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Deliverable 10 from Workpackage 6

Deliverable 10 of the Nat-Man project

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Abstract

Species composition and diversity of fungi and bryophyte communities occurring on dead beech trees were analysed in five European countries (Slovenia, Hungary, The Netherlands, Belgium and Denmark). Altogether 1009 trees were inventoried in 19 beech dominated forest reserves. The realized species pool of fungi was approximately three times larger than that of bryophytes (456 versus 161 species).

The two most important factors influencing the composition of both fungal and bryophyte assemblages were decay stage of the trees and geographic region. In the case of fungi the effect of decay stage exceeded the effect of geographical difference, whereas in the case of bryophytes it was the opposite. For both organism groups species richness per tree was positively associated with tree size. In the case of fungi obligate wood decaying species dominated the studied communities in all countries. Bryophyte communities were composed of species belonging to widely different ecological groups. The proportion of epixylic species was higher in Slovenia than in Hungary (more continental climate) and in the Atlantic region (lower naturalness of sites). The significance of bryophyte taxonomic groups changed with countries: in Slovenia hepatics, in Hungary and Denmark pleurocarps, and in The Netherlands and Belgium acrocarps were the most important.

Diversity of communities differed considerably among regions. Slovenian sites were the hotspot of bryophyte diversity characterized by high alpha (species richness of trees) and beta (species richness of sites) diversity and a high fraction of rare and threatened species. Fungal alpha diversity is low, but beta diversity is high with rich occurrences of infrequent and threatened species. This richness is most likely caused by the combination of high air humidity and a very high degree of naturalness of the Slovenian sites. Hungarian stands are characterized by intermediate levels of fungal alpha and beta diversity, intermediate to rather high levels of bryophyte alpha and beta diversity, and very high fractions of rare and threatened fungal species. These characteristics reflect the relatively high naturalness of the study sites, as well as a rather continental climate. In the Danish sites alpha and beta diversity of fungal assemblages, as well as the number of infrequent species was high, while the number of threatened species was intermediate. For bryophytes, alpha diversity was low and beta diversity was intermediate. These characteristics are explained by a combination of forest history, present forest structure and climatic traits, and show that Danish beech reserves have a good potential for restoring rich bryophyte and fungal communities if more or bigger forest reserves are declared. The Belgium site was characterized by high alpha, but

low beta fungal diversity, and intermediate alpha, but low beta bryophyte diversity, and a rather low frequency of threatened species. These patterns seem to reflect the favourable climate for growth in combination with severe impact from past human disturbance. The Dutch sites are characterized by low fungal alpha and beta diversity, and low bryophyte alpha, but intermediate beta diversity, and very low frequencies of threatened species in both groups. These characteristics clearly relate to the low degree of naturalness of the beech forests in The Netherlands.

Introduction

An important feature of natural forests is that they possess high amounts of coarse woody debris (CWD) in all stages of decay and also high proportion of old, living trees with dead parts (Maser and Trappe 1984, Harmon et al. 1986, Ferris-Kaan et al. 1993, Peterken 1996, Csóka 2000). These different CWD types provide important habitats for a diversity of organisms, including fungi, bryophytes, lichens, invertebrates, amphibians, cavity nesting birds and small mammals (Maser and Trappe 1984, Harmon et al. 1986, Eckloff and Ziegler 1991, Ferris-Kaan et al. 1993, Samuelsson et al. 1994, Esseen et al. 1997, Csóka, 2000; Siitonen 2001).

In temperate European beech *(Fagus sylvatica)* forests fine scale gap dynamics, based on the death of individual or small groups of trees, is the main form of natural disturbance, providing a continuous presence of dead wood of different size and decay categories over time (Korpel 1995, Peterken 1996, Emborg et al. 2000, Standovár and Kenderes 2003).

Man has heavily influenced the European beech forest landscape for centuries (Rose 1992, Peterken 1996,), causing artificial stand structure and disturbance regime in most present-day beech forests. Many structural elements important for forest dwelling organisms, e.g. water bodies, veteran trees, dead wood, intermixing tree species, have decreased considerably both in quantity and quality (Christensen and Emborg 1996, Kirby et al. 1997). For CWD it has been estimated that the decline in availability has been in the range of 90-98% in the Fennoscandian region (Siitonen 2001). In the European beech forest zone the degree of decline in available CWD is not known with certainty, but it is estimated to be comparable to the degree in Fennoscandia (Christensen et al. 2004). Forest fragmentation has imposed additional difficulties for dispersal of dead wood dependent forest organisms between remaining old-growth stands (Saunders et al. 1991, Söderström and Jonsson 1992). Especially, sites retaining natural characteristics are now widely separated at the regional and continental scales. The combination of forest management and forest fragmentation has lead to a substantial decline in the populations of most forests dwelling organisms, and especially of species depending on dead wood, of which many have decreased or gone extinct locally and regionally (Rose 1992, ECCB 1995, Siitonen 2001, Söderström and Jonsson 1992). Generally, remnants of semi-natural beech stands are more widespread and less influenced by human activities in the mountains of Central Europe and the Dinaric region, than in the Atlantic lowlands of northwest Europe (Standovár and Kenderes 2003, Peterken 1996).

Fungi are the principal agents of wood decay in terrestrial habitats and hence they open up the wood resource for most other organisms living in dead wood (Boddy 2001). Wood inhabiting fungi constitute a highly diverse group of organisms. A large group of species are obligatorily associated with dead wood, as active wood decayers or mycoparasites, but also litter decomposing, mycorrhizal and bryophile species are associated with decaying wood (Heilmann-Clausen 2003). Decay stage appears to be the most important variable for understanding fungal community composition on decaying wood at the local scale, but also tree species, tree size, microclimatic conditions, death cause as well as the original position of the dead wood in the tree are key variables influencing species composition (Keizer and Arnolds 1990, Renvall 1995, Høiland and Bendiksen 1996, Lindblad 1998, Heilmann-Clausen 2001, 2003, Heilmann-Clausen and Christensen 2003a, b, Heilmann-Clausen et al. 2003). At the regional scale climatic conditions, soil type, tree species composition, continuity and management history have been identified as important variables influencing species diversity and community structure (Strid 1975, Mathiasen 1993, Bader et al. 1995, Sippola and Renvall 1999, Lindblad 2001, Nordén & Paltto 2001, Stokland 2001, Heilmann-Clausen and Christensen 2003c). At the continental European scale climatic regions are known to support distinctly different communities of wood inhabiting fungi, but also the actual tree species composition has a major impact on the species diversity, due to widespread host selectivity (e.g. Ryvarden and Gilbertson 1994).

Among bryophytes many species occur on dead wood obligatorily (true epixyls) or facultatively (epiphytic, terricol and epilithic species). Successional studies focusing on one habitat type typically show a clear compositional change of bryophyte vegetation during the decay of trees (McCullough 1948, Söderström 1988a, 1993, Heilmann-Clausen et al. 2003, Ódor and van Hees in press). The most important functional groups among dead wood dwelling bryophytes are epiphytes (occurring on bark), epixylic species (occurring on soft wood), terricol species, and opportunistic species (generally common species that occur in all stages of dead wood and on other substrates). Accidentally epilithic bryophytes and colonist species of mineral soil can occur at the base of dead trees.

At the continental scale a lot of bryophyte species has a relatively restricted distribution, hence phytogeographic and climatic factors are the major determinants of species composition (Barkmann 1958, Phillippi 1965, Hübschmann 1986, Marstaller 1986, Qian et al. 1999). At the regional scale other factors (forest types, management type, distance from water body, microclimate, tree species composition, soil/bedrock type) are highly important

(McCullough 1948, Raschendorfer 1949, Barkman 1958, Muhle and LeBlanc 1975, McAlister 1997, Aude and Lawesson 1998).

This present study aims to compare the community composition and diversity of fungi and bryophytes inhabiting decaying beech trees in different beech forest areas of Europe. Diversity, species composition and the distribution of different functional groups are compared in semi-natural beech reserves of different geographical regions, emphasizing the relative importance of site and tree specific variables.

Material and Methods

Study sites

Altogether 19 forest reserves were selected for this study in Slovenia, Hungary, The Netherlands, Belgium and Denmark (Fig. 1). The criteria for site selection were the followings: a) beech should be dominant and b) the sites should represent, as closely as possible, the best natural reference of beech forests for the region. In each country approximately 200 fallen dead trees were selected for the study. In Belgium only one site was selected, but it was divided into two parts based on different age and forest history. In Hungary and Slovenia two sites were studied, each represented by cc. 100 trees. In Denmark five sites were included representing four regions. Finally, The Netherlands is represented by eight sites with a variable numbers of studied trees. The high number of study sites in The Netherlands reflects the low amount of CWD available at each site.

Some general features of the investigated sites relating to naturalness, age, stand structure, soil type and climate are shown in Table 1.

Climatic conditions vary considerably among the selected forest stands. The sites in Denmark, Belgium and The Netherlands are generally characterized by a more or less Atlantic climate. The Hungarian sites have a mid-European continental climate, while the Slovenian sites have a mountainous, Dinaric climate. Annual precipitation is rather similar (700-900 mm) except for the two Slovenian forests, where the annual precipitation is 1500-1600 mm. In the Atlantic region mean annual temperature is higher in The Netherlands (T_{ave} 9.4°C) than in Denmark (T_{ave} 7-8 C°). The Hungarian sites have a colder, more continental character than the Slovenian ones (T_{ave} c. 6 °C in Hungarian and c. 8 °C in Slovenian sites). The difference between the mean temperature of the coldest and warmest month is considerably higher in Slovenia and Hungary (18-20 °C) than in Belgium and The Netherlands (14-15 °C), with Denmark showing intermediate values (15.5-17°C).

The bedrock is generally formed by young deposits in Atlantic sites (sand, clay, loess, chalk), dolomite and limestone in Slovenian sites and andesite and limestone in Hungarian sites. Generally, soil acidity is higher, whereas its nutrient content is lower in sites characterized by sand or andesite bedrock compared to soils developed on clay, loess or limestone. Therefore, the soil characteristics (acidity, nutrient content, etc.) differ considerably among sites, both between and within countries.

