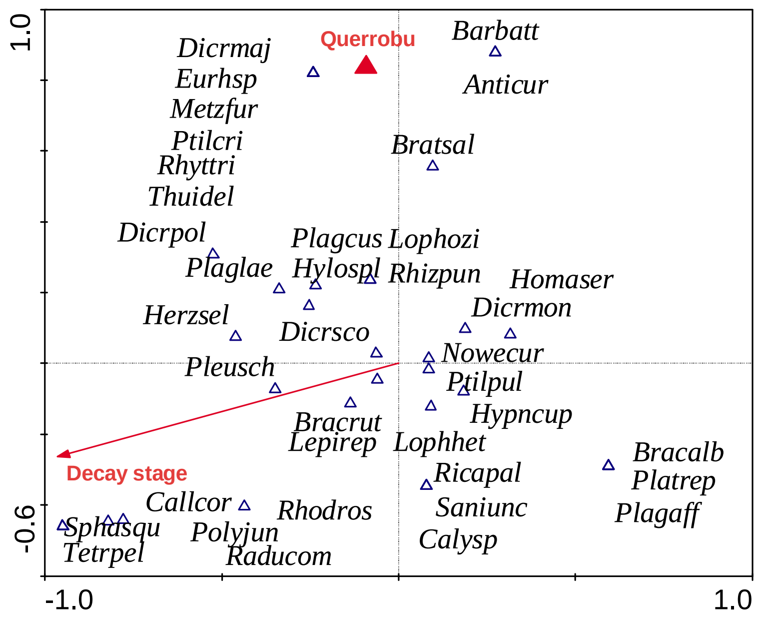


Figure 5. Epixylic bryophyte species composition in a CCA ordination was related to log decay stage (decay stage) and *Quercus robur*.

Abbreviations (including only those not mentioned in Fig. 3): Anticur – *Antitrichia curtipendula*, Barbatt – *Barbilophozia attenuata*, Bracalb – *Brachythecium albicans*, Bratsal – *Brachythecium salebrosum*, Callcor – *Calliergon cordifolium*, Dicrmaj – *Dicranum majus*, Dicrpol – *Dicranum polysetum*, Eurhsp – *Eurhynchium sp.*, Herzsel – *Herzogiella seligeri*, Lophozi – *Lophozia sp.*, Lepirep – *Lepidozia reptans*, Nowecur – *Nowellia curvifolia*, Plagcus – *Plagiomnium cuspidatum*, Plaglae – *Plagiothecium laetum*, Pleusch – *Pleurozium schreberi*, Polyjup – *Polytrichum juniperinum*, Ptilcri – *Ptilium crista-castrensis*, Ptilpul – *Ptilidium pulcherrimum*, Rhyttri – *Rhytidiadelphus triquetrus*, Ricapal – *Riccardia palmata*, Tetrpel – *Tetraphis pellucida*, Thuidel – *Thuidium delicatulum*, Sphasqu – *Sphagnum squarrosum*.

Several bryophyte species preferred logs with a higher decay stage – *Sphagnum squarrosum, Tetraphis pellucida, Calliergon cordifolium, Polytrichum juniperinum, Rhodobryum roseum, Pleurozium schreberi*. Other species – *Homalothecium sericeum, Dicranum montanum, Platygyrium repens, Plagiomnium affine, Ptilidium pulcherrimum* were found more on logs with a lower decay stage (Fig. 5).

Composition of bryophyte species gradually changes depending on decay stage (Āboliņa 1979; Crites, Dale 1998; Rambo, Muir 1998; Lindström 2003;

Kushnevskaya et al. 2007, Āboliņa 2008). The largest number of bryophyte species was found on logs in the third decay stage, as there can be found not only epixylic bryophytes that reach their maximum in the mid decay stage, but also epiphytic bryophytes that can remain on decayed logs till the third and fourth decaying stage, and also epigeous species (Crites, Dale 1997). The mid decay stages support epiphytics such as *Ptilidium pulcherrimum* and *Hypnum cupressiforme* and epixylics – *Lepidozia reptans, Nowellia curvifolia, Riccardia palmata* (Kushnevskaya et al. 2007, Āboliņa 2008).

The CCA ordination does not indicate distinct clusters (communities) in relation to decay stages, possible because:

(1) 17 bryophyte species were found only one time on one decayed log;

(2) Logs in first and fifth decaying stage were less frequent.

Some bryophyte species preferred *Quercus robur – Barbilophozia attenuata, Antitrichia curtipendula, Brachythecium salebrosum, Dicranum majus*. This may be because most of the decayed logs (21 decayed logs) were *Quercus robur* and other species species like *Ptilium crista-castrensis, Antitrichia curtipendula, Barbilophozia attenuata, Dicranum majus, Metzgeria furcata* were found only on one decayed log.

Several authors have described the importance of log species in explaining composition of epixylic vegetation (Āboliņa 1968; Stokland 2001; Kushnevskaya et al. 2007).

Epigeic bryophyte communties were related to soil pH (r=0.90) explaining CCA axis 1, *Alnus glutinosa* (r=0.70) explaining axis 2 and soil organic substances (r=0.62) explaining axis 3 (Fig. 6). Several bryophyte species (*Mnium hornum, Rhizomnium punctatum, Brachythecium rutabulum, Plagiothecium cavifolium, Plagiomnium undulatum, Bryum capillare*) were found in sample plots with relatively higher soil pH value.

