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EPIPHYTIC LICHENS AND BRYOPHYTES IN THE FORESTS OF LILLE VILDMOSE IN 2013

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Cover
Front page: Late summer beams of light working their ways through the beech forest canopy at Tofte Bøge, Tofte Skov, 2013-08-27.
Back page: Assistance in the plots from Andreas Malmqvist and Mia Mouridsen in Tofte Skov, April 2013.

Contents

The forests in Høstemark and Tofte are characterized by mixed deciduous tree species. Due to the dense population of browsing Red Deer the forests are quite open, bringing down a high amount of light to the base of the trunks. Despite the relatively low precipitation the presence of extensive alder swamps and the nearby large Tofte Mose rise the humidity to high levels year round. The occurrences of various species of deciduous trees of different ages, many veteran trees, the light open and humid conditions, all favor the existence of many epiphytic species.

Summary

On behalf of the University of Copenhagen a survey of epiphytic lichens and bryophytes was carried out in the forests of Høstemark and Tofte on northern Jutland, Denmark, in 2013.

In total 107 randomly distributed circular plots (radius 15 m) were surveyed (totally 7,5 ha). In each plot every tree species were included in the survey. Presence of epiphytic lichens and bryophytes were recorded on every tree trunk measuring at least 10 cm in diameter. In addition, because of being an expected hotspot for lichens, the old beech forest Tofte Bøge was strategically surveyed (free search).

In total, 201 species (186 species in the plots) were identified in the forests, of which were 133 (120 in the plots) lichens and 68 (66 in the plots) bryophytes. There were both many common as well as rare lichens. Among the bryophytes a few very abundant species dominated, whereas the other bryophytes were less common and rare.

In all 20 different species of trees were surveyed in the plots. However, forests containing black alder *Alnus glutinosa*, birch *Betula* spp., beech *Fagus sylvatica*, oak *Quercus robur* and rowan *Sorbus aucuparia* were by far the most common habitats surveyed. Beech was not only the most epiphyte species rich tree species, but also the tree hosting most exclusive epiphytes, i.e. not found on any other tree species; in all 125 epiphyte species (15 exclusive species), followed by black alder (97 and 8), oak (93 and 8) birch (87 and 10), rowan (59 and 1) and ash (55 and 3).

In the plots more species were recorded in Tofte (111 lichens, 59 bryophytes) than in Høstemark (88 lichens, 43 bryophytes). This may partly be explained by the substantially higher number of plots surveyed in Tofte, but partly also because of the presence of some exclusive habitats in Tofte, foremost old beech forest, but also old oak pastures and mixed deciduous woodlands (*Tilia*, *Fraxinus*, *Populus* etc).

Very high numbers of redlisted lichens were recorded in the forests, in all 67 species on the Danish Red List (23 on the Swedish). Some species, for example *Opegrapha ochroheila* and *Thelotrema lepadinum*, were even among the most common lichens. Many species are not reported before from the forests. The recorded species *Bactrospora corticola*, *Pachyphiale carneola* and *Sclerophora peronella* were even regarded as regionally extinct (RE) in Denmark. *Bacidina arnoldiana* and *Normandina acroglypta* may be new to Denmark. Among the bryophytes the rare *Neckera pumila* can be mentioned in particular. The high amount of light and high humidity together with the mixed deciduous forests, a long history of low intervention and the many veteran trees may explain the rich epiphyte flora.

The old beech forest Tofte Bøge was indeed a hot spot for lichens. More than 30 species noted are on the Danish Red List (11 on the Swedish), for example the rare *Bacidia incompta*, *Caloplaca luteoalba*, *Lobaria pulmonaria*, *Megalaria laureri, Pachyphale carneola* and *Thelopsis rubella*. The forests at Lille Vildmose, and Tofte Bøge in particular, should be considered to be of national importance for lichens.

Epiphytic lichens and bryophytes in the forests of Lille Vildmose in 2013

Background & order

On behalf of the Centre for Macroecology at the University of Copenhagen the company Naturcentrum AB conducted surveys of epiphytic lichens and bryophytes in Tofte Skov and Høstemarks Skov at Lille Vildmose at Northern Jutland in 2013.

The main aim was to establish a base line for monitoring epiphytic species in the forests of Lille Vildmose. This work is part of a larger project in which the effects on biodiversity are monitored after planned rising water levels in part of the forests. The idea of the study design was to establish plots representing a gradient of wetness, where one half were planned to be affected of rising water levels and the second half unaffected. The basic methodology of the survey of epiphyte species used inspiration from a study design in the nature reserve of Biskopstorp in Halland, Sweden (Fritz 2004).

Material & methods

Plots

The study design followed the 110 plots randomized in Tofte and Høstemarks Skov (**Figur 1**). In total 107 plots were surveyed because three plots lacked trees to study. Each sampling plot was circular with a 15 m radius. This means that the total area surveyed was 7.5 ha, i.e. only about 2 % of the deciduous forest area.

After identification of the center of the plot (marked with a stick) the limits of the plot was measured using two 30 m long tapes that intersected the centre of the plot making four sections. Trees were surveyed in each of the four sections following a clockwise order. The systematic approach was important in order to know which trees were surveyed and which trees remained.

In the sampling plots epiphytic lichens and bryophytes were surveyed on standing living and dead trees from 0 up to 2 m height. Stumps higher than breast height (1.5 m) were also included, whereas logs and twigs (below 2 m) were excluded from the survey. To avoid a lot of smaller young trees and bushes, the diameter of the tree was restricted to larger trees (≥10 cm). Thinner trees or bushes were excluded from the survey even if the height exceeded 2 m.

Almost all epiphytic species of lichens and bryophytes were identified to the species level, the exception being the *Cladonia*, where only the name of the genera was noted. Identifications were principally made in the field with a hand lens (10x, with a light option) and using the chemical spot tests K and C. Some tricky specimens were collected (herb. ÖF) and samples were later identified under the microscope. Identified species were noted on a written template. In every circular plot

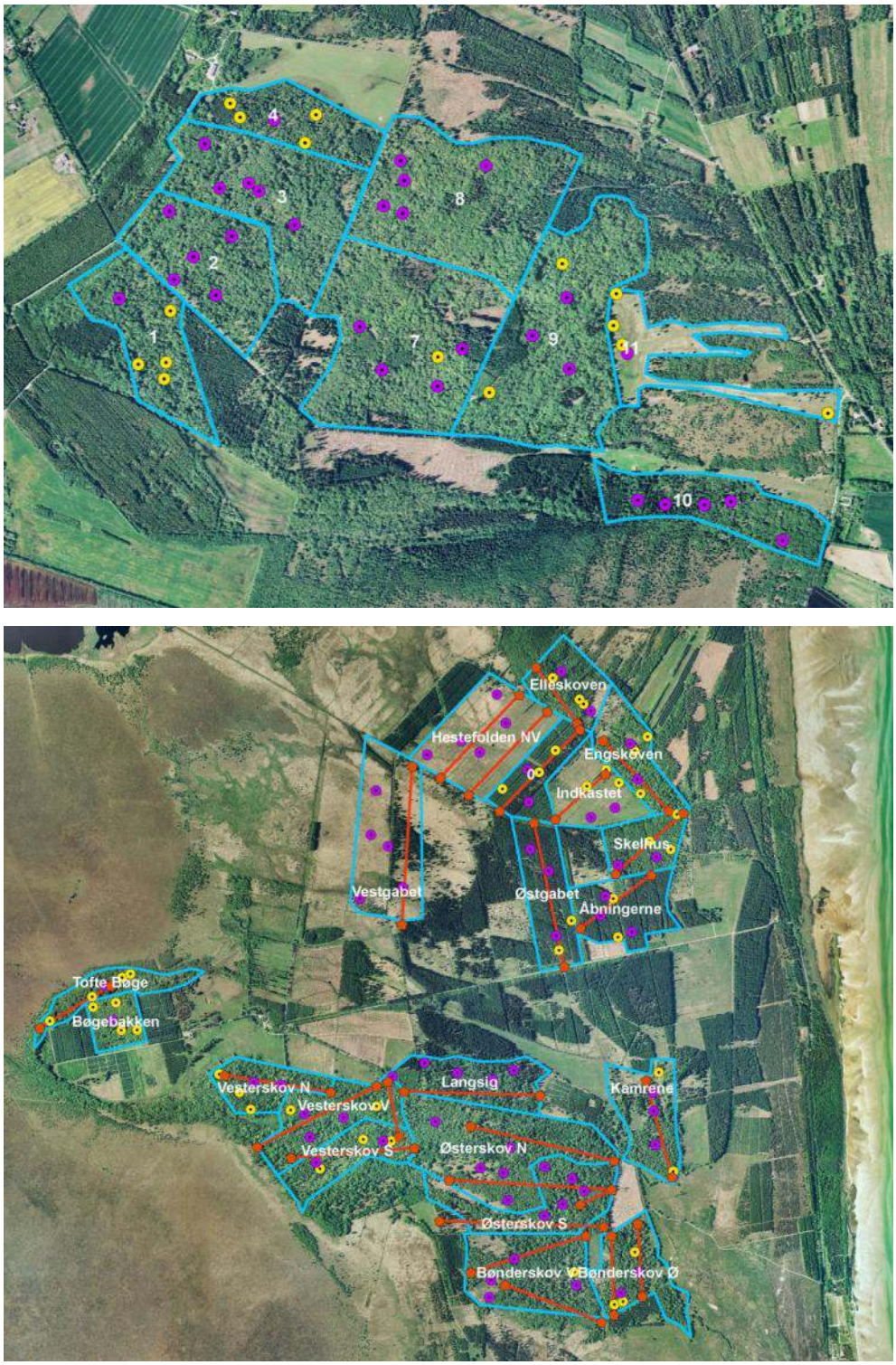

Figure 1. Map of the different sections and plots surveyed in Høstemark Skov (above) and Tofte Skov (below) in 2013.

the presence of epiphytic lichens and bryophytes were recorded for each phorophyte (in all 20 tree species). Field work was carried out during 10 days (2 persons during 2 of the days) in three periods; 19 plots in April (with assistance from Andreas Malmqvist), 54 in August and 32 in October. Supplementary surveys of bryophytes were made by Erik Aude, HabitatVision, in 18 plots. In general it took about 45 minutes (min 30 min, max 90 min) to complete a plot.