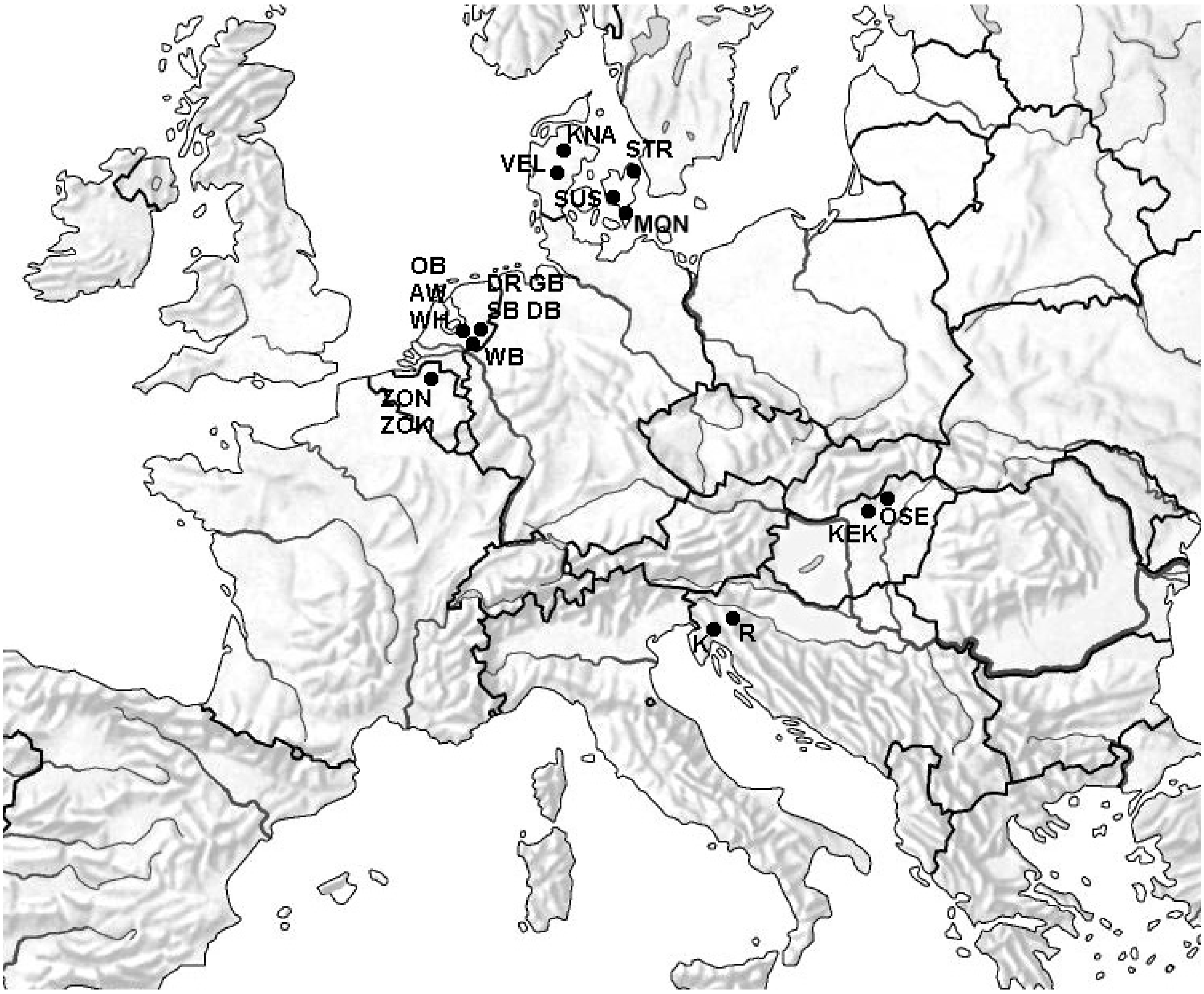


Fig. 1. Geographic location of investigated forest stands. Abbreviation of sites is explained in Table 1.

Country	Reserve	Size (ha)	Age (yr)[1]	Other trees[2]	Living volume (m^3/ha)	CWD volume (m^3/ha)	No. of sampled trees	DBH of CWD (cm)[3]	Decay stages of CWD[4]	Elevation (m)	Bedrock	Tave (°C)[5]	Tmin (°C)[6]	Tmax (°C)[7]	Precipitation (mm)[8]
Slovenia (S)	Rajhenav (R)	51	old	Abies alba	813	299	110	50 (17, 97)	1-6	865	limestone	7.7	-1.9	16.9	1579
	Krokar (K)	73	old	Abies alba	633	153	101	37 (10, 98)	1-6	1120	limestone	8.4	-1.6	17.8	1526
Hungary (H)	Kékes (KEK)	63	old	Tilia platyphyllos, Acer pseudoplatanus, A. platanoides	454	99	97	55 (23, 125)	1-6	850	andesite	5.7	-4.7	15.5	840
	Oserdo (OSE)	25	200	-	765	164	110	66 (18, 135)	1-6	850	limestone	6.1	-4.1	15.5	896
The Netherlands (N)	Speuldebos (SB)	27	200	*Quercus robur, Q. petraea*	457	44	42	46 (25, 83)	1-4	42	sand	9.4	2.2	17.2	876
	Drie (DR)	5	200	Quercus robur, Q. petraea	457	44	21	51 (21, 90)	1-3	35	sand	9.4	2.2	17.2	876
	Gortelsebos (GB)	15	200	Quercus robur, Q. petraea	507	66	11	62 (14, 95)	2,3	45	sand	9.4	2.2	17.2	873
	Weversbergen (WB)	12	100	-	469	49	32	55 (18, 120)	1-3	80	loam-sand	9.4	2.2	17.2	856
	Wulperhorst (WH)	3	200	Quercus robur, Fraxinus excelsior, Carpinus betulus	701	72	44	68 (36, 120)	2-4	3	clay	9.4	2.8	17.2	827
	Oostbroek (OB)	3	150	Quercus robur, Fraxinus excelsior	-	-	10	71 (57, 88)	2	2	clay	9.4	2.8	17.2	827
	Dassenberg (DB)	12	200	Quercus robur, Q. petraea	402	63	37	67 (18, 105)	1-3	96	sand	9.4	2.2	17.2	906
	Amelisweerd (AW)	3	150	Quercus robur, Fraxinus excelsior	-	-	5	73 (60, 90)	1,3	2	clay	9.4	2.8	17.2	827
Belgium (B)	Zoniënwoud (ZON)	80	150	Quercus robur, Quercus petraea	602	24	67	45 (15, 118)	1-5	105	loess	9.4	3.4	18.2	829
	Zoniënwoud - Kern (ZOK)	18	220	-	794	139	125	69 (15, 117)	1-5	105	loess	9.4	3.4	18.2	829
Denmark (D)	Knagerne (KNA)	6	230	-	449	152	25	72 (27, 108)	1-4	80	sand	7.5	0	15.5	719
	Velling (VEL)	24	275	-	489	114	25	53 (20, 93)	1-6	70	sand	7.5	0	15.5	839
	Suserup (SUS)	19	old	Fraxinus excelsior, Ulmus glabra, Q. robur	674	176	50	76 (24, 131)	2-6	20	loam-sand	8.1	0.8	16.7	644
	Møns Klinteskov (MON)	25	350	-	201	100	50	48 (21, 86)	1-6	100	chalk	7.9	0.2	16.2	586
	Strødam (STR)	25	250	Q. robur	490	181	50	77 (21, 127)	1-6	23	loam-sand	7.7	-0.5	16.2	697

Table 1. Stand structural and climatic features of the selected forest stands. [1]Age since last cutting or plantation; old: the stand was never cut in the past. [2]Tress with min. 5% stand volume besides beech. [3]Mean diameter at breast height (DBH) based on the investigated dead trees, minimum and maximum are in brackets. [4]Minimum number of trees from the same decay stage is 3 from one site. [5]Mean annual temperature. [6]Mean temperature of the coldest month. [7]Mean temperature of the warmest month. [8]Annual precipitation.

All stands are dominated by beech, but in some sites other tree species are also important (especially *Abies alba* in Slovenian sites, *Quercus robur* and *Fraxinus excelsior* in some Atlantic forests). Forest history differs considerably among sites and countries. Some stands were cut completely in the past and have a rather uniform age structure, with dominant tree ages between 100 and 250 years. Some of these stands have unbroken forest continuity (e.g. Oserdo in Hungary, part of Strødam in Denmark, the Dutch reserves on sandy soils) while others were used as arable or pasture land for a long time breaking forest continuity (e.g. Dutch reserves on clay soil). Other sites have a more complex history of human use, including periods of forest grazing, selective cutting and even small-scale agriculture, but have never been cut totally in the past. These forests are characterized by uneven age structure, and the ones with the least human influence (e.g. Suserup in Denmark, Kékes in Hungary, Krokar in Slovenia) by structures and gap dynamics similar to those reported from virgin forests (Korpel 1995, Emborg et al. 2000, Standovár and Kenderes 2003, Hartman 1999). However, there is only one site, Rajhenav in Slovenia that seems to support a true virgin forest, which has suffered minimal, if any direct human intervention (Boncina 1999).

The observed features of CWD differ considerably among the investigated stands. The volume of CWD is generally 40-70 m^3/ha in the Dutch sites, 100-180 m^3/ha in other sites and very high, 300 m^3/ha in Rajhenav, Slovenia (Christensen et al. 2004, Kraigher et al. 2002). All investigated reserves hold large dead beech trees (diameter at breast height (DBH) larger than 80 cm), but in the reserves in Belgium and The Netherlands strongly decayed trees (decay phase 4, 5, 6) are missing or scarce.

Dead tree selection and description

Trees were selected using two criteria: decay stage and, size (DBH). Different decay stages and size (DBH) categories were as evenly distributed among the c. 200 selected trees per country as possible. It is proved from different forest types that these two features are very important factors influencing species richness and composition of fungi and bryophytes (Söderström 1988a, Renvall 1995, Heilmann-Clausen 2001, Ódor and van Hees in press). Because of the absence of well-decayed trees in The Netherlands and Belgium the later decay classes (4-6) are considerably underrepresented in these countries. Minimum 70% of log should have soil contact in the case of selected trees. Selected dead trees were described by the following characteristics:

COUNTRY: Nominal scale variable coding the country in which it was found.

SITE: Nominal scale variable coding the forest reserve, where it was sampled.

DS (decay stage): Ordinal scale variable described by using a 6-class system based on outer physical features of trees (presence of bark, branches, softness and surface of wood, shape of trunk, Table 2, Ódor and van Hees in press). Most dead trees represent a mixture of different decay stages (decay is not homogenous at different parts of the tree), therefore the dominant decay class was used during the analysis.

DBH: Ratio scale variable expressing tree size by diameter at breast height (at 130 cm height).

BARK: Ratio scale variable describing the percentage of tree surface covered by bark.

GAP: Binary scale variable describing whether the tree occurs in a large canopy gap or not. The minimum diameter of the gap was 150% of the height of surrounding dominant trees.

SOIL: Ratio scale variable describing the percentage of the log length in direct contact with the soil.

Decay stage	Bark	Twigs and branches	Softness	Surface	Shape
1	intact or missing only in small patches, more than 50%	present	hard or knife penetrable to 1-2 mm	covered by bark, outline intact	circular
2	missing or less than 50%	only branches (>3 cm) present	hard or knife penetrable to less than 1 cm	smooth, outline intact	circular
3	missing	missing	begins to become soft, knife penetrable to 1-5 cm	smooth or crevices present, outline intact	circular
4	missing	missing	soft, knife penetrable to more than 5 cm	large crevices, small pieces missing, outline intact	circular or elliptic
5	missing	missing	soft, knife penetrable to more than 5 cm	large pieces missing, outline partly deformed	flat elliptic
6	missing	missing	soft, partly reduced to mould, only a core of wood	outline hard to define	flat elliptic covered by soil

Table 2. Description of decay stages.