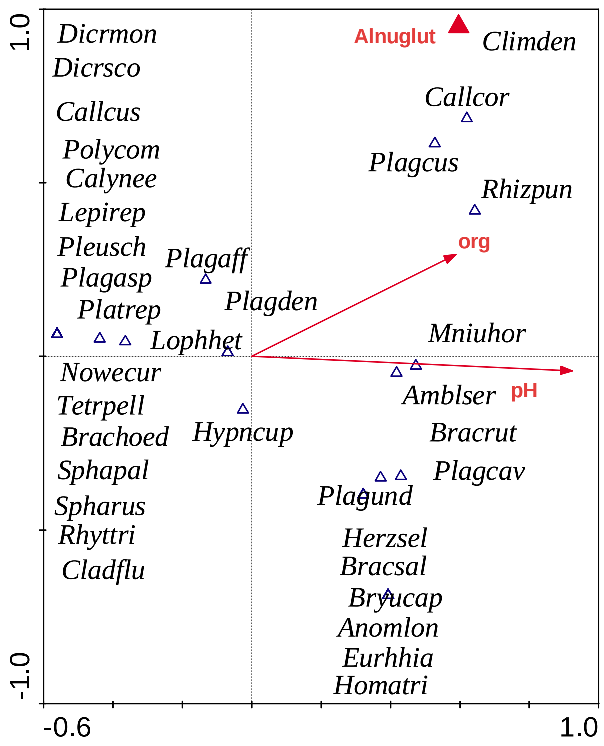


Figure 6. CCA ordination of epigeic bryophyte species in relation to environmental variables.

Abbreviations: (including only those not mentioned in Fig. 3 and Fig. 5): org (average organic matter content), pH – soil pH, Alnuglut – *Alnus glutinosa*, Anomlon – *Anomodon longifolius*, Brachoed – *Brachythecium oedipodium*, Bryucap – *Bryum capillare*, Callcus – *Calliergonella cuspidata*, Calynee - *Calypogeia neesiana*, Cladflu – *Cladopodiella fluitans*, Climden – *Climacium dendroides*, Eurhhia – *Eurhynchium hians*, Plagasp – *Plagiochila asplenioides*, Plagcav – *Plagiothecium cavifolium*, Polycom – *Polytrichum commune*, Spharus – *Sphagnum russowii*, *Sphapal* – *Sphagnum palustre*.

Other bryophyte species (*Dicranum montanum*, *Dicranum scoparium*, *Polytrichum commune*, *Nowellia curvifolia*) preferred a lower soil pH (Fig. 6). Some bryophyte species (*Plagiomnium cuspidatum*, *Rhizomnium punctatum Calliergonella cuspidate*) were associated with relatively higher organic matter content in the soil. Also nearness of *Alnus glutinosa* was significant for *Climacium dendroides, Calliergonella cuspidata* and *Plagiomnium cuspidatum* (Fig. 6).

The highest epigeic bryophyte species richness was found in sample plots located in broad-leaved-*Picea abies* forest (Fig. 7, bryophyte species in the left part of the CCA ordination Fig. 6). A stable moisture regime ensured by *Sphagnum* species is characteristic in sample plots of broad-leaved-*Picea abies* forest. As a result many bryophyte species are found in microtopographic depressions (Vellak and Ingerpuu 2005), where average pH value is 2.87. These results disagree with Vellak et.al. (2003), who found higher bryophyte species richness with higher pH value. Distance to tree was not significant in the present study in contradiction with Vellak et al. (2003), where bryophyte species richness increased with increasing distance to tree stem.

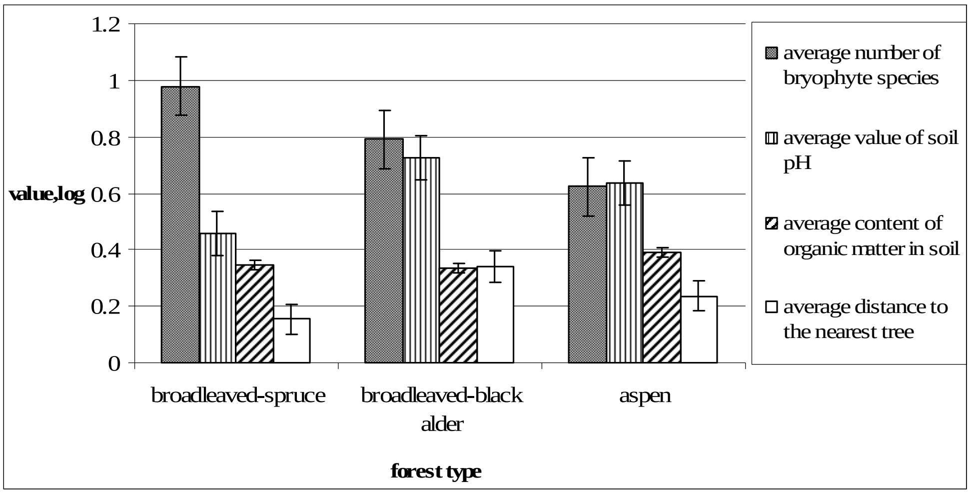


Figure 7. Epigeic bryophyte species in relation to environmental variables in different studied forest stands. Environmental variable values in a logarithmic scale.

Probably bryophyte species are soil pioniers before vascular plants establish in broad-leaved-*Alnus glutinosa* forest. Soil in this forest type is open without vascular plants due to a fluctuating water level. Organic content in the studied forest stands was similar. Probably organic content is variable even in one forest type. Long-term studies of bryophyte and lichen distribution and ecology are needed in the future about different habitats in Moricsala Island.