Stands

Tofte Bøge was surveyed at the 24th of October 2013. Most parts of the beech forest were visited and beech trees were searched for predominantly species of nature conservation concern. Furthermore, ash *Fraxinus excelsior* was surveyed in the swamp beneath the beech forest and a separate species list was compiled.

Results

Number of species

In all, 201 epiphytic species (133 lichens and 68 bryophytes) have been identified in 2013, of which 186 species (120 lichens and 66 bryophytes) were recorded specifically in the plots (**Table 1**, **Appendix 1**).

The most common lichens (presence in >80 % of the plots) were *Cladonia* spp., *Lecanactis abietina* and *Lepraria incana*, but also *Pertusaria amara*, *P. pertusa, Phlyctis argena* and *Pyrrhospora quernea* were very common (>70%). Usually in forest ecosystems most lichen species are quite rare. Even if totally 23 lichens were only recorded once there were unusually many species in the intermediate frequency, neither common nor rare (**Figure 2**).

The most common bryophytes were *Hypnum cupressiforme* (97 %), almost present in every plot (!), followed by *Dicranum scoparium* (84 %) and *Mnium hornum* (77 %). Except from a few very common bryophytes most species were rare, and totally 18 bryophytes were recorded only once (**Figure 2**).

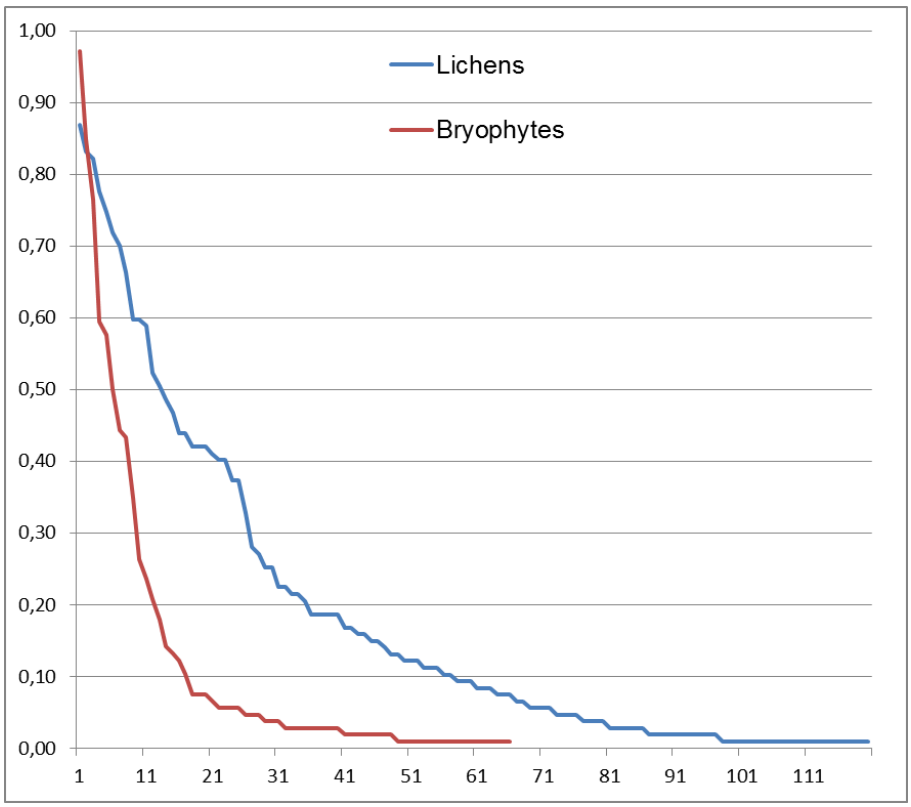

Figure 2. Frequency distribution of lichens (n=120 species) and bryophytes (n=66 species) respectively in the plots (n=107) in the forests of Høstemark and Tofte 2013.

Table 1. Total number and exclusive species of epiphytic lichens and bryophytes per tree species in the plots. The frequency of each tree species is also provided.

	Ace	Aln g	Aln i	Bet	Cor	Cra	Fag	Fra	Ile	Jun	Lar	Mal	Que	Pic	Pin	Pop	Pru	Sal	Sor	Til	In total
Frequency in the plots	0,01	0,59	0,01	0,50	0,07	0,02	0,58	0,07	0,03	0,02	0,02	0,04	0,36	0,10	0,01	0,01	0,01	0,01	0,21	0,02	
Number of lichens	12	63	9	52	32	2	84	36	21	5	7	4	70	9	1	15	3	9	48	18	120
Exclusive lichens	0	3	1	5	0	0	15	2	0	0	0	0	6	0	0	0	0	1	1	0	34
Number of bryophytes	3	35	1	35	11	1	41	19	6	5	4	2	23	6	4	8	4	2	11	6	66
Exclusive bryophytes	0	6	0	5	0	0	6	1	0	0	0	0	2	0	0	0	0	0	0	0	18
Number of all species	**15**	**98**	**10**	**87**	**43**	**3**	**125**	**55**	**27**	**10**	**11**	**6**	**93**	**15**	**5**	**23**	**7**	**11**	**59**	**24**	**186**
All exclusive species	**0**	**9**	**1**	**10**	**0**	**0**	**21**	**3**	**0**	**0**	**0**	**0**	**8**	**0**	**0**	**0**	**0**	**1**	**1**	**0**	**52**

Beech *Fagus sylvatica* is the most species rich tree species

In the plots a total of 20 tree species (trees or larger bushes) were surveyed. Black alder *Alnus glutinosa*, beech *Fagus sylvatica,* birch *Betula* sp. and oak *Quercus robur*. were by far the most common tree species surveyed in the plots (**Table 1**).

Beech was the most species rich tree for epiphytes in the survey, but black alder, and birch hosted surprisingly many species. Considering the low frequency in the plots ash *Fraxinus excelsior* also hosted a lot of species (**Table 1**).

Beech hosts many exclusive species

In all, 52 species (34 lichens, 18 bryophytes) were exclusive on only one tree species. Beech *Fagus sylvatica* was the most important tree species considering exclusive species for a particular tree species (**Table 1**). On the contrary there were 12 species of trees without any records of exclusive epiphyte species.

Species in the plots

Including all the epiphytes recorded the mean number of species was 30 species (min 6, max 54). The most species-rich plots (>50 species) were nr 124 (Ødums graner S) in Høstemarks Skov, nr 51 (Vesterskov N) and nr 109 (Elleskoven) in Tofte Skov. These three plots were dominated by either old beech forest or a mixture of broadleaved deciduous trees with black alder. The poorest plots (<10 species) were all situated in Høstemark Mose N (plot nr 12-14) in Høstemarks Skov with young birch and Norway spruce.

For lichens the mean number of recorded species was almost 22 species (min 4, max 39), whereas for bryophytes the mean number of recorded species was almost 9 (min 2, max 19). The richest and poorest plots in species number for lichens and bryophytes respectively were almost identical to the summed species per plot presented above. The young oak forest Bøgebakken in Tofte Skov was also species poor for the bryophytes.

Species of conservation concern

In total as much as 67 species of the recorded lichens are listed on the Danish Red List (www.redlist.dmu..dk) and 23 on the Swedish Red List (Gärdenfors 2010) (**Appendix 1**). Of those, three species were considered extinct (*Bactrospora corticola, Pachyphiale carneola, Sclerophora peronella*) and 15 species critically endangered in

Denmark. *Bacidina arnoldiana* and *Normandina acroglypta* may even be new to Denmark. The frequencies of single redlisted species were very high for some species, for example the crustose lichens *Opegrapha ochrocheila* (NT) and *Thelotrema lepadinum* (VU), that were recorded in 37 % and 50 % of the plots respectively.

The bryophytes have not been evaluated for the Red List in Denmark. One recorded bryophyte species, *Neckera pumila*, is redlisted in Sweden (Gärdenfors 2010). However, some of the recorded bryophytes are rare or considered of conservation concern in Denmark, e.g. *Antitrichia curtipendula*, *Frullania fragilifolia*, *Loeskeobryum brevirostre*, *Lejeunea cavifolia*, *Neckera pumila* and *Plagiothecium latebricola* (Erik Aude and Rasmus Fuglsang Frederiksen, in emails).

Most redlisted lichens were recorded in the plots situated in Tofte Bøge.

Tofte Bøge – an important lichen locality

The results from the five sample plots in August and a search during a few hours in October 2013, show that the beech forest Tofte Bøge is a very interesting and valuable forest, for lichens in particular. In total, 63 species of lichens and 17 species of bryophytes were found in the beech stand. A large number of rare species or indicator species for forests of high conservation concern were recorded. In total 34 lichen species are on the Danish Red List and 11 on the Swedish Red List (**Appendix 1E**). Several lichens are considered to be critically endangered (CR) in Denmark.

In addition, several of the rare lichens were recorded on more trees than one (**Appendix 1E**). The crustose lichens *Bacidia incompta*, *Megalaria laureri*, *Pachyphiale carneola* and *Thelopsis rubella* are all very nice examples of more frequent redlisted species in good condition at Tofte Bøge. Often the thalli were richly fertile with many fruitbodies emphasizing the suitable conditions at the locality.