Inventory of bryophytes and fungi

Bryophytes occurring on the selected trees were recorded in each country in summer and autumn 2001. The inventory included the log, the uprooting part of the log, the snag (if present), and the major branches of the crown (if present). The nomenclature used follows Corley et al. (1981) and Corley and Crundwell (1991) for mosses, and Grolle (1983) for hepatics. All bryophytes were identified at the species level with the following exceptions: *Drepanocladus sp.* (unidentified *Drepanocladus* specimens, separated from *Drepanocladus aduncus* and *Sanionia uncinata*, 2 occurrences); *Grimmia sp.* (unidentified *Grimmia* specimen, separated from *Grimmia hartmanii*, one occurrence); *Pottia sp.* (unidentified *Pottia* specimen, one occurrence). The following pairs of species were not separated during the inventory: *Plagiothecium denticulatum* and *P. ruthei*, *Plagiothecium nemorale* and *P. succulentum*, *Plagoithecium laetum* and *P. curvifolium*, *Plagiochila porelloides* and *P. asplenioides*.

Fungi were recorded on three occasions at each site in the period of 2000-2001. On each occasion, each fallen dead tree, including eventual snag and crown was inventoried for fungal sporocarps occurring strictly on dead wood. Sporocarps were either identified in the field or collected for microscopic identification. Within the basidiomycetes all morphological groups, excluding fully resupinate corticoid fungi, were included, while non-stromatic pyrenomycetes and inoperculate discomycetes with sporocarps regularly smaller than 10 mm were excluded from the ascomycetes. Nomenclature for fungi in general follows Hansen and Knudsen (1992, 1997 and 2000), but several special taxonomical works were consulted for certain groups (e.g. pyrenomycetes).

Data analysis

The general structure of the data sets was explored by detrended correspondence analysis (DCA, Hill and Gauch 1980, Jongman et al. 1987, Økland 1990). The analysis was carried out separately for the fungal and the bryophyte data set using CANOCO 4.5 (ter Braak and Šmilauer 2002). In both organism groups the species with less than five records and trees with less than five species recorded were excluded. In the case of fungi only truly lignicolous species were included. The interaction between sample scores of different DCA axes and environmental variables was analysed by different statistics depending on the type of environmental variables. In the case of nominal scale environmental variables (COUNTRY, SITE, GAP) heterogeneity analysis was carried out using $?^2$ statistics, sample scores on DCA axes were classified according to the quartiles (Zar 1999). In the case of ordinal (DS) and ratio scale (DBH, BARK, SOIL) variables Sperman rank correlation was calculated (Zar 1999). Geographical location (COUNTRY, SITE) and decay stage (DS) of samples, and the position of species were also evaluated by visual inspection of scatter diagrams.

Diversity of dead wood dwelling fungi and bryophytes were compared among countries based on the whole dataset investigating the following descriptors: number of species (beta diversity), number of occurrences, average number of species per tree (alpha diversity) and species rank – relative frequency curves. Number of species per trees was compared among countries by ANOVA and Tukey-type multiple comparison after logarithmic transformation of the original data (Zar 1999). The effects of decay stage (DS), tree size (DBH) and geographical region (COUNTRY) on species richness (alpha diversity) were analysed by multiple regression (McCullagh & Nelder, 1983, Crawley 1993). During the analysis a general linear model was used with the following criteria: (1) dependent variable: species richness, (2) explanatory variables: DS (factor), DBH (interval) and COUNTRY (factor), (3) error structure: normal and (4) link function: logarithmic. The model selection was based on backward elimination from the full model (including all interactions) tested by deviance analysis (McCullagh & Nelder, 1983, Crawley 1993). The effects of DS and DBH were analysed in different countries by comparing the predicted values of the selected model.

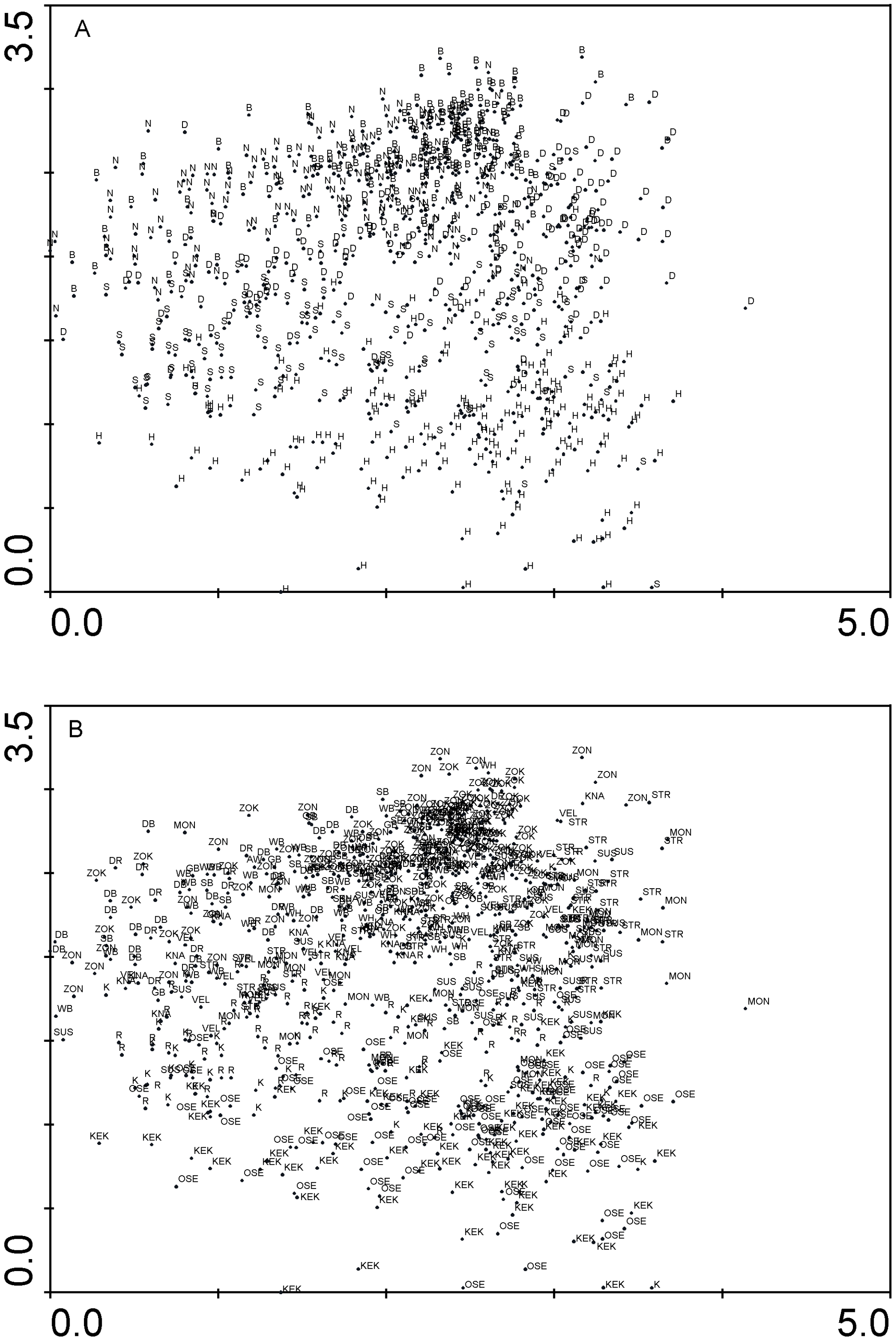
Apart from the general analyses of species richness, special emphasis was given to species that are considered to be threatened all over or regionally in Europe. The "Red Data Book of European Bryophytes" (ECCB 1995) was the major reference for Europe, but regional red lists for different countries (Martincic 1992, Papp et al. 2001) were also used. Due to the lack of a common European red list for fungi a number of species were classified as "Species of Special Interest" (SSI) based on data from several national red lists for fungi (Benkert et al. 1992, Arnolds and van Ommering 1996, Stoltze and Pihl 1998, Rimóczi et al. 1999, Gärdenfors 2000). This classification was only carried out for truly lignicolous species. Three classes of SSI were defined. Class A includes widespread species regarded as very rare and severely threatened everywhere in Europe (IUCN threat categories "Endangered" to "Critically Endangered"). Class B includes widespread species regarded as rare all over Europe, and threatened in several countries (IUCN threat categories "Near Threatened" to "Vulnerable"). Finally, class C encompasses species that are considered to be threatened (IUCN threat categories "Vulnerable" to "Critically Endangered") in one or several of the covered European countries/regions, but frequent in others. A few poorly known but apparently rare species are also included in this category.

In addition to species based diversity analyses, species'ecological preferences, and in the case of bryophytes also their taxonomical status were used for further analyses. Importance of these ecological and taxonomic groups was compared among countries considering their relative frequencies based on a) the species list and b) weighted by the number of occurrences. In the latter cases the distribution of functional groups among countries was analysed by heterogeneity analysis of contingency tables (Zar 1999). Bryophytes were grouped as hepatics, acrocarp and pleurocarp mosses. This is called "taxonomy type", although pleurocarp and acrocarp are not real taxonomic categories. Secondly, species were classified according to their substrate preference using the following categories: obligate epixylic (occurring mainly on well decayed wood), epiphytic (occurring mainly on bark), opportunistic (no special substrate preference), terricolous (occurring on forest floor and litter), uproot (occurring on the mineral soil of the vertical uprooting part of the logs), epilithic (occurring on rocks). The ecological classification was based on different handbooks (Frey and Frahm 1995, Smith 1978, 1990, Dierssen 2001), quantitative studies (Söderström 1988a, Ódor and van Hees in press) and on field experience of the authors. Appendix 1 contains the list of bryophytes, their number of occurrences per country, and their classification into taxonomic and ecological types. Fungi were grouped as lignicolous, litter inhabiting/terrestrial, ectomycorrhizal and bryophile species, mainly based on information provided by Hansen & Knudsen (1992, 1997, 2000). Appendix 2 contains the list of species, their number of occurrences per country, and their classification into ecological groups, and also the classification into SSI categories.