CONCLUSIONS

1) A diverse bryophyte and lichen flora has been described for Moricsala Island from 1912 until 2008. Overall 166 bryophyte and 147 lichen species were found in the present study. Ten bryophyte species and five lichen species are red-listed (one bryophyte species is protected under European legislation), 11 bryophyte species and 22 lichen species are WKH signal species, eight bryophyte species and six lichen species are protected under Latvian Republic legislation, ten lichen species are new to the Latvian lichen flora.
2) Epiphytic bryophyte and lichen species richness and composition were explained mostly by tree species.
3) Epixylic species composition was influenced mostly by log decay stage.
4) Epigeic species composition was mostly affected by forest type, soil pH and organic substance content in the soil. Some species preferred more acidic and nutrient-poor soil, while other bryophyte species were found more on soil more basic and rich in organic content.

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LITERATURE

Āboliņa A. 1994. *Latvijas retās un aizsargājamās sūnas*. Rīga, 24 pp.
Āboliņa A. 2001. Latvijas sūnu saraksts. *Latvijas Veģetācija* 3: 47–87.
Āboliņa A. 1979. Sūnas un to substrāts. Grām: *Dabas un vēstures kalendārs 1980. gadam*. Rīga, Zinātne: 168 – 173.
Āboliņa A. 2008. Sūnas uz trupošas koksnes Latvijā. *LLU Rak*sti 20 (315): 103 – 116.
Barkman J.J. 1958. *Phytosociology and ecology of cryptogamic epiphytes*. Van Gorcum. Assen. 628 pp.
Crites S., Dale R. T. 1998. Diversity and abundance of bryophytes, lichens, and fungi in relation to woody substrate and successional stage in aspen mixewood boreal forests. Canadian Journal of Botany 76: 641 – 651.
Ek T., Suško U., Auziņš R. 2002. *Mežaudžu atslēgas biotopu inventarizācija. Metodika.* Valsts meža dienests, Östra Götaland mežu pārvalde, 76 lpp.

Gleason H.A. 1939. The individualistic concept of the plant association. *American Midland Naturalist* 21: 92-110.

Hallingbäck T., Holmåsen I. 2000. *Mossor. En fälthanbok.* Stockholm, 287.

Kabucis I. 1995. Ģeobotāniskie rajoni. *Latvijas Daba.* Enciklopēdija. 2. sējums. Latvijas enciklopēdija, Rīga, 255 lpp.

Klane V. 1975. Austrumkurzemes augstiene. Rietumkurzemes augstiene. Ventas – Usmas ieplakas smiltāju rajons. Latvijas PSR ģeogrāfija. Otrs, papildināts izdevums. Rīga: Izdevniecība Zinātne. 671 lpp.

Kupffer K. R. 1931. Die Naturschonstäte Moritzholm. Eine geobotanische Studie. Arb. D. Naturforsch-Vereins zu Riga, Neue Folge, H. 19, S. 1 – 139.

Kushnevskaya H., Mirin D., Shorohova E. 2007. Patterns of epixylic vegetation on spruce logs in late-successional boreal forests. *Forest Ecology and Management* 250: 25 – 33.

Laiviņš M., Laiviņa S. 1980. *Moricsalas rezervāts*. Zinātne, Rīga, 71 lpp.

Latvijas Republikas Ministru kabinets 2000a (LRMK 2000a). Moricsalas dabas rezervāta likums 2000.16.03. Latvijas Vēstnesis, 121/122 (2032/2033).

Latvijas Republikas Ministru kabinets 2000b (LRMK 2000b). Noteikumi par īpaši aizsargājamo biotopu veidu sarakstu. Noteikumi nr. 421. – Latvijas vēstnesis, 08.12.2000, 446/447: 4-6. (grozījumi 25.01.2005 nr. 61).

Latvijas Republikas Ministru kabinets 2001 (LRMK 2001). Mikroliegumu izveidošanas, aizsardzības un apsaimniekošanas noteikumi. Noteikumi Nr 45. 1. pielikums. Īpaši aizsargājamo dzīvnieku, ziedaugu, paparžaugu, sūnu, ķērpju un sēņu sugas, kurām izveidojami mikroliegumi. – Latvijas Vēstnesis (19): 11-12.

Lindström K. 2003. *Wood-living bryophyte species diversity and distribution – differencies between small-stream and upland spruce forests.* Sweden: Umeå University, 19 pp.

Löbel S., Snäll T. & Rydin, H. 2006. Species richness patterns and metapopulation processes – evidence from epiphyte communities in boreo–nemoral forests. *Ecography* 29 :000-000.

Mežaka A., Strazdiņa L., Brūmelis G. & Piterāns A. 2008a. Epifītu flora un ekoloģija Dārznīcas pilskalnā. *Latvijas Veģetācija* 16: 19-34.

Mežaka A., Brūmelis G., Piterāns A. 2008. The distribution of epiphytic bryophyte and lichen species in relation to phorophyte substrate in Latvian natural old-growth broad leaved forests. *Folia Cryptogamica Estonica* 44:89-99.

Piterāns A. 1985. Aizsargājamās ķērpju sugas Slīteres un Moricsalas valsts rezervātos. *Mežsaimniecība un Mežrūpniecība* 1: 32-33. lpp.

Piterāns A. & Vimba E. 1996. *Red Data Book of Latvia. Rare and endangered species of plants and animals. Fungi and lichens.* Riga. 202 pp.