Old beech trees with many rare microhabitats and the favorable local climate (constant high air humidity at the border of the bog) are suggested to be important factors. With more time at hand and a ladder to climb there are certainly more interesting species to find if all trees were carefully surveyed.

The alder-ash swamp area down the northern slope towards Tofte Mose was also surveyed the 24th of October, the main purpose being identifying the epiphytes on *Fraxinus excelsior* (no plot covered that area). In all, 39 species of epiphytes were recorded on the large and mossy ash trunks. The cyanolichen *Peltigera praetextata* was new to the survey, and some other recorded redlisted species were *Lecanora glabrata* (NT), *Opegrapha rufescens* (NT), *Opegrapha ochrocheila* (NT), *Opegrapha vermicellifera* (NT), *Schismatomma decolorans* (R) and *Thelotrema lepadinum* (VU).

Tofte Skov versus Høstemarks Skov

In total, 129 epiphyte species (86 lichens, 43 bryophytes) were recorded in Høstemark and 170 species (111 lichens, 59 bryophytes) in Tofte. This means that 57 epiphyte species (34 lichens, 23 bryophytes) were exclusive in Tofte Skov, whereas only 17 species (10 lichens, 7 bryophytes) were unique to Høstemarks Skov.

Table 2. Comparisons between recorded lichen species on Beech *Fagus sylvatica* in Tofte Bøge 1975–77 (Søchting & Christensen 1989) and 2013 (this study).

	Danish RL	Swedish RL	In total
Number of species	41	13	**81**
Species recorded 1975–77 AND 2013	20	8	**40**
Species recorded in 1975–77	28	8	**58**
Species recorded in 2013	34	11	**63**
Species recorded ONLY in 1975–77	7	2	**18**
Species recorded ONLY in 2013	14	3	**23**

Skov. This difference could to some extent be attributed to the higher number of plots surveyed in Tofte (68 plots) compared to Høstemark (39 plots). However, when comparing the exclusive species it is obvious that there are some specific habitats present in Tofte Skov which are absent in Høstemarks Skov. The presence of old beech forest (Tofte Bøge) and old open oak woodland (Bønderskov Ø and Kamrene) in Tofte Skov are the most prominent differences. Even the rather common crustose lichen *Chrysothrix candelaris*, growing in deep fissures of mostly older oaks, was entirely missing in the plots of Høstemarks Skov. In all, the frequencies of present single species in the two forest areas were rather similar, but higher frequencies were recorded for birch lichens (*Ochrolechia microstictoides*, *Leptorhaphis epidermis*) in Høstemark, and higher frequencies of some foliose and nitriphilous lichens in Tofte (**Appendix 1C, 1D**).

Discussion

Method

The method seems to work well in the actual area. The sampling is most effective with two persons (dividing the different sampling tasks in each plot), but one experienced person may well carry out the survey and is less costly per plot. During the surveys in spring and summer between 12 and 15 plots were surveyed each day, using the light evenings. During the late autumn visit between 8 and 10 plots were surveyed. Comparing the efficiency of the method and survey during three seasons, springtime (April) is the best period, because of favorable light conditions (no shading leafs, often dry weather), long days and no bugs. However, one obstacle may be a high water level in the many swamps.

Some practical experiences:

- The transportation between plots takes time. GPS with all the plots mapped (gpx-file) helps a lot to find the closest plot and the best route.

- Using a tape line for measuring the size and borders of each plot is useful. The tape lines were also used for dividing the plots in four sections, because after some intense time of search in the plot the question often rise

which trees have been surveyed and which ones remain. Walking for example clockwise in each section can help. Also the GPS can show where you have been in the plot, but after some time running around in the plot all tracks can get a messy pattern, difficult to interpret.

- Keeping separate epiphyte species lists for each and every tree species is also time consuming, because many plots contains several tree species. A template for filling in the required data and epiphyte species for the right tree species was very useful, not only time saving but helps to keep more focus on finding species than writing things down. In addition, it saved time to transfer the data to the computer.

The data from this study have been compiled into several Excel-files, and are prepared for data analysis. With combination of various structural and environmental variables collected elsewhere in the project, data could also be analyzed with multivariate methods. It could be potentially valuable also to use the bioindication properties of epiphytes to determine the importance of different conditions in the plots. One way to work with the data material could be to apply Ellenbergs indicator values for different variables (e.g. light, humidity, nutrients) for the species concerned (Wirth 1991, Mouridsen 2014). Then the mean value can be calculated for each plot, which could be used for comparing with other plots in the area or with the same plot after a resurvey testing for changes in the environment.

Comparisons with other surveys

Stand (locality) level – lichens in Tofte Bøge

Also for the beech forest Tofte Bøge there is an older survey (1975–77) of lichens (Søchting & Christensen 1989). Interestingly almost an identical number of lichen species was recorded growing on beech in the 1970ies and 2013; 58 and 63 taxa respectively (**Appendix 1E**). However, the species recorded were quite different between the surveys. Of totally 81 species of lichens identified, only 49 % were the same species both years of survey (**Table 2**). Different knowledge, methods, surveyors, taxonomi and time used in the investigations probably explains the major differences.

From a Danish perspective the number of species and old forest indicators found on beech at Tofte Bøge was very high, ranking that locality number 8 among 55 studied forests in Denmark 1975–77 (Søchting & Christensen 1989). The species richness should also from an international perspective be considered rather high for a single beech forest locality, but not extremely high. With 135 species growing on beech, the beech forest at Ödegärdet (30 ha, with a core area of ca 5 ha) is the most species rich locality for epiphytic lichens known so far in Sweden (Gustavson 1995). The most interesting beech forests in Sweden, such as Ödegärdet, have at least 20–25 redlisted lichens (on the Swedish Red List), but beech forests having more than 10 redlisted lichens are often considered also to have high conservation values. From an epiphytic lichen perspective Tofte Bøge, with 13 known redlisted lichens, would definitively be a valuable beech forest for lichens also in Sweden.

Forest level – lichens in Høstemarks Skov

For Høstemarks Skov, there is an existing study of lichens (Poulsen & Søchting 2008). The recorded number of epiphytic species of lichens in Høstemarks Skov were quite similar, 86 species in this study (92 species if species outside the plots are included) and 88 species in the former lichen investigation (Poulsen & Søchting 2008). This is interesting since the methods used were very different. The result suggests that this study succeeded to capture most of the present epiphytic lichens in the forest area even if only a fraction of the forest area actually was surveyed in the plots. A closer inspection of the species lists reveals many differences. Missing species in this study were for example *Amandinea punctata*, *Buellia alboatra*, *Caloplaca cerinella*, *C. citrina*, *Cetraria chlorophylla*, *Chrysothrix candelaris*, *Cyphelium sessile*, *Lecanora conizaeoides*, *Loxospora elatina* and *Melanohalea exasperatula*, whereas the crustose lichens *Bacidia circumspecta*, *Chaenotheca chlorella*, *Lecania cyrtellina*, *Lecanora glabrata*, *Ochrolechia subviridis*, *Pertusaria multipuncta, Ropalospora viridis, Sclerophora peronella and Trapeliopsis pseudogranulosa* all were new to Høstemarks Skov. In addition, the redlisted lichens *Bactrospora corticola* and *Cladonia parasitica* were recorded in this study but outside the plots. All but two species (*Cetraria* and *Melanohalea*) refer to small and rare crustose lichens, which can be difficult to find and identify. The most likely explanation for the differences may simple be that most of the missing species have been present but undiscovered.

Forest level – bryophytes in Tofte Skov

From Tofte Skov there is an existing study of bryophytes (Lægaard et al. 2012), to compare with the results from this study. In all, they list 135 species as a result from several visits in the area during different years (2005-2008) made of several bryologists. That list includes bryophytes from all habitats (also open spaces such as grasslands and wetlands) and substrates (also species growing on the ground). That makes it difficult to compare with the 61 epiphytic species recorded in this study from Tofte Skov. Some listed and considered rare species were also recorded in this study, for example *Antitrichia curtipendula*, *Frullania fragilifolia*, *Loeskeobryum brevirostre*, *Plagiothecium latebricola* and *Zygodon rupestris*. Those species occur mostly in either wet black alder swamps, or in older beech forests. Some preferably epiphytic species in the list suggest that for example *Amblystegium serpens*, *Isopterygium elegans* and *Metzgeria fruticulosa* (rare) have been missed in the plots in this study. On the contrary, at least 15 species of bryophytes recorded in this study seem to be new compared to the published species list (Lægaard et al. 2012). Some of those form a set of species, which are probably more common at the landscape level, but perhaps less distributed in the forest, and has been missed or overlooked (*Bryum* and *Orthotrichum* species). Several species are, however, probably really rare in the area, such as *Homalia trichomanoides*, *Neckera pumila* (the only recorded bryophyte in Tofte that is redlisted in Sweden) and *Zygodon viridissimus*. All in all, the bryophyte flora in Tofte Skov should be considered diverse and of conservation concern, in particular the black alder swamps and in older beech forests.

Landscape level – epiphytes in Biskopstorp, Sweden

In the nature reserve of Biskopstorp (ca 900 ha), situated in nemoral southwest Sweden, a similar study was carried out in 2000–2003 (Fritz 2004). The plots were

somewhat larger (radius 20 m), but the number of plots were almost the same (n=115). The plots in Biskopstorp were distributed randomly, covering 14.4 ha (≈1.5 % of the forest). The forest landscape consists of beech and oak forests but also includes a high frequency of Norway spruce (to be replaced by deciduous forests). The forest landscape has a high topographical variety and rather high precipitation (1 200 mm/year). In all 224 species (137 lichens, 87 bryophytes) were recorded, of which 18 were redlisted (Swedish Red List). The total epiphyte species number recorded in 107 plots of Høstemarks Skov and Tofte Skov summed up to 186 species (120 lichens, 66 bryophytes), of which 18 were redlisted (Swedish Red List). Considering the different areas surveyed in the plots, the figures are not dramatically different between the two forest landscapes. Higher precipitation (suboceanic conditions) and denser forest habitats in Biskopstorp favor more bryophyte species and cyanolichens. Another explanation could be the presence of a higher diversity of habitats in Biskopstorp.