Results

Species composition of fungi

The complete dataset contained 12596 occurrences representing 456 species occurring on 1014 trees. After omitting a) facultative wood-inhabiting species, b) species occurring on less than five trees and c) trees with less than five species, the data set used in the ordination analysis contained 10080 occurrences, including 178 species occurring on 790 trees (Fig. 2). The eigenvalues of DCA axis 1 and 2 were 0.39 and 0.31 respectively, while axes 3 and 4 possessed much lower values (0.18 and 0.15). Thus, the first two ordination axes explained most of the variation in species composition. The gradient lengths of these two axes were 4.14 and 3.19 SD (standard deviance), respectively.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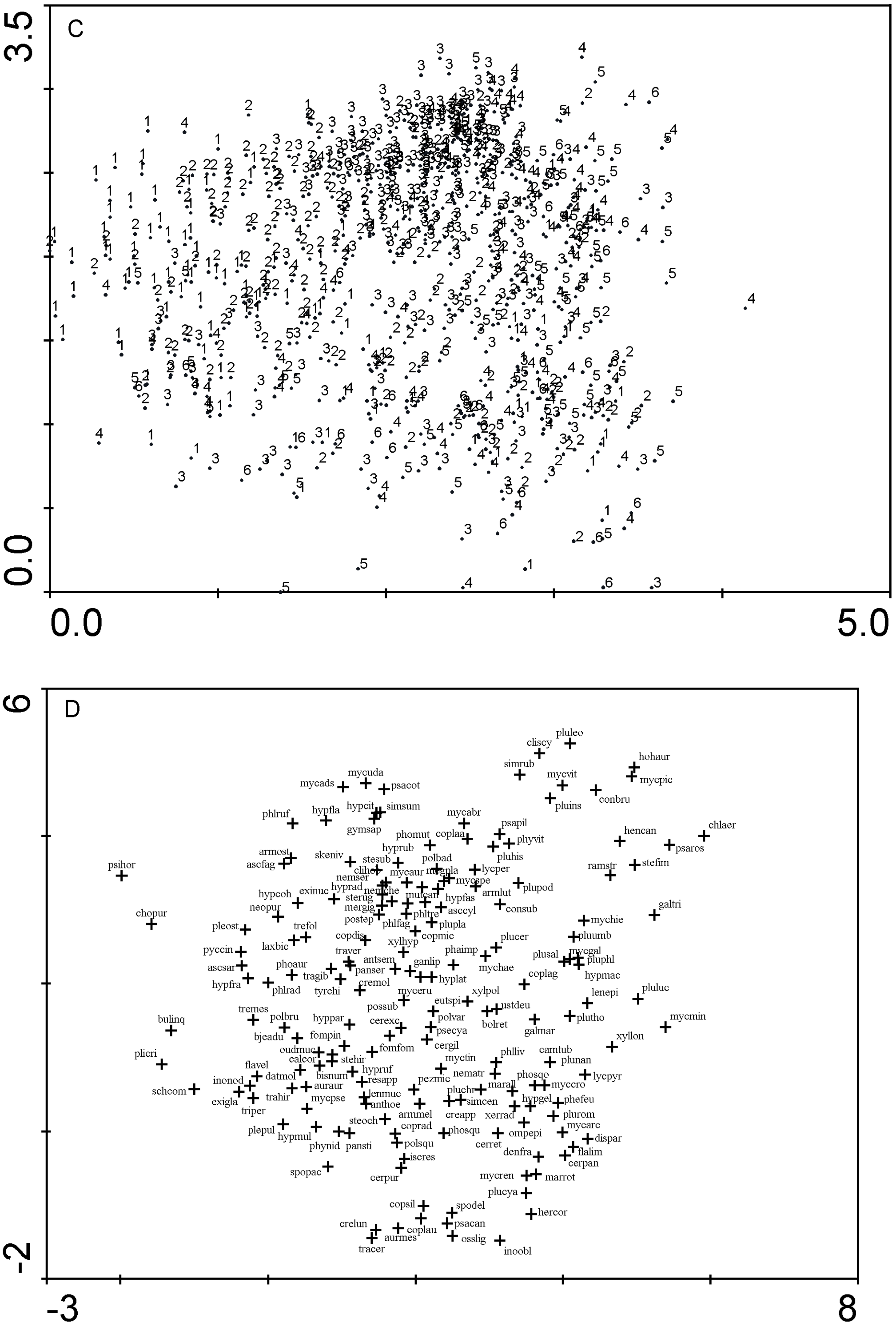


Fig. 2. Position of samples (A-C) and species (D) along the first two axes of DCA analysis using the fungal dataset. Samples are labelled by country codes (A), site codes (B) and decay stages (C). Explanation of sample codes can be found in Table 1, of species codes in Appendix 2.

DCA1 was highly correlated with decay stage and with factors related to the process of decay (bark cover, soil contact of log), with low axis scores obtained by weakly decayed trees and high axis scores obtained by strongly decayed trees (Fig. 2, Table 3). DCA1 had a weak correlation with tree size, but this factor seems to be less important for the composition of fungi than factors related to decay and geographical location. Along the second axis (DCA2) the trees were ordered primarily according to country. With low axis scores the Hungarian samples made a distinct cluster, while the Belgian and Netherlands samples formed an equally distinct cluster at the opposite end of the axis. The Slovenian (closer to Hungarian ones) and Danish (closer to Dutch and Belgian ones) samples were more or less intermingled in the middle part of DCA2. Thus, the gradient expressed along DCA2 seems primarily to reflect climatic or geographical differences, separating the distinctly continental sites of Hungary from the highly Atlantic sites of Belgium and The Netherlands. The Dinaric Slovenian and Subatlantic Danish sites obtained intermediate positions. There was hardly any clear within-country tendency in the distribution of sample trees according to SITE. The only exception was Slovenia, where trees from Krokar had lower DCA2 scores than those from Rajhenav.

		DCA1					DCA2				
Variable	Scale	?^{2}	df	R_s	N	p	?^{2}	df	R_s	N	p
COUNTRY	nominal	198.3	12	-	-	***	897.3	12			***
SITE	nominal	328.1	54	-	-	***	933.9	54			***
DS	ordinal	-	-	0.45	788	***			0.02	788	n.s.
DBH	ratio	-	-	0.11	788	**			0.03	788	n.s.
GAP	nominal	8.6	3	-	-	*	12.3				**
BARK	ratio	-	-	- 0.40	788	***			0.00	788	n.s.
SOIL	ratio	-	-	0.32	788	***			0.03	788	n.s.

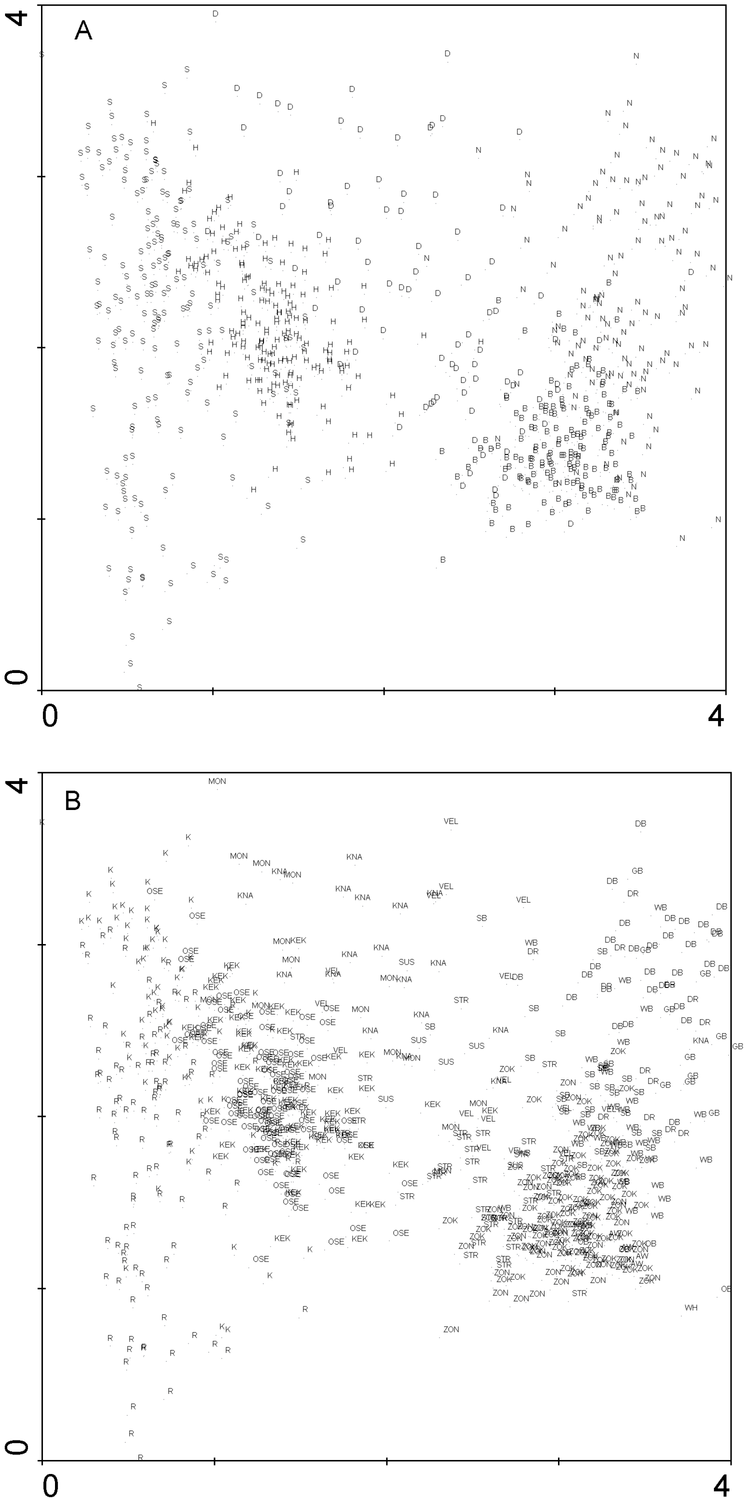
Table 3. Interaction between sample scores on DCA axes and environmental characteristics of logs during DCA analysis of fungi. In case of nominal variables heterogeneity analyses were used (?^{2}, df) categorizing sample scores according to quartiles. In case of ordinal and interval variables Spearman-rank correlation was calculated (R_s, N). Codes of p values: n.s.: not significant, *: p<0.05, **: p<0.01, *: p<0.001.

The distribution of species in the DCA1/DCA2 ordination space (Fig 2) reflects the factors influencing species composition. Thus, species with low DCA1 scores are characteristic of hardly decayed dead wood (e.g. *Bulgaria inquinans, Chondrostereum purpureum, Plicaturopsis crispa, Psilocybe horizontalis, Schizophyllum commune*), while species with high axis scores generally are associated with severely decayed wood (e.g. *Chlorociboria aeruginascens, Galerina triscopa, Mycena spp, Pluteus spp., Ramaria stricta*). Species with intermediate scores include very common species, producing sporocarps during most of the decay process (e.g. *Coprinus micaceus, Eutypa spinosa, Fomes fomentarius, Marasmius alliaceus*), as well as species with a distinct preference for intermediately decayed trees (e.g. *Ceriporia excelsa, Ceriporiopsis gilvescens, Peziza micropus*).