Piterāns A. 2001. Latvijas ķērpju konspekts. *Latvijas Veģetācija* 3: 5-46.

Pyle C., Brown M. M. 1998. A rapid system of decay classification for hardwood logs of the eastern deciduous forest floor. *Journal of the Torrey Botanical Society* 125 (3): 237 – 245.

Rambo T. R., Muri P. S. 1998. Bryophyte Species Associations with Coarse Woody Debris and Stand ages in Oregon. *The Bryologists* 101(3): 366 – 376.

Stokland J.N. 2001. The coarse woody debris profile: an archive of recent forest history and an important biodiversity indicator. *Ecological Bulletins* 49: 71 – 83.

Smith A.J.E. 2004. *The moss flora of Britain and Ireland*. Cambrige, 1012 pp.

Snäll T., Hagström A., Rudolphi J., Rydin H. 2004. Distribution pattern of the epiphyte *Neckera pennata* on three spatial scales – importance of past landscape structure, connectivity and local conditions. *Ecography* 27: 757-766.

The Council of the European Communities 1992 (EU 1992). Council Directive 92/43/EEC on the Conservation of natural habitats and of wild fauna and flora. Official Journal L 206, 22/07/1992 P. 0007 - 0050. http://www.jncc.gov.uk/page-1374

Vimba E. 1997. Moricsalas rezervāts. Latvijas Daba. Enciklopēdija. 4. sējums. Preses nams, Rīga, 254 lpp.

Smith A. J. E. 1996. *The Liverworts of Britain & Ireland.* United Kingdom Cambridge University Press, 362 pp.

Vellak K., Paal J. & Liira J. 2003. Diversity and distribution pattern of bryophytes and vascular plants in a boreal spruce forest. *Silva Fennica* 37(1): 3–13.

Vellak K., Ingerpuu N. 2005. Management effects on bryophytes in Estonian forests. *Biodiversity and Conservation* 14: 3255-3263.

Аболинь А.А. 1968. *Листостебельные мхи Латвийской ССР*. Рига, 332 стр.

Аболинь А., Гемсте И., Лайвиня С., Лайвиньш М. 1979. *Почвы и растительность природного резервата Морицсала.* Зинатне, Рига, 154 стр.

Игнатов М.Г., Игнатова Е.А. 2003. *Флора мхов средней части Европейской России Sphagnaceae – Hedwigiaceae.* Scientific Press KMK, Москва, *Том* 1., 608 стр.

Игнатов М.Г., Игнатова Е.А. 2004. *Флора мхов средней части Европейской России Fontinalaceae – Amblystegiaceae*. Scientific Press KMK, Москва Том 2., 960 стр.

Лайвиня С. 1983. Флора резервата Морицсала. Буш К. (ред) *Природный резерват Морицсала*. Авотс, Рига, с. 21-40.

Питеранс А. В. 1974. Новые виды лишайников во флоре Латвийской ССР. *Современные успеки микологии и лихенологии в Советской Прибалтике*. Тарту, стр. 214 – 216.

Питеранс А. В. 1975. Лишайники резервата Морицсала. *Охрана примечательных природных объектов в Латвийской ССР*. Зинатне, Рига, стр. 68 – 72.

Питеранс А. В. 1982. *Лишайники Латвии*. Зинатне, Рига, 352 стр.

Internet resources:
Natural History Museum, University of Oslo, 2005.
Āboliņa A. 2002. Latvijas sūnu saraksts:
http://latvijas.daba.lv/scripts/db/saraksti/saraksti.cgi?d=suunas.

Checklist of Norwegian mosses:
http://www.nhm.uio.no/botanisk/mose/tax_brya.htm

Moricsalas dabas rezervāta sūnu un ķērpju flora saistībā ar augtenes īpašībām

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Kopsavilkums

Raksturvārdi: sūnas, ķērpji, Moricsala, Latvija.

Rakstā apkopota informācija par 166 sūnu un 147 ķērpju sugām. Apkopoti vēsturiskie un pašreizējie dati par sūnu un ķērpju izplatību Moricsalā, Moricsalas Rezervātā veidojot sūnu un ķērpju sarakstus. Epifītiskās sūnas un ķērpji, epiksilās un epigeiskās sūnas pētītas atkarībā no substrāta parametriem. Parametri, kas būtiski ietekmē sūnu un ķērpju izplatību tika noskaidroti ar CCA ordinācijas metodi. Epifītisko sūnu un ķērpju izplatību būtiski ietekmēja koka suga, epiksilo sūnu izplatība visvairāk atkarīga no kritalas trūdēšanas pakāpes, bet epigeisko sūnu izplatību būtiski ietekmēja meža tips, augsnes pH un organisko vielu saturs augsnē.