Including knowledge from the whole forest areas respectively, Biskopstorp (38 species) hosts more redlisted lichens than Lille Vildmose (26 species). The main difference is probably due to a large number of smaller but very old beech and oak forests (woodland key habitats) located in different topographical situations in Biskopstorp, whereas such hotspots are rare in Lille Vildmose. In any case, the forests of Lille Vildmose have such high qualities that they should be considered of national importance for epiphytic species, mainly lichens, in Denmark.

Effects from air pollution

No special study has been designed or done in this project to analyze the possible effects from air pollution on epiphytes in the forests of Lille Vildmose (but see Mouridsen 2014). However, the general impression is that effects on the lichen flora from acid rain are *not* very obvious inside the forests. Remarkable is that the air pollution resistant crustose lichen *Lecanora conizaeiodes* could not be detected in Tofte Skove, nor in Høstemark during 2013, despite being searched for. The species has a rapidly declining trend since the content of sulphur dioxide in the air and rain has decreased radically since the 1980ies. This species was recorded on black alder not only at Tofte Bøge in Tofte Skov during the 1980ies (Søchting & Christensen 1989), but also in Høstemark growing on birch, beech and oak during the 1990ies (Poulsen & Søchting 2008). Most epiphyte lichens recorded in the forests of Lille Vildmose seem to be intermediate as indicators for air pollution (Hultengren et al. 1991). There are also a number of species present that are recognized as very tolerant (*Lepraria incana*), as well as very sensitive to air pollution (*Lobaria pulmonaria*).

Effects from nitrogen deposition are more obvious, in particular on deciduous trees along open and exposed forest edges. Here it is possible to find the lichen community dominated by *Xanthoria parietina* (nitrophilous species). When growing on acid bark (birch) this lichen indicates influence of fertilization from airborne particles. Inside the forest, this set of nitrophilous lichens is rare to find.

Ecological conditions in the forest

Several factors characterize the ecological conditions for epiphyte species in Lille Vildmose. Among probably the most important factors promoting the high diversity of epiphyte species may be the following:

- High and rather even humidity (due to the flat area with many wet swamps and the nearby very large bog Tofte Mose)
- Long continuity as deciduous woodland
- Many old veteran deciduous trees
- High structural diversity (microhabitats in the trees)
- Predominantly mixed forests with many tree species
- Low recent management activity
- Open forests result in a generally high availability of light

Absence of topographical diversity is perhaps the most pronounced lacking ecological factor of Lille Vildmose. Presence of various topographical conditions can result in different expositions creating more microhabitats for epiphytes. At the same time, the flat area assemble water that forms wet black alder forests, contributing to a high air humidity and to some extent compensate many epiphytes for a rather low precipitation. The high air humidity could be tracked by for example liverworts such as *Frullania tamarisci* and the crustose lichens *Lecanactis abietina* and *Thelotrema lepadinum*. The two lichens are really common throughout the forests in Lille Vildmose.

High air humidity alone does not, however, facilitate the conditions for cyanolichens, which is a group of lichens using cyanobacteria as a photobiont. Those species of lichens needs precipitation from rain to function physiologically. Indeed, cyanolichens are scarce in the forests of Lille Vildmose. Genera such as *Collema*, *Leptogium* and *Nephroma* seem to be missing completely. Only some trees with *Lobaria pulmonaria* can be found. In addition, the large foliose cyanolichen *Peltigera praetextata* is almost missing in Lille Vildmose, but common on deciduous tree trunks in Biskopstorp nature reserve, SW Sweden, which receives about 1 200 mm of rain per year.

The populations of larger animals, such as Red Deer and Wild Boar, also affect the life of epiphytes. Many animals scratch themselves on the bark at the base of the tree stems. The animal fur may thereby function as a vector for spores and other propagules from lichens as well as bryophytes. Browsing Red Deer also keep bushes down. This may decrease the humidity but increase the availability of light, in general favoring lichens but disfavoring bryophytes.

In addition, Red Deer creates suitable substrates when they use their cors to scrape off the bark from the stems of different tree species, thereby creating the microhabitat exposed hard wood. The wood-living redlisted lichen *Opegrapha ochrocheila* use this very microhabitat to a large extent in these forests, and this process might very well explain the widespread distribution and exceptional high frequency of this lichen species in the forests of Lille Vildmose.

Management issues

One main impression from the forests of Lille Vildmose in 2013 was the large number of veteran trees now standing often in shady conditions surrounded by competing younger trees. Maintaining old veteran trees and creating new suitable veteran trees for the future, cutting of young secondary forest, i.e. high bushes and trees growing under veteran trees into their crowns, should be executed. Such a measure would keep many old veteran trees (mainly oaks) alive and vital for many more years to come. Furthermore, managing veteran trees result in more open conditions, i.e. increase the amount of light to the stem, which is beneficial for many rare epiphytic lichens growing on veteran oaks (Paltto et al. 2011).

The lack of grazing animals is another impression. Red Deer is commonly mainly considered a browser, i.e. eating bushes and herbs, thereby favoring high growing bracken and grass in the forests and open spaces. After some initial work from machines with cutting blades (and small scale fires), glades and open spaces could be maintained from the introduction of grazers, such as European Bison, forming a complete mosaic landscape of forests, glades and wetlands. Having grazing animals in the area is imperative in order to maintain the characteristic open sub-canopy forests of Lille Vildmose. Such forests are scarce and unique nowadays! Pasture woodland is an increasingly rare habitat throughout Europe (Porley & Hodgetts 2005) and should be favoured at Lille Vildmose. Having that said, there is a downside for the epiphytic bryophytes. Open forests results in more desiccating winds and less humidity (Odor et al. 2013). This could be counteracted by rising water levels in the forest area, but also keeping parts of the forests more dense. This would also benefit epiphytic lichens, in particular beech forest species.

Effects of rising water levels

In general a rising (and high) water table in a forest habitat would mean higher and even humidity levels perhaps year round. In Lille Vildmose such measures would certainly benefit many moisture-dependent epiphytic lichens and bryophytes. Higher levels would affect the epiphytic flora the most IF it the water rise up the stems (leaving the epiphytes below the water table) or kill the trees. In birch forests with a rising water table would probably transform to black alder (or mixed) swamps.

Beech is probably one of the most sensitive tree species in the forests of Lille Vildmose to higher water levels. It could die off, and in such places the lichen flora connected to beech might impoverish. Vesterskov (sector V, N, S) would probably be the most critical area. However, the oldest beech stand Tofte Bøge, which carry most epiphytes, seem to be unaffected. Loss of specific epiphytic species is of major conservation concern, but it is unlikely that epiphytic species die out from Lille Vildmose in the short term. Lost beech habitat and decreasing suitable beech substrate would probably be the largest loss in the long term. But with higher water levels there is also a lot to gain, for example more natural forest ecosystems, which benefit many cryptogams (Remm et al. 2013).

Suggestions for further studies

Epiphytes grow rather slowly, especially crustose lichens. Total and sudden expositions to light might kill off lichens and bryophytes rather rapidly. For more subtle changes in the close environment statistically detectable changes among the epiphytes will most probably take some time (years) to develop. With the rather rough method used in Lille Vildmose, it could be advisable to make the first resurvey of the epiphytes in the plots five years at the earliest after major management impacts to get detectable changes.

Conclusions

- The method used for collecting epiphyte data worked well in the field.
- A huge amount of interesting species presence/absence data was gathered.
- The data should be valuable to analyze further with multivariate methods making it possible to explain important correlations between species, the environment and geographical parts of the forest.

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Appendix 1. Species lists.

a) Lichens (n=120) in plots (n=107), sorted per tree species (n=20)

Presence for each lichen species in the number of plots recorded per tree species. Exclusive species are marked in yellow rows.