Species with low DCA2 scores have their optima in the Hungarian and to some extent the Slovenian sites. This group includes several agarics, polypores and hedgehog fungi associated with heart-rot (*Dentipellis fragilis, Hercium coralloides, Inonotus obliquus, Ischnoderma resinosum, Ossicaulis lignatilis, Pholiota squarrosoides, Polyporus squamosus, Spongipellis spp.*). Low DCA2 scores were also obtained by a group of agarics that occurred frequently in Hungary, Slovenia and to some extent in Denmark, but which were very infrequent or completely absent in Belgium and The Netherlands. These species were associated with distinctly decayed wood (e.g. *Coprinus silvatica* (only in Hungary), *Flammulaster limulatus, Mycena crocata, M. renatii)*. At the other end of the axis there were a number of species with their optima in the Belgian and Netherlands sites. This group is dominated by non heart-rot forming agarics, crust fungi and polypores (e.g. *Hohenbuehelia auriscalpium, Hyphodontia flavipora, Mycoacia uda, Phlebia rufa, Pholiota mutabilis, Physisporinus vitreus, Simocybe rubi, S. sumptuosa, Skeletocutis nivea*), while known heart-rot agents are almost absent, with the exception of *Meripilus giganteus*. Species with intermediate DCA2 scores showed either no preference for countries, or had their maxima in the Danish and/or Slovenian sites. The latter groups include *Galerina triscopa, Lentaria mucida, Mycena erubescens* and *Nemania atropurpurea.*

Species composition of bryophytes

The whole dataset contained 8986 occurrences of 161 species present on 1009 trees. The dataset used for ordination contained 102 species and 732 trees after deleting species with less than five occurrences and logs with less than five species. The eigenvalues of the first two axes were 0.57 and 0.27, with gradient lengths of 3.99 and 3.90 SD units, respectively. The samples were separated according to the regions along the first ordination axis (DCA1), in the order Slovenia, Hungary, Denmark, Belgium and The Netherlands (Fig. 3). The very large obtained ?^{2} values also confirmed the strength of the effects of geographical location (COUNTRY, SITE), and showed that the gradient was weakly correlated with other variables, especially decay stage (Table 4). The interpretation of the second axis (DCA2) was more difficult. Generally the axis was highly correlated with decay related factors (DS, BARK), but the effect varied considerably among countries (Fig. 3c). The effect was very pronounced in Slovenia, distinct in Hungary and Denmark, and insignificant in The Netherlands and Belgium.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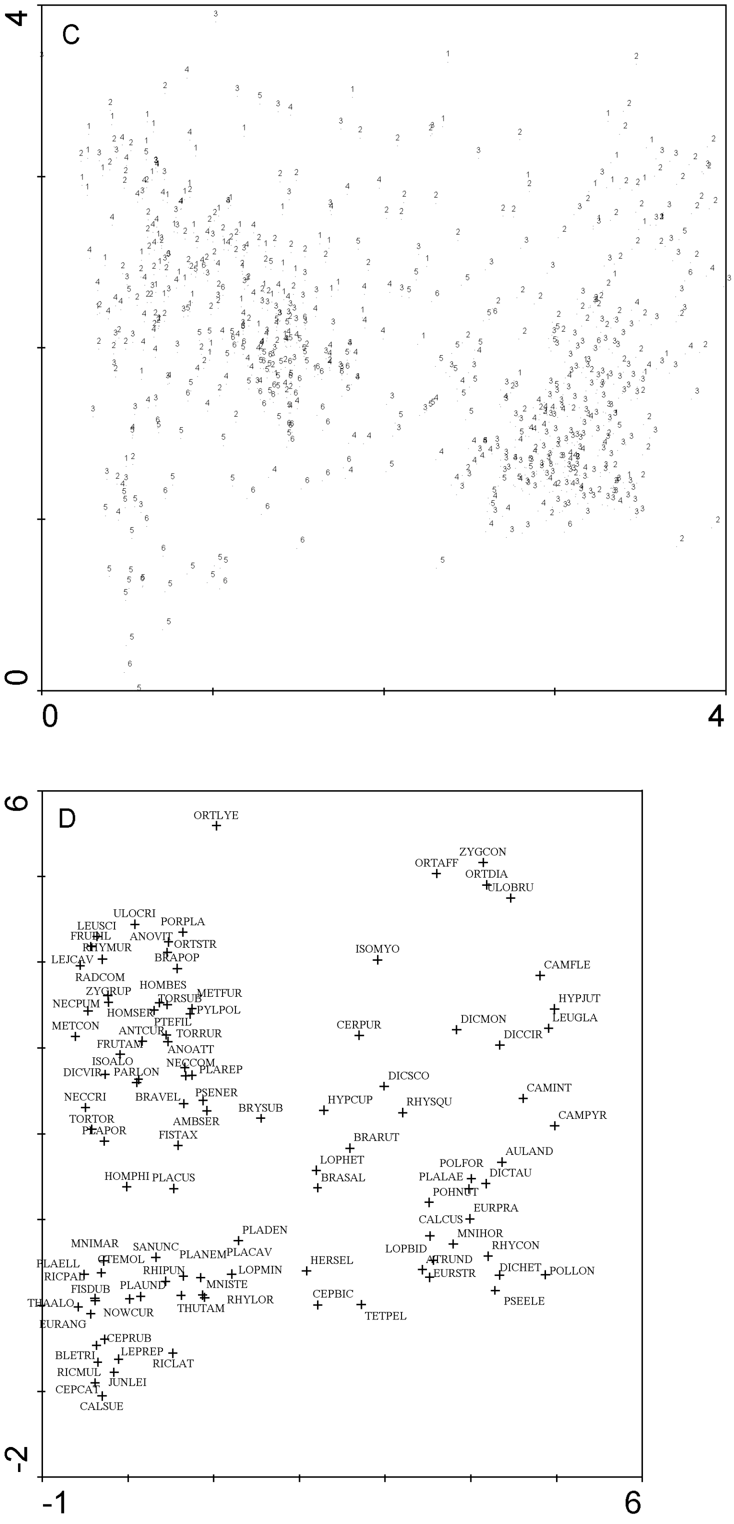

Fig. 3. Position of samples (A-C) and species (D) along the first two axes of DCA analysis using the bryophyte dataset. Samples are labelled by country codes (A), site codes (B) and decay stages (C). Explanation of sample codes can be found in Table 1., of species codes in Appendix 1.

The two Slovenian sites – especially Rajhenav – represented very high variation along the axis, which is definitely related to the high variation in decay stage. The two Hungarian sites had similar axis scores and exhibit small variation along both DCA1 and 2. The species composition of the Danish samples was very heterogeneous. They covered a large variation along the first axis and partly also along the second axis. Along the first axis the Danish samples were separated according to SITE: Knagerne samples had low DCA1 scores, while Strødam samples intermingled with trees from the Belgian and Dutch sites with high DCA1 scores. Samples from the three other Danish stands (Møns Klinteskov, Velling and Suserup) had intermediate positions. Several trees from Velling and Suserup were excluded from the multivariate analyses because of their low species richness. The species composition of the Belgian sites was homogeneous, since they belong practically to the same forest stand (Zoniën and Zoniën-K). The two neighbouring stands differ only in their age and history, and represent low variation in decay stages. The Dutch samples covered a large variation mainly along the second axis. Their order with decreasing scores along the axis was: Dassenberg, Gortelsebos intermingling with Drie, Weversbergen intermingling with Speulderbos. The samples from Wulperhorst, Oostbroek and Amelisweerd were intermingled with Belgian samples or missing because of their low species richness. The high variation of Dutch samples on the second axis relates to heterogeneity in site conditions, since they represent little variation of decay stage.

		DCA1					DCA2				
Variable	Type	?^{2}	df	R_s	N	p	?^{2}	df	R_s	N	p
COUNTRY	nominal	1226.7	12	-	-	***	293.3	12	-	-	***
SITE	nominal	1291.3	54	-	-	***	599.0	54	-	-	***
DS	ordinal	-	-	-0.094	732	*	-	-	-0.413	732	***
DBH	ratio	-	-	0.197	732	***	-	-	-0.046	732	n.s.
GAP	nominal	62.0	3	-	-	***	15.1	3	-	-	**
BARK	ratio	-	-	0.013	732	n.s.	-	-	0.348	732	***
SOIL	ratio	-	-	0.216	732	***	-	-	-0.250	732	***

Table 4. Interaction between sample scores on DCA axes and environmental characteristics of logs during DCA analysis of bryophytes. In case of nominal variables heterogeneity analyses were used (?^{2}, df) categorizing sample scores according to quartiles. In case of ordinal and interval variables Spearman-rank correlation was calculated (R_s, N). Codes of p values: n.s.: non-significant, *: $p<0.05$, **: $p<0.01$, *: $p<0.001$.

The positions of species in the ordination diagram mainly reflected regional differences (Fig. 3d). The central species group in the middle of the diagram included frequent and widespread species: *Herzogiella seligeri, Lophocolea heterophylla*, (obligate epixyls), *Hypnum cupressiforme, Brachythecium rutabulum, Brachythecium salebrosum, Dicranum scoparium, Bryum subelegans*, (opportunistic species). *Tetraphis pellucida* (obligate epixyl) had a low score along the second axis, because it is frequent in Slovenia and

The Netherlands, but rare in the Hungarian, Belgian and Danish sites. Species with low DCA1 scores preferred the Dinaric and Central-European sites and several of them occurred mainly in the Slovenian sites. True epixylic species had low scores on both DCA1 and 2, and several of them were specific for Rajhenav and missing or very rare in other sites, e.g. *Calypogeia suecica, Jungermannia leiantha, Cephalozia catenulata, Riccardia multifida, Blepharostoma trichophyllum, Cephaloziella rubella, Nowellia curvifolia*. Some epiphytes with high scores along DCA2 were also restricted to the two Slovenian forests (*Lejeunea cavifolia, Zygodon rupestris, Neckera crispa, Ulota crispa, Dicranum viride*), while other species occurred both in Slovenian and Hungarian sites (*Orthotrichum stramineum, Pylaisia polyantha, Pterygynandrum filiforme*). Species that have most of their occurrences in Hungary are mainly epiphytes (*Anomodon viticulosus, Platygyrium repens, Pseudoleskeella nervosa, Homalia besseri*). Species occurring on strongly decayed trees in Hungary belong to the opportunistic and epixylic species of the central species group (*Plagiothecium denticulatum, Herzogiella seligeri, Lophocolea heterophylla*). Danish trees were dominated mainly by opportunistic species that are frequent everywhere. Species with high DCA1 scores were specific for the Atlantic region. Their position along DCA2 reflects more a site (or habitat type) specific response than the effect of decay. Species with low DCA2 scores of this group were mainly terricol species occurring on mineral soil attached to the uprooted parts of fallen trees and on the bases of broken dead trees (*Pohlia nutans, Atrichum undulatum, Mnium hornum, Pseudotaxiphyllum elegans*), while high scores were obtained by a number of epiphytes (*Zygodon conoideus, Ulota bruchii, Dicranoweisia cirrata, Dicranum tauricum*). A number of opportunistic and epixylic species obtained intermediate DCA2 scores (*Campylopus species, Leucobryum glaucum, Aulacomnium androgynum, Eurhynchium praelongum*).

Species richness of fungi

Overall species richness was the highest in Denmark, followed by Hungary, Slovenia, Belgium and The Netherlands in decreasing order (Table 5). Considering the number of records per country a different pattern emerges with the highest number of records in Belgium and the lowest in Slovenia. The average number of species recorded per tree is significantly different among countries (ANOVA; df = 4, 1003; F value 42.61). It is the lowest in Slovenia, intermediate in Hungary and The Netherlands and the highest in Denmark and Belgium.

Based on the multiple regression analysis, tree size was the most important factor explaining species richness per tree (expressed as DBH, F value 482.5), although the effects of decay stage (DS, F value 36.3) and geographic region (COUNTRY, F value 20.87) were also considerable (Table 6). It is obvious that some of the differences found in average species richness per tree among countries relate to the differences in size and decay class distributions of selected trees within countries. In all countries average species richness increases with DBH, but the increment is distinctly steeper in Slovenia, compared to the other countries, and in The Netherlands the increase is only weak (Fig. 4). The effect of DS is less clear and differs between countries. In most countries the highest average species richness was recorded on trees in intermediate decay stage but in Slovenia distinctly decayed trees (decay stage 5-6) were found generally to be very species poor, compared to the situation in Denmark and Hungary. For Belgium and The Netherlands the figures for the late decay stages are highly uncertain due to the low number of trees represented.