Appendix 1

Bryophyte cheklist of Moricsala Nature Reserve

	K. Kupffer (1931)	A. Mežaka u.c. (2006-2008)	A. Āboliņa (1979)
1. Dry forests, dominated tree species – *Q uercus robur, Tilia cordata, Pinus sylvestris*			
Amblystegium subtile (Hedw.) Schimp.	+	+	+
**Anomodon longifolius* (Brid.) Hartm.	+	+	+
**Anomodon viticulosus* (Hedw.) Hook. & Taylor	+	+	+
Atrichum undulatum (Hedw.) P.Beauv.	+	+	+
Brachythecium albicans (Neck. ex Hedw.) Schimp.		+	+
Brachythecium populeum (Hedw.) Schimp.			+
Brachythecium reflexum (Starke) Schimp.	+	+	
*Brachythecium salebrosum (*Hoffm. ex F.Weber & D.Mohr) Schimp.	+	+	+
Callicladium haldanianum (Grev.) H.A.Crum	+	+	
Chiloscyphus polyanthos (L.) Corda		+	
Cirriphyllum piliferum (Schreb. ex Hedw.) Grout		+	+
♠☼◙*Dicranum viride* (Sull. & Lesq.) Lindb.			+
Eurhynchium striatum (Schreb. ex Hedw.) Schimp.	+	+	+
Homalothecium sericeum (Hedw.) Schimp.	+	+	+
Homomallium incurvatum (Schrad. ex Brid.) Loeske		+	
Hypnum imponens Hedw.	+	+	
**Isothecium alopecuroides* (Lam. ex Dubois) Isov.	+	+	+
**Jamesoniella autumnalis* (DC.) Steph.		+	
Mnium stellare Reichard ex Hedw.			+
Orthotrichum patens Bruch ex Brid.	+	+	
Orthotrichum speciosum Nees	+	+	+
Plagiothecium succulentum (Wilson) Lindb.	+	+	
Platygyrium repens (Brid.) Schimp.	+	+	+
Pseudoleskeella nervosa (Brid.) Nyholm			+
Ptilium crista-castrensis (L. ex Hedw.) De Not.	+	+	+
Rhodobryum roseum (Hedw.) Limpr.	+	+	+
Thuidium philibertii Limpr.	+		
Tortula ruralis (Hedw.) F.Web. & D.Mohr	+	+	+
2. Swamp forests, dominated tree species – *Quercus robur, Picea abies, Alnus glutinosa*			
Amblystegium varium (Hedw.) Lindb.		+	+
♠☼(*Antitrichia curtipendula* (Timm ex Hedw.) Brid.	+	+	+

Aulacomnium palustre (Hedw.) Schwägr.	+	+	
♠☼*Barbilophozia attenuata* (Schleich.) K. Muell.			+
Blepharostoma trichophyllum (L.) Dumort.	+	+	+
Calypogeia neesiana (C. Massal &. Carestia) Müll Frib	+	+	+
Calypogeia trichomana (Linn.) Corda	+	+	
Chiloscyphus pallescens (Ehrh. Ex Hoffm.) Dum.			+
Cladopodiella fluitans (Nees) Joerg.			+
Dicranella cerviculata (Hedw.) Schimp.	+	+	+
Dicranum polysetum Sw. ex Anon.	+	+	+
Eurhynchium hians (Hedw.) Sande Lac.		+	+
Hypnum pallescens (Hedw.) P.Beauv.		+	
☼**Jungermannia leiantha* Grolle			+
Leptodictyum riparium (Hedw.) Warnst.	+	+	
Leskea polycarpa Ehrh. ex Hedw.			+
♠*Lophocolea minor* Nees		+	
Lophocolea sp.			+
Lophozia sp.			+
♠☼**Neckera complanata* (Hedw.) Huebener	+	+	+
Plagiochila asplenioides (L.) Dum.	+	+	+
Plagiomnium elatum (Bruch & Schimp.) T.J.Kop.	+	+	
Plagiomnium ellipticum (Brid.) T.J.Kop.			+
Plagiomnium medium (Bruch & Schimp.) T.J.Kop.	+	+	
♠☼(*Plagiothecium latebricola* Schimp.	+	+	+
Plagiothecium nemorale (Mitt.) A.Jaeger	+	+	
Polytrichastrum formosum Hedw.	+	+	
Rhizomnium punctatum (Schreb. ex Hedw.) T.J.Kop.	+	+	+
Riccardia latifrons (Lindb.) Lindb.	+	+	+
♠☼*Riccardia palmata* (Hedw.) Carruth.	+	+	+
Scleropodium purum (Hedw.) M.Fleisch.	+	+	+
Sphagnum angustifolium (C.E.O.Jensen ex Russow) C.E.O.Jensen	+	+	
Sphagnum capillifolium Scop.	+	+	
Sphagnum centrale C.E.O.Jensen		+	
Sphagnum fallax (H.Klinggr.) H.Klinggr.	+	+	
Sphagnum fimbriatum Wilson		+	
Sphagnum girgensohnii Russow		+	
Sphagnum magellanicum Brid.		+	
Sphagnum palustre L.	+	+	+
Sphagnum riparium Ångstr.	+	+	+
Sphagnum russowii Warnst.	+	+	+
Sphagnum squarrosum Crome	+	+	+
Sphagnum teres (Schimp.) Ångstr.		+	