Scientific name	DR	SR	Ace	Aln g	Aln i	Bet	Cor	Cra	Fag	Fra	Ile	Jun	Lar	Mal	Que	Pic	Pin	Pop	Pru	Sal	Sor	Til	No of trees
Amandinea punctata			0	2	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	2
Anisomeridium biforme	EN		0	0	0	0	1	0	4	0	0	0	0	0	2	0	0	1	0	0	1	0	5
Anisomeridium polypori	VU		1	2	0	2	1	0	16	0	0	0	0	0	6	0	0	0	0	1	1	0	8
Arthonia didyma	VU		0	0	1	0	3	0	16	0	0	0	0	0	2	0	0	1	0	0	1	0	6
Arthonia radiata	VU		0	0	0	0	2	0	14	0	0	0	0	0	1	0	0	0	0	0	4	0	4
Arthonia ruana			0	0	0	0	3	0	4	2	0	0	0	0	0	0	0	0	0	0	1	0	4
Arthonia spadicea			1	30	0	5	5	0	26	1	0	0	0	0	5	0	0	0	0	0	4	0	8
Arthonia vinosa	VU		0	1	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	2
Arthopyrenia sp.			0	0	0	3	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Bacidia circumspecta	V		0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	1	0	2
Bacidia incompta		VU	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Bacidia rosella	R	NT	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Bacidia rubella			0	0	0	0	0	0	2	1	0	0	0	0	2	0	0	0	0	0	1	0	4
Bacidina arnoldiana			0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Bacidina phacodes	EN	NT	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Bactrospora corticola	RE	VU	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1
Biatora globulosa			0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	1
Buellia griseovirens			0	6	1	4	0	0	9	0	1	1	0	0	4	0	0	0	0	0	3	1	9
Calicium salicinum			0	0	0	1	0	0	0	0	0	0	0	0	2	0	0	0	0	0	1	0	3
Calicium viride			0	15	0	2	0	0	0	0	0	0	1	0	9	0	0	0	0	0	0	0	4
Caloplaca lucifuga	EN	NT	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1
Caloplaca luteoalba	CR	EN	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Candelariella efflorescens			0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Candelariella xanthostigma	NT		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
Chaenotheca brachypoda	E		0	3	0	2	0	0	2	1	0	0	0	0	0	0	0	0	0	0	1	0	5
Chaenotheca chlorella	V		0	10	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	1	0	3
Chaenotheca chrysocephala	R		0	9	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	2
Chaenotheca ferruginea			0	14	0	14	0	0	0	0	0	0	2	0	0	1	0	0	0	0	0	0	4
Chaenotheca furfuracea	R		0	11	0	2	0	0	1	1	0	0	0	0	1	0	0	0	0	0	0	0	5
Chaenotheca hispidula	R	NT	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Chaenotheca stemonea			0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1
Chaenotheca trichialis	R		0	31	0	4	0	0	2	0	0	0	1	0	12	0	0	0	0	0	0	0	5
Chaenothecopsis cf pusilla	CR		0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Chaenothecopsis cf vainoiana	CR		0	1	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	2
Chrysothrix candelaris			0	13	0	0	0	0	2	0	0	0	0	0	12	0	0	0	0	0	0	0	3
Cladonia sp.			1	49	0	44	1	0	23	1	2	2	0	0	19	5	1	1	0	0	3	2	14
Cliostomum griffithi	NT		0	18	0	2	1	0	12	0	0	0	0	0	18	0	0	1	0	0	2	0	7
Dactylospora parasitica	VU		0	0	0	0	0	0	2	0	0	0	0	0	1	0	0	0	0	0	0	0	2
Dimerella pineti			0	25	0	10	0	0	9	1	0	0	0	0	8	1	0	0	0	0	0	0	6
Evernia prunastri			0	15	0	5	4	0	8	1	0	0	0	0	20	0	0	0	0	1	2	0	8
Graphis scripta			0	3	1	0	1	0	39	1	2	0	0	0	0	0	0	0	0	0	5	1	8
Haematomma ochroleucum	EN		0	2	0	0	0	0	7	2	0	0	0	0	8	0	0	0	0	0	0	0	4
Hypocenomyce scalaris			0	1	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Hypogymnia physodes			0	12	0	22	1	0	2	0	1	0	1	0	9	1	0	0	0	0	1	0	9
Hypotrachyna revoluta		VU	0	13	0	2	1	0	4	0	0	0	0	0	0	0	0	0	0	0	2	0	5
Lecanactis abietina	CR		1	54	1	31	0	0	23	1	1	0	0	0	27	0	0	0	0	0	1	0	9
Lecania cyrtella			0	0	0	1	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Lecania cyrtellina	CR		0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Lecanora allophana	DD		0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	1	0	0	0	0	3
Lecanora argentata	VU		0	2	0	1	0	0	5	0	0	0	0	0	0	0	0	0	0	0	1	0	4
Lecanora carpinea			0	0	0	0	0	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	2
Lecanora chlarotera			0	7	0	0	2	0	36	3	1	0	0	0	12	0	0	0	0	0	5	1	8
Lecanora expallens			0	24	1	7	0	0	14	0	0	0	0	0	14	0	0	0	0	1	4	0	7
Lecanora glabrata	EN	NT	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Lecanora intumescens	VU		0	0	0	0	0	0	8	0	0	0	0	0	4	0	0	0	0	0	0	0	2
Lecanora pulicaris	VU		0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	2
Lecanora symmicta			0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Lecidella elaeochroma			0	1	0	0	2	0	17	2	0	0	0	0	2	0	0	0	0	0	1	0	6
Lepraria incana			0	37	1	33	2	0	33	2	1	1	2	0	22	7	0	0	0	0	3	1	13
Lepraria lobificans			1	28	0	15	0	0	33	2	0	0	1	3	14	4	0	0	0	1	3	0	11
Lepraria membranacea	NT		0	1	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	3
Lepraria rigidula			0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Leptoraphis epidermis			0	0	0	14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Lobaria pulmonaria	VU	NT	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Megalaria pulverea	DD	VU	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Melanelixia glabratula			0	21	1	6	5	0	27	1	2	0	0	0	15	0	0	1	0	1	4	2	12
Melanelixia subaurifera			0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1
Micarea peliocarpa			0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Micarea prasina			0	15	0	8	2	0	6	0	0	0	2	0	6	4	0	1	0	0	1	0	9
Mycoblastus fucatus			0	10	0	17	2	0	14	2	2	0	0	0	3	0	0	1	1	0	5	1	11
Normandina acroglypta			0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
Normandina pulchella	CR		0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1

Scientific name	DR	SR	Ace	Aln g	Aln i	Bet	Cor	Cra	Fag	Fra	Ile	Jun	Lar	Mal	Que	Pic	Pin	Pop	Pru	Sal	Sor	Til	No of trees	Exclusive
Ochrolechia androgyna	VU		0	2	0	3	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	3	0
Ochrolechia microstictoides	CR		0	0	0	13	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	2	0
Ochrolechia subviridis	EN		0	4	0	0	0	0	3	1	0	0	0	0	5	0	0	0	0	0	0	0	4	0
Opegrapha atra			0	0	0	0	0	0	6	1	0	0	0	0	0	0	0	0	0	0	1	0	3	0
Opegrapha niveoatra			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Opegrapha ochrocheila	CR	NT	0	5	0	13	2	0	12	0	1	0	0	0	1	0	0	1	0	0	8	1	9	0
Opegrapha rufescens	NT		0	0	0	0	0	0	11	2	2	0	0	0	0	0	0	1	0	0	0	2	5	0
Opegrapha sorediifera	CR		1	2	0	0	1	0	14	0	0	0	0	0	3	0	0	1	0	0	0	0	6	0
Opegrapha varia			0	3	0	3	0	0	9	0	0	0	0	0	1	0	0	0	0	0	1	0	5	0
Opegrapha vermicellifera	VU	VU	0	0	0	0	0	0	18	1	0	0	0	0	2	0	0	0	0	0	0	0	3	0
Opegrapha viridis	EN		0	0	0	0	0	0	13	0	0	0	0	0	1	0	0	0	0	0	0	0	2	0
Opegrapha vulgata	EN		0	5	0	0	1	0	35	0	1	0	0	0	2	0	0	0	0	0	5	1	7	0
Pachyphiale carneola	RE	VU	0	0	0	0	0	0	7	0	0	0	0	0	2	0	0	0	0	0	0	0	2	0
Parmelia ernstiae			0	3	0	0	1	0	3	2	1	0	0	0	8	0	0	0	0	0	1	1	8	0
Parmelia saxatilis			1	30	0	10	4	1	17	2	1	1	0	1	20	1	0	0	1	1	5	1	16	0
Parmelia sulcata			0	5	0	3	0	0	3	0	1	0	0	0	10	0	0	0	0	1	2	1	8	0
Parmeliopsis ambigua	NT		0	0	0	5	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	2	0
Peltigera hymenina	VU		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	1
Pertusaria albescens			0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
Pertusaria amara	VU		1	33	0	11	6	0	29	3	3	0	0	2	24	0	0	1	0	0	11	2	12	0
Pertusaria coccodes	EN		1	7	0	2	0	0	8	1	1	0	0	0	11	0	0	0	0	0	2	1	9	0
Pertusaria flavida	CR		0	5	0	1	1	0	10	1	0	0	0	0	2	0	0	0	0	0	0	0	6	0
Pertusaria hemisphaerica	VU		1	32	0	2	0	0	17	0	0	0	0	0	7	0	0	0	0	0	1	0	6	0
Pertusaria hymenea			0	4	0	0	1	0	25	0	0	0	0	0	5	0	0	1	0	0	1	0	6	0
Pertusaria leioplaca	CR		0	0	0	0	4	0	11	2	0	0	0	0	0	0	0	0	0	0	3	0	4	0
Pertusaria multipuncta	CR	VU	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
Pertusaria pertusa			1	31	1	5	6	0	47	4	2	0	0	0	17	0	0	1	0	0	12	2	12	0
Phlyctis argena			0	18	0	6	4	0	52	2	2	0	0	1	12	0	0	0	1	1	10	1	12	0
Physcia pulverulenta			0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	1
Physcia tenella			0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
Physconia perisidiosa	NT		0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	2	0
Placynthiella sp.			0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
Platismatia glauca			0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	2	0
Pseudosagedia aenea	VU		0	0	0	1	0	0	16	0	0	0	0	0	2	0	0	0	0	0	1	0	4	0
Pyrenula nitida	EN	NT	0	0	0	0	0	0	13	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
Pyrrhospora quernea	VU		1	36	0	7	3	0	31	4	3	0	0	0	20	1	0	1	0	0	7	2	12	0
Ramalina farinacea			0	1	0	0	2	0	2	1	0	0	0	0	5	0	0	0	0	0	0	0	5	0
Rhaphidicyrtis trichosporella	CR		0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	2	0
Ropalospora viridis			0	1	0	4	0	0	12	0	0	0	0	0	0	0	0	0	0	0	1	0	4	0
Schismatomma decolorans	R	NT	0	1	0	0	0	0	5	1	0	0	0	0	5	0	0	0	0	0	0	0	4	0
Sclerophora peronella	RE	NT	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
Scoliciosporum chlorococcum			0	2	0	1	0	0	9	0	0	0	0	0	3	0	0	0	0	0	0	0	4	0
Stenocybe pullatula			0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
Thelotrema lepadinum	VU		0	26	0	9	1	0	35	0	1	0	0	0	6	0	0	0	0	0	6	0	7	0
Trapeliopsis flexuosa			0	2	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0
Trapeliopsis pseudogranulosa			0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
Xanthoria parietina			0	1	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0
Xanthoria polycarpa			0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0
Total number of species			**12**	**63**	**9**	**52**	**32**	**2**	**84**	**36**	**21**	**5**	**7**	**4**	**70**	**9**	**1**	**15**	**3**	**9**	**48**	**18**		
Number of exclusive species			**0**	**3**	**1**	**5**	**0**	**0**	**15**	**2**	**0**	**0**	**0**	**0**	**6**	**0**	**0**	**0**	**0**	**1**	**1**	**0**		**34**

b) Bryophytes (n=66) in plots (n=106), sorted per tree species (n=20)

Presence for each bryophyte species in the number of plots recorded per tree species. Exclusive species are marked in yellow rows.