Variable	Slovenia	Hungary	The Netherlands	Belgium	Denmark	Whole data set
number of trees	213	207	197	192	200	1009
number of species	207	227	155	190	257	457
number of occurrences	1819	2635	2300	3264	2938	12965
number of species/tree mean?st.dev	9.08?8.03^{a}	13.11?7.74^{b}	11.62?7.40^{b}	16.74?8.75^{c}	14.69?9.13^{c}	12.79?8.65

Table 5. Species richness of fungal communities in different countries. Number of species per trees significantly differed among countries (ANOVA, F(4,1009)=42.61, p<0.001), the letters show the results of multiple comparison test.

steps	SS$_e$	DF$_e$	MS$_e$	dSS$_e$	dDf$_e$	dMS$_e$	F	p
without regression	75271	1007	74.75	-	-	-	-	-
+ full model	35960	951	37.81	-39311	-56	702.0	9.39	***
-DBH.DS.COUNTRY	36668	969	37.84	708	18	39.3	1.04	n.s.
-DBH.DS				534	5	106.7	2.82	*
-DBH.COUNTRY				498	4	124.4	3.29	*
-DS.COUNTRY				2106	19	110.8	2.93	***
-all interaction	40238	997	40.36					
-DS				7334	5	1466.8	36.34	***
-DBH				19472	1	19472.0	482.49	***
-COUNTRY				3367	4	841.7	20.87	***

Table 6. Steps of multiple regression model building of species richness of fungi during backward selection. SS$_e$, DF$_e$, MS$_e$: Sum of squares, degrees of freedom and mean square of the error part of regression. dSS$_e$, dDF$_e$, dMS$_e$: Deviation in sum of squares, degrees of freedom and mean square of error after the regression step. “p” is the significance level of deviance using F statistics, n.s.: not significant, *: p<0.05, **: p<0.01, ***: p<0.001. The minimum adequate model was based on the backward selection of COUNTRY + DBH + DS + DBH.DP + DBH.COUNTRY + DP.COUNTRY. R^2 value of the regression was 0.51.

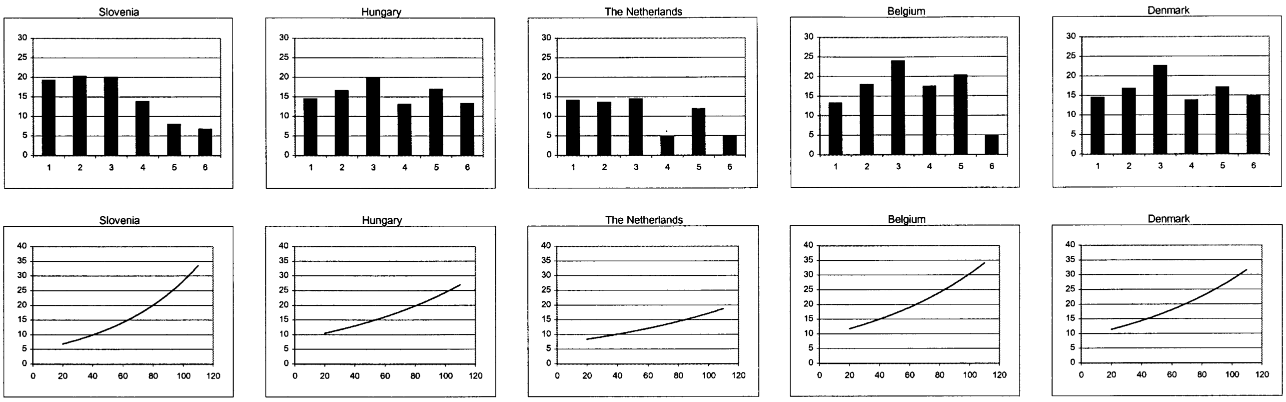

Fig. 4. Species richness of fungi. First row: predicted values of species richness at different decay stages in different countries. Tree DBH is fixed at 80 cm. Second row: predicted values of species richness depending on DBH values in different countries. Decay stage of trees is fixed at DS=3 (in case of other decay stages the curves are similar).

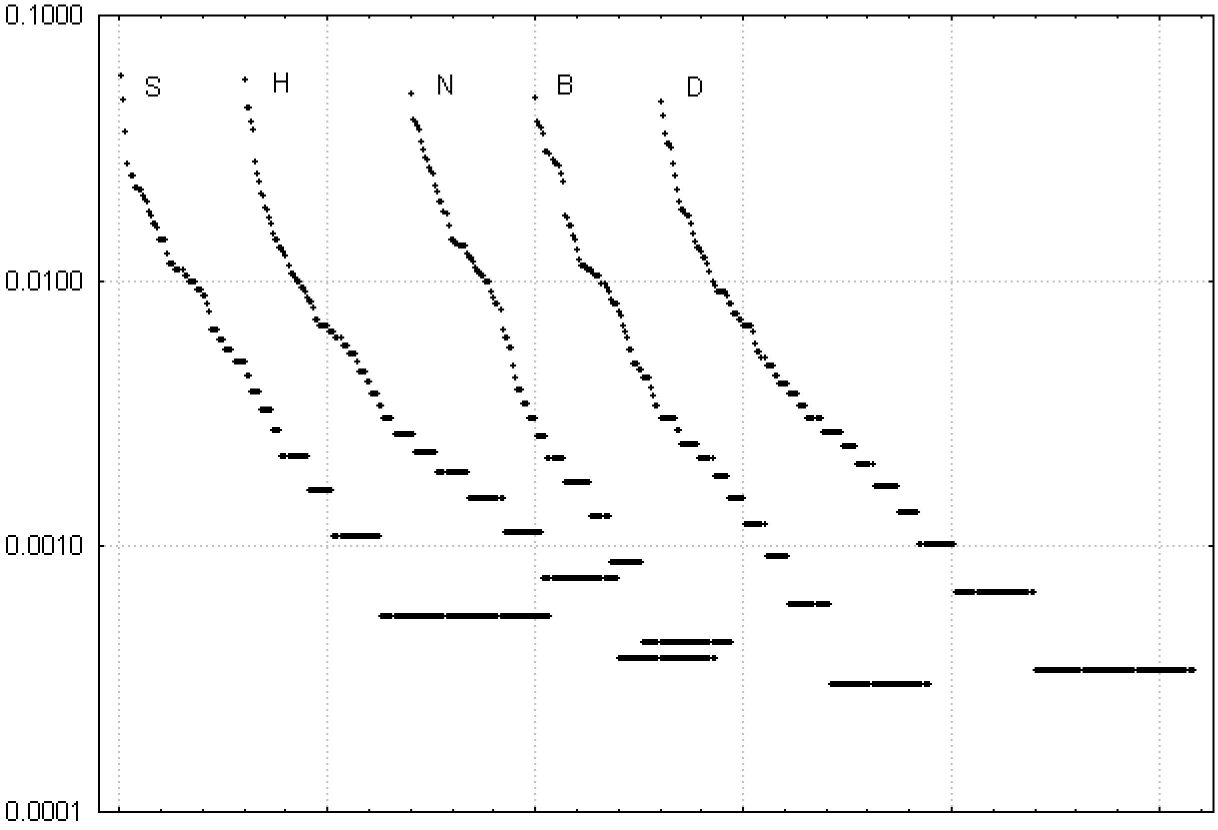

Fig. 5. Rank – relative frequency curves of fungal communities in different countries. The order of countries is: Slovenia (S), Hungary (H), The Netherlands (N), Belgium (B) and Denmark (D).

Comparisons of rank abundance curves showed that the decrease in relative frequencies was the fastest in The Netherlands and Belgium and the slowest in Hungary and Denmark (Fig. 5). This reflects a high proportion of species with low to very low frequency in the two later countries, while the curves for Belgium and The Netherlands points to a rather high proportion of moderately frequent species (relative frequency c. 0.01). The curve for Slovenia had a somewhat mixed appearance with a high proportion species of very low frequency and with the characteristic hump at relative frequencies of c. 0.01, which was also evident in Belgium and The Netherlands.

Species richness of bryophytes

The highest species richness of bryophytes was recorded in Slovenia, 103, whereas it was between 50 and 70 in the other countries (Table 7). More than one third of all the records (3397 of 8986) were made in Slovenia. Average species richness per tree showed similar differences among countries (ANOVA; df = 4, 1003; F value 71.71). It was the lowest in Denmark and The Netherlands, intermediate in Belgium and Hungary and the highest in Slovenia.

Unlike in the case of fungi, multiple regression model showed that the effect of geographic region (COUNTRY, F value 168.53) was as important as that of tree size (DBH, F value 152.52) in determining species richness per tree (alpha diversity, Table 8). For each country a different effect of tree size was shown (F value of COUNTRY-DBH interaction 4.45). Alpha diversity increased considerably with DBH in Slovenia, moderately in Hungary and Belgium, while DBH had hardly any effect in The Netherlands and Denmark (Fig. 6). The importance of decay stage was less clear (F value 4.60, Table 8, Fig. 6) in determining alpha diversity of bryophytes.

Variable	Slovenia	Hungary	The Netherlands	Belgium	Denmark	Whole data set
number of trees	213	207	197	192	200	1009
number of species	103	65	56	48	69	161
number of occurrences	3397	1928	1170	1525	966	8986
number of species/tree mean?st.dev	15.95?9.81^a	9.31?5.31^b	5.94?4.76^c	7.94?4.11^b	4.83?3.66^c	8.91?7.21

Table 7. Species richness of bryophyte communities in different countries. Number of species per trees significantly differ among countries (ANOVA, F(4,1004)=71.71, p<0.001), the letters show the results of multiple comparison test.

steps	SS$_e$	DF$_e$	MS$_e$	dSS$_e$	dDf$_e$	dMS$_e$	F	p
without regression	52559	1007	52.19	-	-	-	-	-
+ full model				-23972	-56	428.1	8.20	***
	28587	951	30.06					
-DBH.DS.COUNTRY				622	18	34.6	1.15	n.s.
	29209	969	30.14					
-DBH.DS				242	5	48.34	1.60	n.s.
-DBH.COUNTRY				536	4	134.1	4.45	**
-DS.COUNTRY				771	19	40.6	1.35	n.s.
-all interaction	30886	997	30.98					
-DS				712	5	142.4	4.60	***
-DBH				4725	1	4725.0	152.52	***
-COUNTRY				20884	4	5221	168.53	***

Table 8. Steps of multiple regression model building of species richness of bryophytes during backward selection. SS$_e$, DF$_e$, MS$_e$: Sum of squares, degrees of freedom and mean square of the error part of regression. dSS$_e$, dDF$_e$, dMS$_e$: Deviation in sum of squares, degrees of freedom and mean square of error after the regression step. “p” is the significance level of deviance using F statistics, n.s.: not significant, *: p<0.05, **: p<0.01, ***: p<0.001. The minimum adequate model was based on the backward selection of COUNTRY + DBH + DP + DBH.COUNTRY. R^2 value of the regression is 0.42.

Comparing the species rank – relative frequency curves of different countries (Fig. 7), it is distinct that in Slovenia: (1) the curve was less steep, (2) the frequency distribution of species was more even, than in other countries and (3) the proportion of true epixyl species was higher than in other countries. In Denmark the curve was less steep because of the relatively high beta diversity and the large proportion of species with intermediate relative frequency. In the case of Belgian data the beta diversity was low, hence the curve was rather steep. In the Hungarian data the number and proportion of low frequent species were considerable, while in the Dutch data the proportion of species with intermediate frequency was relatively high. The higher number of sites than in Hungary and Belgium may explain the high proportion of subordinate species in the Dutch and Danish data. These different sites represent different habitat types, and hence may support somewhat different bryophyte communities.