Straminergon stramineum (Dicks. ex Brid.) Hedenäs	+	+	
Thuidium recognitum (Hedw.) Lindb.	+	+	
Thuidium tamariscinum (Hedw.) Schimp.	+	+	+
Ulota bruchii Hornsch. ex Brid.	+	+	
3. Wetlands along coast of Moricsala Island, where *Alnus glutinosa*, *Salix sp*., *Betula pendula* dominate			
Brachythecium mildeanum (Schimp.) Schimp. ex Milde		+	
Bryoerythrophyllum recurvirostrum (Hedw.) P.C.Chen	+	+	
Bryum bimum (Schreb.) Turner	+		
Bryum capillare Hedw.	+	+	+
Bryum turbinatum (Hedw.) Turner	+		
Calliergonella lindbergii (Mitt.) Hedenäs	+	+	
Campylophyllum sommerfeltii auct. eur. non (Brid.) Mitt.		+	
Cephalozia bicuspidata (L.) Dum.		+	+
Dicranella heteromalla (Hedw.) Schimp.	+	+	
Drepanocladus polygamus (Schimp.) Lange & C.E.O.Jensen		+	
Encalypta streptocarpa Hedw.		+	
Eurhynchiastrum pulchellum (Hedw.) Ignatov & Huttunen		+	
Fissidens adianthoides Hedw.		+	+
Pellia sp.	+	+	
Plagiothecium cavifolium (Brid.) Z.Iwats.		+	+
Pohlia cruda (L. ex Hedw.) Lindb.		+	
Pseudobryum cinclidioides (Huebener) T.J.Kop.		+	
Tortula subulata Hedw.	+	+	
4. Moist grasslands dominated by *Carex* sp.			
♠☼*Bryum neodamense* Itzigs. ex Müll.Hal.	+	+	
*Calliergon giganteum (*Schimp.) Kindb.	+	+	
Cratoneuron filicinum (L. ex Hedw.) Spruce	+	+	
Drepanocladus cossonii (Schimp.) Loeske	+	+	
Drepanocladus sendtneri (Schimp. ex H.Müll.) Warnst.		+	
Helodium blandowii (F.Weber & D.Mohr) Warnst.	+	+	
Pohlia wahlenbergii (F.Web. & D.Mohr) A.L.Andrews	+	+	
♠☼*Pseudocalliergon lycopodioides* (Brid.) Hedenäs	+	+	
Rhytidiadelphus subpinnatus (Lindb.) T.J.Kop.		+	
Sphagnum contortum Schultz	+	+	
Warnstorfia exannulata (Schimp.) Loeske		+	
5. Anthropogenic habitats (broken soil, pastures, ditches, buildings)			

Barbula unguiculata Hedw.		+	
Bryum argenteum Hedw.		+	+
Dicranella varia (Hedw.) Schimp.	+	+	
Dicranum bonjeanii De Not.	+	+	
Grimmia pulvinata (Timm ex Hedw.) Sm.		+	
Orthotrichum affine Schrad. ex Brid.	+	+	+
Orthotrichum gymnostomum Bruch ex Brid.	+	+	
Schistidium apocarpum (Hedw.) Bruch & Schimp.		+	
6. Generalist species – distributed in various habitats			
Amblystegium serpens (L. ex Hedw.) Schimp.	+	+	+
Aulacomnium androgynum (Hedw.) Schwägr.	+	+	+
Brachytheciastrum velutinum (Hedw.) Ignatov & Huttunen	+	+	
Brachythecium oedipodium (Mitt.) A.Jaeger	+	+	+
Brachythecium rutabulum (L. ex Hedw.) Schimp.	+	+	+
Bryum caespiticium Hedw.	+	+	
Bryum pseudotriquetrum (Hedw.) P.Gaertn. et al.	+	+	
Calliergon cordifolium (Hedw.) Kindb.	+	+	+
Calliergonella cuspidata (L. ex Hedw.) Loeske	+	+	+
Campylium stellatum (Schreb. ex Hedw.) Lange & C.E.O.Jensen	+	+	
Ceratodon purpureus (Hedw.) Brid.	+	+	+
Climacium dendroides (Hedw.) F.Weber & D.Mohr	+	+	+
Dicranum flagellare Hedw.	+	+	
Dicranum majus Sm.	+	+	+
Dicranum montanum Hedw.			
Dicranum scoparium Hedw.	+	+	+
Drepanocladus aduncus (Hedw.) Warnst.	+	+	
Eurhynchium angustirete (Broth.) T.J.Kop.		+	
Frullania dilatata (L.) Dum.	+	+	+
Funaria hygrometrica Hedw.	+	+	+
Herzogiella seligeri (Brid.) Z.Iwats.	+	+	+
**Homalia trichomanoides* (Hedw.) Brid.	+	+	+
Hylocomium splendens (Hedw.) Schimp.	+	+	+
Hypnum cupressiforme Hedw.		+	+
Jungermannia lanceolata L. emd. Schrad.	+	+	
Lepidozia reptans (L.) Dum.	+	+	+
Leptobryum pyriforme (Hedw.) Wilson	+	+	
Leucodon sciuroides (Hedw.) Schwägr.	+	+	+
Lophocolea heterophylla (Schrad.) Dum.	+	+	+
Marchantia polymorpha L.	+	+	
Metzgeria furcata (L.) Dum.	+	+	+

Mnium hornum Hedw.	+	+	+
Mnium rugicum (Laur.) Bruch & Schimp.		+	
♠**Neckera pennata* Hedw.	+	+	+
Nowellia curvifolia (Dicks.) Mitt.	+	+	+
Plagiomnium affine (Blandow) T.J.Kop.	+	+	+
Plagiomnium cuspidatum (Hedw.) T.J.Kop.	+		+
Plagiomnium undulatum (Weiss ex Hedw.) T.J.Kop.	+	+	+
Plagiothecium denticulatum (L. ex Hedw.) Schimp.	+	+	+
Plagiothecium laetum Schimp.	+	+	+
Pleurozium schreberi (Willd. ex Brid.) Mitt.	+	+	+
Pohlia nutans (Hedw.) Lindb.	+	+	+
Polytrichum commune Hedw.	+	+	+
Polytrichum juniperinum Willd. ex Hedw.	+	+	+
Polytrichum longisetum Sw. ex Brid.	+	+	
Preissia quadrata (Scop.) Nees.	+	+	
Ptilidium pulcherrimum (G. Web.)	+	+	+
Pylaisia polyantha (Hedw.) Schimp.	+	+	+
Radula complanata (L.) Dum.	+	+	+
Rhytidiadelphus squarrosus (L. ex Hedw.) Warnst.	+	+	+
Rhytidiadelphus triquetrus (Hedw.) Warnst.	+	+	+
Tetraphis pellucida Hedw.	+	+	+
Thuidium delicatulum (L. ex Hedw.) Schimp.	+	+	+
**Ulota crispa* (Hedw.) Brid.	+	+	+