Scientific name	Ace	Aln g	Aln i	Bet	Cor	Cra	Fag	Fra	Ile	Jun	Lar	Mal	Que	Pic	Pin	Pop	Pru	Sal	Sor	Til	No of trees
Antitrichia curtipendula	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Brachythecium rutabulum	0	1	0	2	0	0	9	0	0	0	0	0	1	0	0	1	0	0	0	0	5
Brachythecium cf salebrosum	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Bryum capillare	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1
Bryum moravicum	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Calypogeia sp.	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Cephalozia bicuspidata	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Ceratodon purpureus	0	1	0	1	0	0	2	0	0	0	0	0	0	1	0	0	0	0	0	0	4
Chiloscyphus sp.	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Dicranella heteromalla	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	2
Dicranoweissia cirrata	0	0	0	3	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Dicranum majus	0	4	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Dicranum montanum	0	6	0	8	0	0	6	0	0	2	0	0	0	0	0	0	0	0	0	0	4
Dicranum scoparium	0	47	0	43	0	1	27	1	0	2	1	0	11	0	1	0	0	0	5	0	10
Eurhynchium striatum	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	2
Frullania dilatata	1	5	0	1	3	0	31	5	0	0	0	0	9	0	0	1	1	0	0	0	9
Frullania fragilifolia	0	1	0	0	1	0	4	1	1	0	0	0	0	0	0	0	0	0	1	1	7
Frullania tamarisci	0	8	0	0	0	0	4	1	0	0	0	0	1	0	0	0	0	0	0	0	4
Homalia trichomanoides	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
Homalothecium sericeum	0	0	0	0	0	0	3	0	0	0	0	0	2	0	0	0	0	0	0	0	2
Hypnum andoi	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Hypnum cupressiforme	1	58	1	51	6	0	56	7	0	1	2	2	32	12	1	1	1	1	21	0	17
Hypnum jutlandicum	0	0	0	1	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	2	3
Isothecium alopecuroides	0	30	0	0	2	0	33	2	0	0	0	0	15	0	0	1	0	0	5	0	7
Isothecium myosuroides	0	30	0	6	0	0	19	1	1	0	0	0	3	0	0	0	0	0	1	1	8
Kindbergia praelonga	0	0	0	0	0	0	1	2	0	0	0	0	0	0	0	1	0	0	0	0	3
Lejeunea cavifolia	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Lepidozia reptans	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Leucobryum glaucum	0	0	0	3	0	0	5	0	0	0	0	0	1	0	0	0	0	0	0	0	3
Loeskeobryum brevirostre	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Lophocolea heterophylla	0	7	0	4	0	0	0	1	0	0	0	0	2	1	1	0	0	0	0	0	6
Lophocolea bidentata	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Metzgeria furcata	1	2	0	0	4	0	45	2	2	0	0	1	8	0	0	1	0	0	5	2	11
Mnium hornum	0	44	0	30	3	0	37	2	2	1	0	0	16	4	0	0	1	0	5	2	12
Neckera complanata	0	0	0	0	0	0	5	2	0	0	0	0	0	0	0	0	0	0	0	0	2
Orthotrichum affine	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Orthotrichum diaphanum	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Orthotrichum lyellii	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Orthotrichum pulchellum	0	0	0	1	1	0	3	1	0	0	0	0	0	0	0	0	0	0	0	0	4
Orthotrichum speciosum	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Orthotrichum stramineum	0	0	0	2	1	0	22	0	0	0	0	0	0	0	0	0	0	1	1	0	5
Orthotrichum striatum	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Plagiomnium affine	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	2
Plagiomnium cuspidatum	0	1	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	3
Plagiomnium undulatum	0	3	0	1	0	0	2	0	0	1	0	0	1	0	0	0	0	0	0	0	5
Plagiothecium curvifolium	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Plagiothecium denticulatum	0	1	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Plagiothecium laetum	0	2	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Plagiothecium latebricola	0	3	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Plagiothecium nemorale	0	23	0	4	1	0	9	1	0	0	0	0	4	0	0	0	0	0	1	0	7
Plagiothecium undulatum	0	0	0	2	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	3
Pleurozium schreberi	0	0	0	6	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	3
Polytrichastrum formosum	0	30	0	19	1	0	21	0	0	0	0	0	4	1	0	0	0	0	1	0	7
Porella platyphylla	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Ptilidium pulcherrimum	0	0	0	4	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	2
Radula complanata	0	0	0	0	0	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	2
Rhizomnium punctatum	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Rhytidiadelphus loreus	0	2	0	2	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	3
Rhytidiadelphus squarrosus	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	2
Rhytidiadelphus triquetrus	0	3	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Scleropodium purum	0	0	0	5	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	3
Sphagnum fimbriatum	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1
Tetraphis pellucida	0	6	0	3	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	3
Thuidium tamariscinum	0	13	0	8	0	0	4	2	0	0	0	0	1	0	0	0	0	0	0	0	5
Ulota crispa	0	1	0	1	3	0	14	1	2	0	0	0	2	0	0	1	1	0	3	2	11
Zygodon rupestris	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Total number of species	**3**	**36**	**1**	**35**	**11**	**1**	**41**	**19**	**6**	**5**	**4**	**2**	**23**	**6**	**4**	**8**	**4**	**2**	**11**	**6**	

c) All lichens (n=133), frequency in the plots (n=107)

	Danish	Swedish	Høstemarks Skov	Tofte Skov	In total
Scientific name	**Red List**	**Red List**	**39 plots**	**68 plots**	**107 plots**
Agonimia allobata	CR	NT	x		
Amandinea punctata			0,00	0,12	0,07
Anisomeridium biforme	EN		0,00	0,10	0,07
Anisomeridium polypori	VU		0,26	0,28	0,27
Arthonia didyma	VU		0,31	0,18	0,22
Arthonia radiata	VU		0,31	0,12	0,19
Arthonia ruana			0,13	0,07	0,09
Arthonia spadicea			0,69	0,54	0,60
Arthonia vinosa	VU		0,00	0,07	0,05
Arthopyrenia sp.			0,08	0,03	0,05
Bacidia circumspecta	V		0,08	0,04	0,06
Bacidia incompta		VU	0,00	0,03	0,02
Bacidia rosella	R	NT	0,00	0,01	0,01
Bacidia rubella			0,00	0,09	0,06
Bacidina arnoldiana			0,00	0,01	0,01
Bacidina phacodes	EN	NT	0,00	0,01	0,01
Bactrospora corticola	RE	VU	0,00	0,03	0,02
Biatora globulosa			0,00	0,01	0,01
Buellia griseovirens			0,31	0,22	0,25
Calicium salicinum			0,03	0,04	0,04
Calicium viride			0,10	0,28	0,21
Caloplaca obscurella	EN		x		
Caloplaca lucifuga	EN	NT	0,00	0,01	0,01
Caloplaca luteoalba	CR	EN	0,00	0,01	0,01
Candelariella efflorescens			0,00	0,03	0,02
Candelariella xanthostigma	NT		0,03	0,00	0,01
Chaenotheca brachypoda	E		0,10	0,07	0,08
Chaenotheca chlorella	V		0,08	0,15	0,12
Chaenotheca chrysocephala	R		0,03	0,13	0,09
Chaenotheca ferruginea			0,23	0,26	0,25
Chaenotheca furfuracea	R		0,15	0,13	0,14
Chaenotheca hispidula	R	NT	0,00	0,01	0,01
Chaenotheca stemonea			0,00	0,03	0,02
Chaenotheca trichialis	R		0,44	0,41	0,42
Chaenothecopsis cf pusilla	CR		0,00	0,01	0,01
Chaenothecopsis cf vainoiana	CR		0,00	0,04	0,03
Chrysothrix candelaris			0,00	0,35	0,22
Cladonia parasitica	CR	NT	x		
Cladonia sp.			1,00	0,79	0,87
Cliostomum griffithi	NT		0,44	0,49	0,47
Cyphelium sessile	CR	VU		x	
Dactylospora parasitica	VU		0,03	0,03	0,03
Dimerella pineti			0,36	0,49	0,44
Evernia prunastri			0,08	0,62	0,42
Graphis scripta			0,64	0,26	0,40
Haematomma ochroleucum	EN		0,00	0,25	0,16
Hypogymnia physodes			0,28	0,47	0,40
Hypocenomyce scalaris			0,08	0,04	0,06
Hypotrachyna revoluta		VU	0,13	0,19	0,17
Lecanactis abietina	CR		0,82	0,82	0,82
Lecania cyrtella			0,05	0,10	0,08
Lecania cyrtellina	CR		0,03	0,04	0,04
Lecanora allophana	DD		0,00	0,04	0,03
Lecanora argentata	VU		0,13	0,03	0,07
Lecanora carpinea			0,05	0,01	0,03
Lecanora chlarotera			0,59	0,49	0,52
Lecanora expallens			0,49	0,38	0,42
Lecanora glabrata	EN	NT	0,05	0,06	0,06
Lecanora intumescens	VU		0,21	0,06	0,11
Lecanora pulicaris	VU		0,08	0,03	0,05
Lecanora symmicta			0,03	0,00	0,01
Lecidella elaeochroma			0,38	0,12	0,21
Lepraria incana			0,85	0,82	0,83
Lepraria lobificans			0,69	0,65	0,66
Lepraria membranacea	NT		0,03	0,03	0,03
Lepraria rigidula			0,03	0,00	0,01
Leptorhaphis epidermis			0,28	0,04	0,13
Lobaria pulmonaria	VU	NT	0,00	0,01	0,01