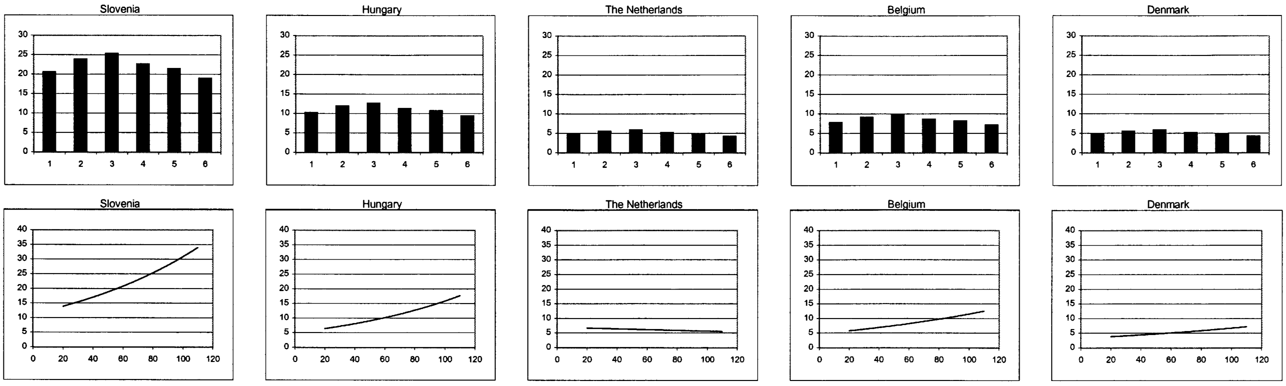

Fig. 6. Species richness of bryophytes. First row: predicted values of species richness at different decay stages in different countries. Tree DBH is fixed at 80 cm. Second row: predicted values of species richness depending on DBH values in different countries. Decay stage of trees is fixed at DS=3 (in case of other decay phases the curves are similar).

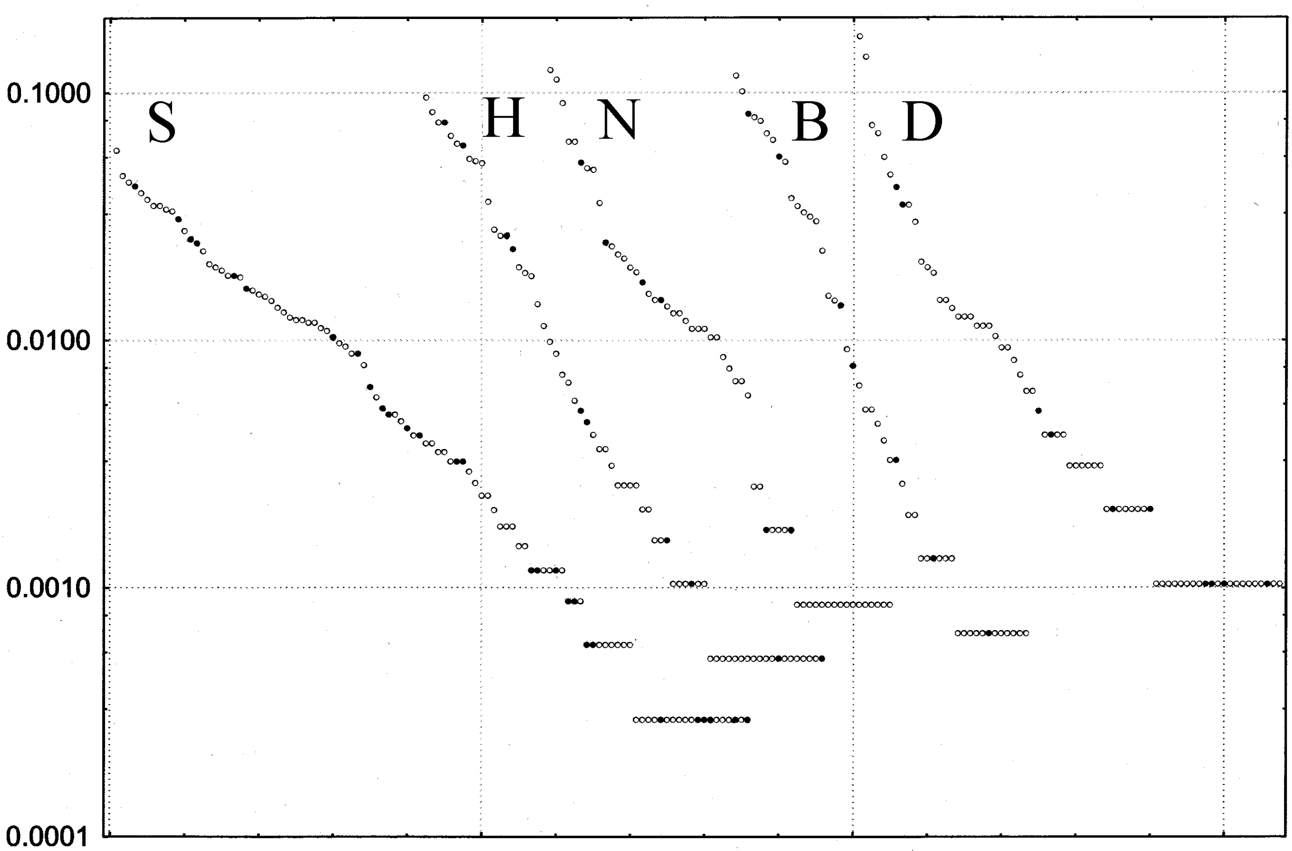

Fig. 7. Rank – relative frequency curves of bryophyte communities in different countries. The order of countries is: Slovenia (S), Hungary (H), The Netherlands (N), Belgium (B) and Denmark (D). The epixylic species are marked.

Conservation issue of fungi

In total 99 species defined as species of special interest (SSI) were recorded. Of these, 11 species were regarded as highly threatened all over Europe (SSI-A), 41 species as rare and potentially threatened (SSI-B), and 47 as threatened only in some of the included countries (SSI-C) (Appendix 2). The number of SSI’s recorded was highest in Hungary (51), slightly lower in Slovenia (43) and Denmark (41) and lowest in The Netherlands (27) and Belgium (24). Of the most threatened species (SSI-A) six were reported from Hungary and only 1-3 species from each of the other countries included. In total 1084 records of SSI’s were made during the study. The highest record numbers were obtained in Hungary (301), with slightly lower values from Denmark (258), Slovenia (235), and low values from Belgium (175) and The Netherlands (115). 66 % of the 29 SSI-A records were made in Hungary.

If the numbers of records of SSI’s are related to the total numbers of records of lignicolous species for each country, it is evident that the proportion of SSI’s was considerably larger in Slovenia and Hungary (>10 % of records), intermediate in Denmark (9 %) and lowest in The Netherlands and Belgium (c. 5 %) (Fig. 8). A Chi Square test confirmed the distinctiveness of theses differences (?^{2}, 4df = 154; $p<0.001$), and showed that the observed number of SSI’s recorded in Hungary and Slovenia was much higher than the expected value, while the opposite is true for The Netherlands and Belgium.

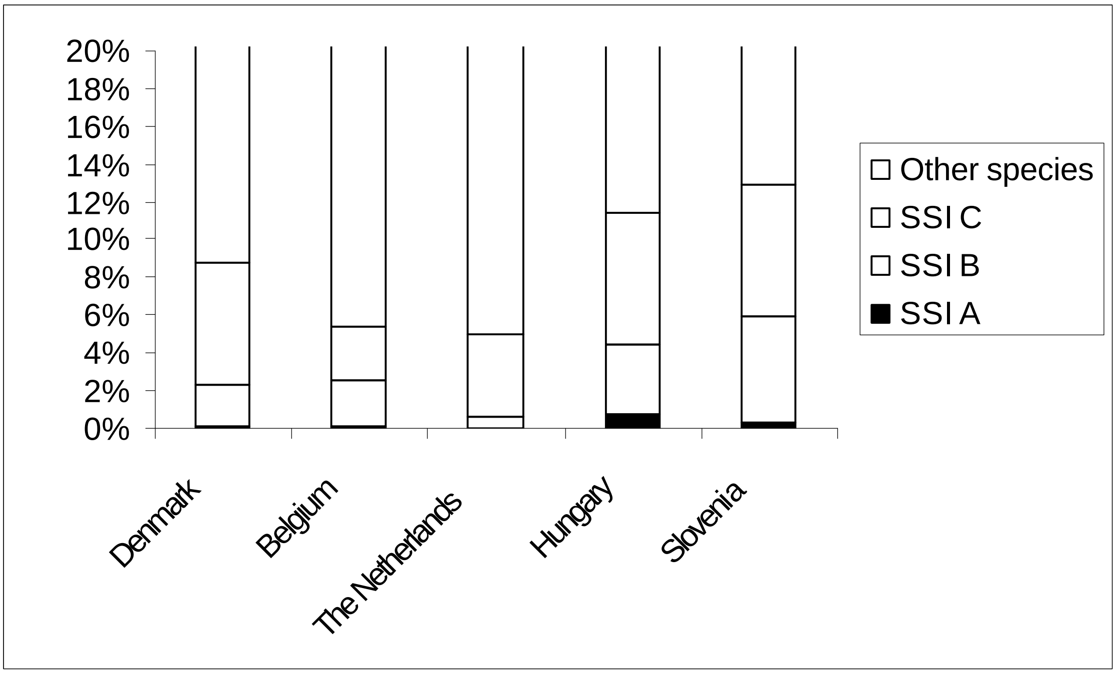

Fig. 8. Relative proportion [%] of threatened fungi in different countries. SSI: Species of special interest.

Conservation issue of bryophytes

The whole data set contained 7 threatened species listed in the European (ECCB 1995) or country level red lists (Martincic 1992) (Table 9). Most of these occurrences were recorded in the virgin forest Rajhenav, Slovenia. These species occurred with very low frequencies, except for *Dicranum viride*, which was recorded very frequently in Rajhenav, where it occurred on almost all of the fallen trees in early stage of decay. This forest seems to hosts the largest and most important local population of this threatened species in Europe.

Species	Red list	Threat category	Country	Site	Number of occurrences	Substrate type
Anacamptodon splachnoides	European	endangered	Slovenia	Rajhenav	1	epixyl
Buxbaumia viridis	European	vulnerable	Slovenia	Rajhenav	2	epixyl
Antitrichia curtipendula	Slovenian	vulnerable	Slovenia	Rajhenav	5	epiphyte
Antitrichia curtipendula	Slovenian	vulnerable	Slovenia	Krokar	1	epiphyte
Dicranum viride	European	vulnerable	Slovenia	Rajhenav	60	epiphyte
Dicranum viride	European	vulnerable	Slovenia	Krokar	1	epiphyte
Dicranum viride	European	vulnerable	Hungary	Oserdo	out of sample, rare	epiphyte
Lophozia ascendens	European	rare	Hungary	Kekes	2	epixyl
Riccardia latifrons	Dutch	extinct	The Netherlands	Weversberg	2	epixyl
Zygodon forsteri	European	vulnerable	Slovenia	Rajhenav	out of sample, rare	epiphyte

Table 9. Occurrences of threatened (locally or all over Europe) bryophytes in the investigated forest stands.