Explanations: ♠ - red-listed species in Latvia (Āboliņa 1994, Piterāns & Vimba 1996), ◙ - European Habitat Directive species (EU 1992), ☼ - specially protected or microhabitat species in Latvia (MK 2000b, MK 2001), * - WKH indicator species (Ek et al. 2002), (- WKH specialist species (Ek et al. 2002). A. Mežaka u.c. 2006-2008 including Līga Strazdiņa, Linda Madžule, Ligita Liepiņa, Vija Znotiņa, Guntis Brūmelis.

Appendix 2.

Lichen cheklist of Moricsala Nature Reserve

Species name	K. Kupffer (1931)	A. Piterāns (1973)	Sv. Hultengren (2001)
**Acrocordia gemmata* (Ach.) A. Massal		+	+
Anaptychia ciliaris (L.) Körb.	+	+	
●*Anisomerideum nyssaegenum* (Ellis & *Everh*.) R.C. Haris			+
●*Arthonia arthonioides* (Ach.) A. L. Sm.			+
☼(*Arthonia byssacea* (Weigel) Almq.			+
☼(*Arthonia cinereopruinosa* Schaer.			+
Arthonia radiata (Pers.) Ach.			

**Arthonia vinosa* Leight.			+
Anisomeridium nyssaegenum (Ellis & Everh.) R. C. Harris			
Arthothelium ruanum (A. Massal.) Körb.			+
Bacidia arnoldiana Körb.			+
●*Bacidia fraxinea* Lönnr			+
Bacidia polychroa (Th.Fr.) Körb.			+
**Bacidia rubella* (Hoffm.) A. Massal			+
Bacidia subincmpta (Nyl.)Arnold			+
●(*Bactrospora dryina* (Ach.) A. Massal			+
●*Biatora ocelliformis* (Nyl.) Arnold			+
●*Biatoridium monasteriense* J.Lahm ex Körb			+
Bryoria capillaris (Ach.) Brodo & D. Hawksw	+		
Bryoria chalybeiformis (L.) Brodo & D. Hawksw.	+		
Bryoria fuscescens (Gyeln.) Brodo & D. Hawksw.		+	
Buellia griseovirens (Turner & Borrer ex Sm.) Almb.			
Buellia punctata (Hoffm.) A. Massal.		+	
●(*Buellia violaceofusca* G. Thor & Muhr			+
☼(*Calicium adspersum* Pers.			+
Calicium quercinum Pers.			+
Calicium glaucellum Ach.			+
Calicium salicinum Pers.			+
Calicium viride Pers.		+	
Caloplaca flavorubescens (Huds.) J. R. Laundon		+	
(*Caloplaca lucifuga* G. Thor			+
Candelariella xanthostigma (Ach.) Lettau			+
Cetraria chlorophylla (Willd.) Vain.		+	
●**Chaenotheca brachypoda* (Ach.) Tibell			+
Chaenotheca brunneola (Ach.) Müll.Arg.		+	
☼(*Chaenotheca chlorella* (Ach.) Müll. Arg.	+		+
Chaenotheca cinerea (Pers.) Tibell			+
Chaenotheca chrysocephala (Turner ex Ach.) Th. Fr.	+		
Chaenotheca ferruginea (Turner & Borrer) Mig.		+	
Chaenotheca furfuracea (L.) Tibell	+		
●*Chaenotheca hispidula* (Ach.) Zahlbr.			+
☼(*Chaenotheca phaeocephala* (Turner) Th. Fr.			+
Chaenotheca stemonea (Ach.) Müll. Arg.	+		
Chaenotheca trichialis (Ach.) Th. Fr.			+
Chrysotrix candelaris (L.) J. R. Laundon		+	+
Cladina rangiferina (L.) Nyl.	+		
Cladina arbuscula (Wallr.) Hale & W. L. Culb.	+		
Cladonia botrytes (K. G. Hagen) Willd.	+		
Cladonia cenotea (Ach.) Schaer.		+	
Cladonia coniocraea (Flörke) Spreng.		+	
Cladonia crispata (Ach.) Flot.	+		
Cladonia digitata (L.) Hoffm.	+	+	
Cladonia fimbriata (L.) Fr.	+		
Cladonia macilenta Hoffm.	+		
Cladonia ochrochlora Flörke	+		
(*Cladonia parasitica* (Hoffm.) Hoffm.			+
Cladonia pyxidata (L.) Hoffm.	+		
Cladonia squamosa Hoffm.	+		
☼(*Cliostomum corrugatum* (Ach.: Fr.) Fr			+
Cliostomum griffithii (Sm.) Coppins in D. Hawksw. Et al.			+
Cyphelium inquinans (Sm.) Trevis			+
Dimerella pineti (Ach.) Vezda			+
Evernia prunastri (L.) Ach.	+	+	+
**Graphis scripta* (L.) Ach.	+	+	+