	Danish	Swedish	Høstemarks Skov	Tofte Skov	In total
Scientific name	**Red List**	**Red List**	**39 plots**	**68 plots**	**107 plots**
Megalaria lauereri	CR	EN		x	
Megalaria pulverea	DD	VU	0,00	0,01	0,01
Melanelixia glabratula			0,49	0,65	0,59
Melanelixia subaurifera			0,00	0,03	0,02
Micarea peliocarpa			0,00	0,01	0,01
Micarea prasina			0,33	0,40	0,37
Mycoblastus fucatus			0,41	0,46	0,44
Normandina acroglypta			0,00	0,01	0,01
Normandina pulchella	CR		0,00	0,01	0,01
Ochrolechia androgyna	VU		0,03	0,04	0,04
Ochrolechia microstictoides	CR		0,26	0,03	0,11
Ochrolechia subviridis	EN		0,03	0,13	0,09
Opegrapha atra			0,15	0,03	0,07
Opegrapha niveoatra			0,03	0,01	0,02
Opegrapha ochrocheila	CR	NT	0,46	0,32	0,37
Opegrapha rufescens	NT		0,13	0,13	0,13
Opegrapha sorediifera	CR		0,28	0,13	0,19
Opegrapha varia			0,10	0,18	0,15
Opegrapha vermicellifera	VU	VU	0,15	0,21	0,19
Opegrapha viridis	EN		0,21	0,07	0,12
Opegrapha vulgata	EN		0,64	0,28	0,41
Pachyphiale carneola	RE	VU	0,08	0,07	0,07
Parmelia ernstiae			0,00	0,24	0,15
Parmelia saxatilis			0,18	0,84	0,60
Parmelia sulcata			0,05	0,29	0,21
Parmeliopsis ambigua	NT		0,08	0,09	0,08
Peltigera canina				x	
Peltigera hymenina			0,03		0,01
Peltigera praetextata	VU			x	
Pertusaria albescens			0,00	0,01	0,01
Pertusaria amara	VU		0,67	0,84	0,78
Pertusaria coccodes	EN		0,18	0,34	0,28
Pertusaria flavida	CR		0,13	0,22	0,19
Pertusaria hemisphaerica	VU		0,49	0,49	0,49
Pertusaria hymenea			0,44	0,26	0,33
Pertusaria leioplaca	CR		0,26	0,12	0,17
Pertusaria multipuncta	CR	VU	0,03	0,00	0,01
Pertusaria pertusa			0,69	0,78	0,75
Phaeophyscia endophoenicea	RE			x	
Phaeophyscia orbicularis				x	
Phlyctis argena			0,67	0,75	0,72
Physcia pulverulenta			0,00	0,01	0,01
Physcia tenella			0,05	0,04	0,05
Physconia perisidiosa	NT		0,00	0,03	0,02
Placyntiella sp.			0,05	0,00	0,02
Platismatia glauca			0,00	0,03	0,02
Pseudevernia furfuracea			x		
Pseudosagedia aenea	VU		0,26	0,15	0,19
Pyrenula nitida	EN	NT	0,10	0,13	0,12
Pyrrhospora quernea	VU		0,56	0,78	0,70
Ramalina farinacea			0,00	0,16	0,10
Ramalina fastigiata			x		
Rhaphidicyrtis trichosporella	CR		0,03	0,01	0,02
Ropalospora viridis			0,33	0,06	0,16
Schismatomma decolorans	R	NT	0,08	0,12	0,10
Sclerophora peronella	RE	NT	0,03	0,00	0,01
Scoliciosporum chlorococcum			0,10	0,12	0,11
Stenocybe pullatula			0,03	0,00	0,01
Thelopsis rubella	CR	VU		x	
Thelotrema lepadinum	VU		0,56	0,47	0,50
Trapeliopsis flexuosa			0,03	0,04	0,04
Trapeliopsis pseudogranulosa			0,03	0,00	0,01
Usnea subfloridana			x		
Xanthoria parietina			0,00	0,04	0,03
Xanthoria polycarpa			0,00	0,03	0,02
Number of lichen taxa, plots	**60**	**18**	**86**	**111**	**120**
Number of lichen taxa, totally	**67**	**23**	**92**	**118**	**133**

d) All bryophytes (n=68), frequency in the plots (n=106)

	Swedish	Høstemarks Skov	Tofte Skov	In total
Scientific name	**Red List**	**38 plots**	**68 plots**	**106 plots**
Antitrichia curtipendula		0,00	0,01	0,01
Brachythecium rutabulum		0,18	0,09	0,12
Brachythecium cf salebrosum		0,03	0,01	0,02
Bryum capillare		0,00	0,01	0,01
Bryum moravicum		0,00	0,01	0,01
Calypogeia sp.		0,03	0,00	0,01
Cephalozia bicuspidata		0,00	0,01	0,01
Ceratodon purpureus		0,05	0,01	0,03
Chiloscyphus sp.		0,00	0,01	0,01
Dicranella heteromalla		0,00	0,03	0,02
Dicranoweissia cirrata		0,05	0,04	0,05
Dicranum majus		0,16	0,03	0,08
Dicranum montanum		0,26	0,13	0,18
Dicranum scoparium		0,97	0,78	0,85
Eurhynchium striatum		0,00	0,03	0,02
Frullania dilatata		0,32	0,51	0,44
Frullania fragilifolia		0,16	0,03	0,08
Frullania tamarisci		0,24	0,07	0,13
Homalia trichomanoides		0,00	0,01	0,01
Homalothecium sericeum		0,00	0,09	0,06
Hypnum andoi		0,00	0,01	0,01
Hypnum cupressiforme		1,00	0,96	0,97
Hypnum jutlandicum		0,00	0,03	0,02
Isothecium alopecuroides		0,66	0,56	0,59
Isothecium myosuroides		0,45	0,43	0,43
Kindbergia praelonga		0,00	0,04	0,03
Lejeunea cavifolia		0,03	0,00	0,01
Lepidozia reptans		0,05	0,00	0,02
Leucobryum glaucum		0,16	0,01	0,07
Loeskeobryum brevirostre		0,00	0,04	0,03
Lophocolea heterophylla		0,08	0,18	0,14
Lophocolea bidentata		0,00	0,01	0,01
Metzgeria furcata		0,55	0,59	0,58
Mnium hornum		0,76	0,76	0,76
Neckera complanata		0,00	0,09	0,06
Neckera pumila	NT		x	
Orthotrichum affine		0,03	0,01	0,02
Orthotrichum diaphanum		0,00	0,01	0,01
Orthotrichum lyellii		0,03	0,00	0,01
Orthotrichum pulchellum		0,03	0,04	0,04
Orthotrichum speciosum		0,03	0,00	0,01
Orthotrichum stramineum		0,29	0,25	0,26
Orthotrichum striatum		0,00	0,01	0,01
Plagiomnium affine		0,03	0,03	0,03
Plagiomnium cuspidatum		0,03	0,03	0,03
Plagiomnium undulatum		0,03	0,03	0,03
Plagiothecium curvifolium		0,00	0,01	0,01
Plagiothecium denticulatum		0,00	0,07	0,05
Plagiothecium laetum		0,00	0,04	0,03
Plagiothecium latebricola		0,05	0,03	0,03
Plagiothecium nemorale		0,21	0,43	0,35
Plagiothecium undulatum		0,08	0,04	0,06
Pleurozium schreberi		0,16	0,00	0,06
Polytrichastrum formosum		0,76	0,35	0,50
Porella platyphylla		0,00	0,01	0,01
Ptilidium pulcherrimum		0,03	0,04	0,04
Radula complanata		0,03	0,01	0,02
Rhizomnium punctatum		0,00	0,01	0,01
Rhytidiadelphus loreus		0,05	0,04	0,05
Rhytidiadelphus squarrosus		0,05	0,01	0,03
Rhytidiadelphus triquetrus		0,05	0,03	0,04
Scleropodium purum		0,16	0,03	0,08
Sphagnum fimbriatum		0,03	0,00	0,01
Tetraphis pellucida		0,11	0,10	0,10
Thuidium tamariscinum		0,26	0,22	0,24
Ulota crispa		0,32	0,15	0,21
Zygodon rupestris		0,00	0,03	0,02
Zygodon viridissimus			x	
Number of bryophyte taxa, plots	**1**	**43**	**59**	**66**
Number of bryophyte taxa, totally	**1**	**43**	**61**	**68**