Hypocenomyce scalaris (Ach.) M. Choisy		+	+
Hypogymnia physodes (L.) Nyl.	+	+	+
Hypogymnia tubulosa (Schaer.) Hav.	+		+
Imshaugia aleurites (Ach.) S. L. F. Meyer			+
**Lecanactis abietina* (Ach.) Körb.			+
Lecanora albella (Pers.) Ach.	+		
Lecanora allophana Nyl.	+	+	+
Lecanora argentata (Ach.) Malme	+	+	+
Lecanora carpinea (Ach.) Vain.	+	+	+
Lecanora chlarotera Nyl.		+	+
Lecanora hagenii (Ach.) Ach.	+		
Lecanora leptyrodes (Nyl.) Degel.		+	
Lecanora populicola (DC.) Duby		+	
Lecanora sambuci (Pers.) Nyl.		+	
Lecanora subrugosa Nyl.		+	
Lecanora symmicta (Ach.) Ach.		+	
Lecanora varia (Hoffm.) Ach.			+
Lecidea nylanderi (Anzi) Th. Fr.			+
Lecidella euphorea (Flörke) Hertel	+	+	
Lepraria incana (L.) Ach.			+
♠(*Lobaria pulmonaria* (L.) Hoffm.	+	+	+
Loxospora elatina (Ach.) A. Massal.			+
♠*Melanelia elegantula* (Zahlbr.) Essl.		+	
Melanelia exasperata (De Not.) Essl.		+	
Melanelia exasperatula (Nyl.) Essl.			+
Melanelia fuliginosa (Fr. Ex Duby) Essl.			+
Melanelia glabratula (Lamy) Essl.	+	+	
Melanelia olivacea (L.) Essl.	+	+	
Melanelia subaurifera (Nyl.) Essl.		+	
Micarea prasina Fr.			+
Micocalicium disseminatum (Ach.) Vain.			+
Mycoblastus fucatus (Stirt.) Zahlbr.			+
Ochrolechia androgyna (Hoffm.) Arnold		+	
Ochrolechia subviridis (Høeg) Erichsen			+
Opegrapha rufescens Pers.	+		+
Opegrapha varia Pers.		+	+
♠*Opegrapha viridis* (Pers. ex Ach.) Behlen& Desberger		+	+
Opegrapha vulgata Ach.			+
Parmelia saxatilis (L.) Ach.	+		
Parmelia sulcata Taylor	+	+	
Peltigera canina (L.) Willd.	+	+	
Peltigera polydactyla (Neck.) Hoffm.	+	+	
Peltigera praetextata (Flörke ex Sommerf.) Zopf			+
Peltigera rufescens (Weiss) Humb.	+		
Pertusaria albescens (Huds.) M.Choisy & Werner		+	+
Pertusaria amara (Ach.) Nyl.	+	+	+
Pertusaria coccodes (Ach.) Nyl.		+	
Pertusaria coronata (Ach.) Th. Fr.		+	
**Pertusaria flavida* (DC.) J. R. Laundon		+	+
Pertusaria leioplaca DC.	+	+	+
Pertusaria multipuncta (Turner) Nyl.	+		
♠**Pertusaria pertusa* (Weigel) Tuck.		+	+
Pertusaria hemisphaerica (Flörke) Erichsen			+
Pertusaria pupilaris (nyl.) Th. Fr.			+
Phaeophyscia ciliata (Ach.) Moberg		+	
Phaeophyscia endophoenica (Harm.) Moberg.			+
Phlyctis argena (Spreng.) Flot.			+

**Phlyctis agelaea* (Ach.) Flot.		+	+
Physcia adscendens (Fr.) H. Olivier		+	
Physcia aipolia (Ehrh. ex Humb.) Fürnr.		+	+
Physcia stellaris (L.) Nyl.		+	
Physcia tenella (Scop.) DC.		+	+
Physconia distorta (With.) J.R. Laundon	+	+	+
Placienthiella uliginosa (schrad.) Coppins & P. James			+
Platismatia glauca (L.) W. L. Culb. & C. F. Culb.	+	+	+
Pseudevernia furfuracea (L.) Zopf	+	+	+
Pyrrospora quernea (Dickson) Körb.			+
Ramalina calicaris (L.) Fr.	+	+	+
Ramalina baltica Lettau			+
Ramalina farinacea (L.) Ach.	+	+	+
Ramalina fastigiata (Pers.) Ach.	+	+	+
Ramalina fraxinea (L.) Ach.	+	+	+
Ramalina pollinaria (Westr.) Ach.	+	+	
●(*Sclerophora coniophaea* (Norman) J.Mattson & Middenb.			+
Scoliciosporum chlorococcum (Grewe ex Stenh.) Vezda			+
(*Thelothrema lepadinum* (Ach.) Ach.			+
Usnea filipendula Stirt.		+	+
♠*Usnea florida* (L.) Weber. ex F. H. Wigg.	+	+	+
Usnea hirta (L.) Weber ex F. H. Wigg.	+	+	
Usnea subfloridana Stirt.		+	+
Vulpicida pinastri (Scop.) J-E. Mattson & M. J. Lai	+		
Xanthoria parietina (L.) Th. Fr.	+	+	+
Xanthoria polycarpa (hoffm.) Th. Fr. Ex Rieber			+

Explanations: ● – new species to Latvian lichenoflora, other explanations after Appendix 1.