e) Lichens on beech at Tofte Bøge 1975–77 and 2013

Scientific name	Danish RL	Swedish RL	Records	Number of trees 2013
Anisomeridium biforme	EN		1975-77, 2013	2
Anisomeridium polypori	VU		2013	
Arthonia didyma	VU		2013	
Arthonia punctiformis			1975-77	
Arthonia radiata	VU		1975-77, 2013	
Arthonia spadicea			2013	
Bacidia incompta		VU	2013	3
Bacidia rosella	R	NT	1975-77	
Bacidia rubella			1975-77, 2013	
Bacidina phacodes	EN	NT	1975-77, 2013	1
Caloplaca luteoalba	CR	EN	2013	1
Cetraria chlorophylla			1975-77	
Chaenotheca brachypoda	E		2013	2
Chaenotheca chlorella	V		2013	2
Chaenotheca furfuracea	R		2013	1
Chaenotheca trichialis	R		2013	2
Chrysothrix candelaris			1975-77, 2013	
Cladonia chlorophaea			1975-77	
Cladonia coniocraea			1975-77, 2013	
Cliostomum griffithi	NT		1975-77, 2013	
Dactylospora parasitica			2013	
Dimerella pineti			1975-77, 2013	
Evernia prunastri			1975-77, 2013	
Graphis scripta			1975-77, 2013	
Haematomma ochroleucum	EN		1975-77, 2013	
Hypogymnia physodes			1975-77	
Hypogymnia tubulosa			1975-77	
Lecanactis abietina	CR		1975-77, 2013	
Lecania cyrtellina	CR		2013	1
Lecanora allophana			2013	
Lecanora chlarotera			1975-77, 2013	
Lecanora expallens			1975-77, 2013	
Lecanora glabrata	EN	NT	1975-77, 2013	>10
Lecanora symmicta	VU		1975-77	
Lecidella elaeochroma			1975-77, 2013	
Lepraria incana			1975-77, 2013	
Lepraria lobificans			2013	
Lobaria pulmonaria	VU	NT	1975-77, 2013	>7
Megalaria laureri	CR	EN	2013	5
Melanelixia glabratula			1975-77, 2013	
Melanelixia subaurifera			1975-77	
Micarea prasina			2013	
Ochrolechia subviridis	EN		1975-77	
Opegrapha atra			1975-77, 2013	
Opegrapha culmigena	EN		1975-77	
Opegrapha rufescens	NT		1975-77	
Opegrapha sorediifera	CR		2013	3
Opegrapha varia	VU		1975-77, 2013	
Opegrapha vermicellifera	VU	VU	1975-77, 2013	>10
Opegrapha viridis	EN		2013	>10
Opegrapha vulgata	EN		2013	
Pachyphiale carneola	RE	VU	1975-77, 2013	7
Parmelia saxatilis			1975-77, 2013	
Parmelia sulcata			1975-77, 2013	
Pertusaria albescens			1975-77	
Pertusaria amara	VU		1975-77, 2013	
Pertusaria coccodes	EN		1975-77	
Pertusaria flavida	CR		1975-77, 2013	
Pertusaria hemisphaerica	VU		1975-77, 2013	
Pertusaria hymenea			1975-77, 2013	
Pertusaria leioplaca	CR		1975-77, 2013	
Pertusaria pertusa			1975-77, 2013	
Phaeophyscia endophoenicea	RE		2013	1
Phaeophyscia orbicularis			1975-77, 2013	
Phlyctis adscendens			1975-77	
Phlyctis argena			1975-77, 2013	
Physcia tenella			2013	
Placynthiella uliginosa			1975-77	
Pseudosagedia aenea	VU		1975-77, 2013	
Pyrenula nitida	EN	NT	1975-77, 2013	>30
Pyrenula nitidella	CR	EN	1975-77	
Pyrrhospora quernea	VU		1975-77, 2013	
Ramalina farinacea			2013	
Ramalina fastigiata			2013	
Ropalospora viridis			2013	
Schismatomma decolorans	R	NT	1975-77, 2013	>5
Scoliciosporum chlorococcum			1975-77, 2013	
Thelopsis rubella	CR	VU	1975-77, 2013	4
Thelotrema lepadinum	VU		1975-77, 2013	
Xanthoria parietina			1975-77	
Xanthoria polycarpa			1975-77	
Number of species in total	**41**	**13**	**81**	

Appendix 2. Photos of habitats

Open oak woodland in Tofte Skov (Bønderskov Ø). In this area several crustose lichens were recorded associated to old oaks (with deep bark fissures) in a light open environment.

Black alder *Alnus glutinosa* swamps are one of the commonest habitats in the forests of Lille Vildmose. However, the stools do not usually grow to this large dimension.

Beech forests *Fagus sylvatica* are also well represented in Lille Vildmose, but only Tofte Bøge has really old trees, both large and thinner slowgrowing stems.

Open birch forests *Betula* sp. are widespread in the northern parts of Høstemarks Skov. Due to the light open conditions quite many species of lichens were recorded on the stems.

Appendix 3. Photos of species

The foliose lichen *Hypotrachyna revoluta* was found to be rather widespread in the forests, mainly in wet or moist *Alnus* swamps, growing on black alder *Alnus glutinosa,* but also on a variety of other tree species (even twigs). The lichen is difficult to separate from *H. afrorevoluta*, and some specimens could actually refer to that taxon.

The foliose redlisted lichen *Lobaria pulmonaria* was principally recorded in the old beech forest of Tofte Bøge. The species is across Europe frequently used as reliable and valuable indicator of forests with high conservation values.

The redlisted crustose lichen *Opegrapha ochrocheila* was surprisingly frequent in the forest. Often it grows on exposed hard dead wood, but also on bark. Many of the specific sites were actually microhabitats caused and shaped by the antler of Red Deer.

The redlisted crustose lichens *Pyrenula nitida* (brown thallus with black perithecia) and *Lecanora glabrata* (light grey thallus with small dark red apothecia) were only recorded on older beech trees, mostly in Tofte Skov.

The redlisted crustose lichen *Thelotrema lepadinum* was very frequent in the forests and actually one of the most abundant lichens. In prefers moist habitats and smooth bark, but can grow on a large number of different tree species.

Large patches on smooth bark are covered by the light thallus yellow colour of the crustose lichen *Pyrrosphora quernea*, normally found on older oaks, but very common on many tree species in the forests of Lille Vildmose. Typical is the dark limit of the thallus and the dark apothecia (though seldom present).

The redlisted crustose lichen *Pertusaria multipuncta* was only recorded on a single tree (a beech) in Høstemarks Skov. The blue-gray thallus has a lot of apothecia covered by a sorediös pruina.

The redlisted crustose lichen *Pachyphiale carneola* is considered to be extinct in Denmark, but was one of several lichens that were rediscovered in the forests of Lille Vildmose in 2013. The thallus with the many red apothecia was recorded on several beech and oak trees with rough bark in as well as Høstemark as Tofte Skov.

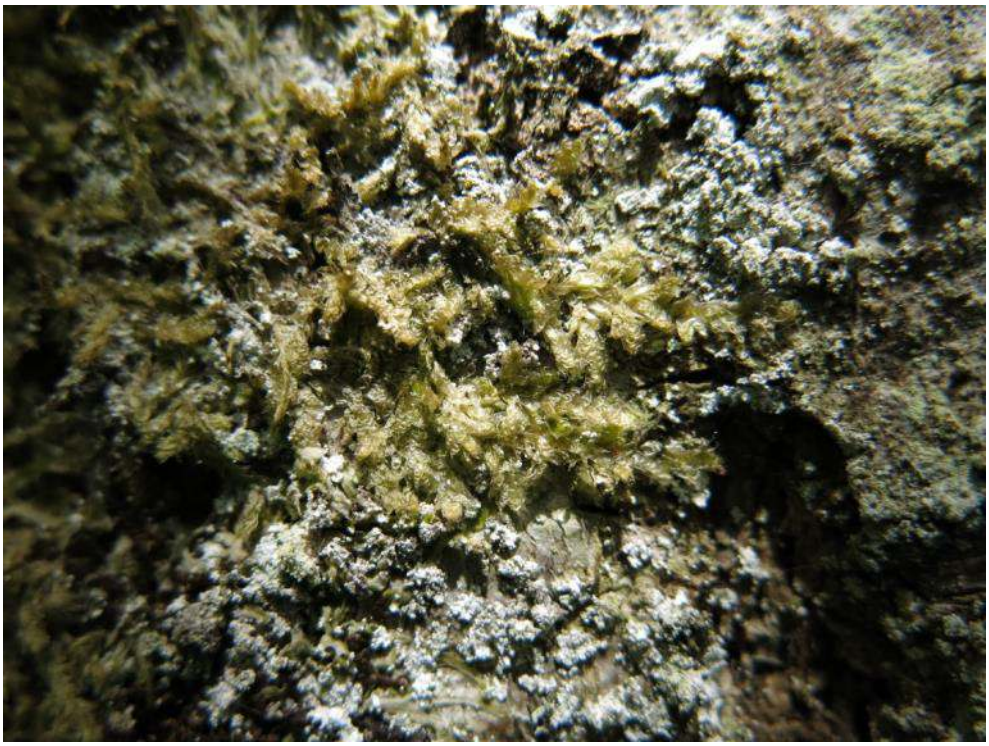
The foliose cyanolichen *Peltigera praetextata* is redlisted in Denmark. It was only recorded once during the survey in 2013. The thallus covered a large patch on a trunk of ash *Fraxinus excelsior* in the ash-black alder swamp at Tofte Bøge.

The light green bryophyte *Leucobryum glaucum* covered the lowest parts of the trunk of trees in moist to wet forest plots in Høstemarks Skov.

The liverwort *Frullania tamarisci* was recorded in several plots in moist forests of Lille Vildmose. When found it often covers large parts of the trunk.

The bryophyte *Antitrichia curtipendula* was recorded only once, on a beech tree in Tofte Skov. When found it often covers large parts of the trunk. In Sweden it is considered to be a valuable indicator for woodlands of conservation concern.

The bryophyte *Homalia trichomanoides* was recorded only once, at the base of an ash tree *Fraxinus excelsior* in the exceptionally rich plot in northwestern part of Vesterskov N.



The only record of the rare bryophyte *Neckera pumila* was made in Vesterskov S, growing on a beech tree just one meter outside a plot.

The rare bryophyte *Loeskeobryum brevirostre* was recorded at the bases of several trees in some moist *Alnus* swamps.