Distribution of fungal species groups

Of the 456 recorded fungal species, 285 were classified as lignicolous, while successively smaller numbers were classified as terrestrial (111), ectomycorrhizal (52) and bryophile (9), respectively. Species richness of all groups was the highest in Denmark, and the lowest in The Netherlands, except for bryophile species, of which only one were recorded from Hungary (Table 10). Lignicolous species dominated the fungal community of dead trees in all countries, but it was more pronounced if the proportion of occurrences was considered (84-95%) rather than the number of species (64-83%). This means that lignicolous fungi tend to be more frequent than species belonging to the other ecological groups. The proportions of other functional groups differed considerably among countries. Thus, the proportion of bryophile species was higher in Belgium (6% of records) than in the other countries (0-2% of records) and for litter inhabiting species the proportion of occurrences was higher in Hungary than in other countries (13% versus 1-5%). According to a ?^{2} test, the frequencies of the different ecological groups differed significantly among countries (?^{2}=758, df=12, p<0.001), but it is uncertain to which degree some of these differences relate to differences in sampling methodology. For instance, it is sometimes disputable whether sporocarps of litter inhabiting or mycorrhizal fungi were associated with dead wood or litter aggregating in fissures and crevices in the log. It is for this reason that the ordination analysis reported in the previous subsection is based on obligate wood-inhabiting species only.

Ecological group		Slovenia	Hungary	The Netherlands	Belgium	Denmark	Whole data set
Bryophile	number of species	4	1	3	4	7	9
	proportion of species	0.02	0.00	0.02	0.02	0.03	0.02
	number of occurrences	18	1	25	199	73	316
	proportion of occurrences	0.01	0.00	0.01	0.06	0.02	0.02
Lignicolous	number of species	155	151	128	141	164	285
	proportion of species	0.75	0.67	0.83	0.74	0.64	0.62
	number of occurrences	1691	2209	2196	2869	2597	11562
	proportion of occurrences	0.93	0.84	0.95	0.88	0.88	0.89
Litter / Soil	number of species	28	60	13	30	62	111
	proportion of species	0.14	0.26	0.08	0.16	0.24	0.24
	number of occurrences	53	348	27	95	150	673
	proportion of occurrences	0.03	0.13	0.01	0.03	0.05	0.05
Mycorrhizal	number of species	20	15	11	15	24	52
	proportion of species	0.10	0.07	0.07	0.08	0.09	0.11
	number of occurrences	57	77	52	101	118	405
	proportion of occurrences	0.03	0.03	0.02	0.03	0.04	0.03

Table 10. Distribution of different functional groups of fungi among countries. The frequencies of different ecological groups differed significantly among countries. (?^{2}=758, df=12, p<0.001).

Distribution of bryophyte species groups

The proportions of hepatics, acrocarp and pleurocarp mosses considerably differed among countries (Table 11, ?^{2}=807, df=8, p<0.001). In Slovenia the proportion of hepatics was very high both on the basis of species list and on the number of occurrences. In Hungary and Denmark the pleurocarps, in The Netherlands and Belgium the acrocarps were the most important.

Taxonomical group		Slovenia	Hungary	The Netherlands	Belgium	Denmark	Whol data s
Hepatics	number of species	27	8	5	9	7	34
	proportion of species	0.26	0.12	0.09	0.19	0.10	0.21
	number of occurrences	943	238	78	152	127	1538
	proportion of occurrences	0.28	0.12	0.07	0.10	0.13	0.17
Pleurocarps	number of species	40	31	21	18	31	60
	proportion of species	0.39	0.48	0.37	0.37	0.45	0.37
	number of occurrences	1468	1261	469	779	584	4561
	proportion of occurrences	0.43	0.65	0.40	0.51	0.60	0.51
Acrocarps	number of species	36	26	30	21	31	67
	proportion of species	0.35	0.40	0.54	0.44	0.45	0.42
	number of occurrences	986	429	623	594	255	2887
	proportion of occurrences	0.29	0.22	0.53	0.39	0.26	0.32

Table 11. Distribution of different taxonomical groups of bryophytes among countries. The frequencies of different taxonomical groups differed significantly among countries (?^{2}=807, df=8, p<0.001).

The proportion of ecological groups was significantly different among countries (?^{2} = 1590, df = 20, p<0.001). In Slovenia epixylic species gave extremely high proportion of the whole species list, compared to other countries (Table 12). This difference was also pronounced if the proportion of occurrences was considered: c. 22% in Slovenian sample, c. 20% in Hungary, c. 14-16% in The Netherlands and Belgium, and lowest (c. 9%) in Denmark. In Slovenia there were a lot of obligate epixylic species with intermediate frequency (Fig. 7), while in other countries the number of these species was much lower, even though some species were very frequent (*Lophocolea heterophylla, Herzogiella seligeri*). The proportion of epiphytes in species lists was similar in all sites, but if numbers of occurrences were also considered, epiphytes were more important in Slovenia than in other countries. The proportion of opportunistic species was similar in all countries when species lists are considered, but lower in Slovenia if the number of occurrences was also considered. The proportion of terricolous species was smaller in Hungary, especially with respect to the number of occurrences. Species occurring on mineral soil (mainly on uprooted part of logs and at the leg of snags) were important in the Atlantic countries, while epilithic species were more frequent in Slovenia and Hungary.

Ecological group		Slovenia	Hungary	The Netherlands	Belgium	Denmark	Whole data se
Epixylic	number of species	27	10	7	7	10	30
	proportion of species	0.26	0.16	0.12	0.15	0.14	0.17
	number of occurrences	740	386	173	250	91	1640
	proportion of occurrences	0.22	0.20	0.15	0.16	0.09	0.18
Epiphyte	number of species	31	23	14	9	20	44
	proportion of species	0.30	0.35	0.25	0.19	0.29	0.27
	number of species	1304	538	312	174	253	2581
	proportion of occurrences	0.38	0.28	0.27	0.11	0.26	0.29
Opportunistic	number of species	20	15	15	13	17	30
	proportion of species	0.19	0.23	0.27	0.27	0.25	0.19
	number of species	1008	965	517	684	502	3676
	proportion of occurrences	0.30	0.50	0.44	0.45	0.52	0.41
Terricol	number of species	9	3	6	10	9	21
	proportion of species	0.09	0.05	0.11	0.21	0.13	0.13
	number of species	148	5	18	61	23	255
	proportion of occurrences	0.04	0.00	0.01	0.04	0.02	0.03
Uproot(mineral soil)	number of species	6	8	14	8	8	21
	proportion of species	0.06	0.12	0.25	0.17	0.12	0.13
	number of species	59	20	150	354	89	672
	proportion of occurrences	0.02	0.01	0.13	0.23	0.09	0.07
Epilythic	number of species	10	6	0	1	5	15
	proportion of species	0.10	0.09	0.00	0.02	0.07	0.09
	number of species	3397	1928	1170	1525	966	8986
	proportion of occurrences	0.04	0.01	0.00	0.00	0.01	0.02

Table 12. Distribution of different ecological groups of bryophytes among countries. The frequencies of different ecological groups differed significantly among countries (?^{2}=1590, df=20, p<0.001).

Discussion

Overall community structure – differences and similarities

The realized species pool for fungi was c. three times larger than for bryophytes investigating the same dead beech trees. For both organism groups species composition changed considerably along the Southeast – Northwest gradient studied. The DCA analyses showed that both for bryophytes and for fungi the sites in The Netherlands and Belgium represent one extreme in species composition within the study region. For bryophytes the Slovenian sites represent the opposite extreme, while the Hungarian sites represent this extreme with respect to fungal community structure. In both cases the Danish sites have intermediate positions.

In both organism groups we interpret the found geographical community gradients to be complex. Both reflect the overall shift in climatic conditions, from the distinctly Atlantic climates in The Netherlands and Belgium, over Sub-Atlantic and Dinaric climates in Denmark and Slovenia to the continental climate of Hungary. A similarly important gradient in human disturbance is also characteristic. The Netherlands and Belgium stands at one extreme, where the original forest landscape has become highly fragmented and present day forests have transformed structure, and in many cases broken continuity. In Denmark there is a slightly more natural remnant of the original forest landscape. In Hungary and Slovenia there are large tracks of beech-dominated forests with unbroken continuity and close to original tree species composition. However it is only in Slovenia, where managed forests have rather natural structure and some remnants of truly natural forests have survived. The climatic gradient seems to have more distinct effect on fungi, while bryophyte communities seem to be strongly affected by human land use history.

The importance of geographic region and decay stage of dead trees was different in structuring fungal and bryophyte communities. For fungi decay stage, for bryophytes geographic region had stronger influence. In other words, fungal communities show a very clear and comparable successional development during log decay across the whole geographical region studied. Variations in species composition between countries are distinct, but still subordinate to this overall pattern. Regional differences in the composition of bryophyte communities are distinct, while decay stages affect the species composition at the local scale. Thus, the succession of bryophytes during log decay differs principally among the countries, as evaluated further below.

Fungal community structure and species richness

It is characteristic that many heart-rot associated polypores, agarics and hedgehog fungi pointing to a preference for continental conditions in Hungary. Several of these species are regarded as rare and threatened in major parts of Europe and are hence regarded as SSI’s in the present report. This is the case, e.g. for *Dentipellis fragilis, Ischnoderma resinosum, Ossicaulis lignatilis, Pholiota squarrosoides, Spongipellis delectans* and *S. pachyodon.* These species were recorded most frequently in Hungary and to some extent in Slovenia, which is the main explanation for the high relative frequencies of SSI A and B's in these two countries. None of the species, however, has a strictly continental or mountainous distribution in Europe, though they are generally extremely rare in Northwest Europe. We interpret the maximum of this species group in Hungary and Slovenia to reflect two different intermingling trends: the degree of continentality and the degree of naturalness at landscape scale.

Heart-rot formers can generally be regarded as stress tolerators, since they are dependent on establishment and growth under special gaseous and chemical regimes characterizing the interior of living trees (Rayner & Boddy 1988). Forestry activities tend to increase the fraction of uncolonized dead wood (open resources) and small diameter wood relative to the fraction of dead wood already colonized by decay fungi (closed resources) especially in the larger diameter classes (Boddy 2001). This is clearly to the benefit of species with ruderal or ruderal-competitive traits, while heart-rot agents suffer from the lack of damaged old trees and large diameter wood decaying in the forest floor (Heilmann-Clausen 2003) Thus, forestry activities changes the composition of wood inhabiting fungal communities, and the very low frequencies of rare heart-rot agents and other SSI's in the strongly human influenced sites in Belgium and The Netherlands seem to reflect this.

In Atlantic climates many rare heart-rot formers are most common on trees growing in exposed conditions, e.g. in forest edges and park-like forests. This probably reflects the stress tolerance of these species, which gives them a competitive advantage under the more stressful conditions characterizing open land and forest edges compared to forest interiors. More generally we suggest that the adaptations of heart-rot agents to stressful conditions give these species a competitive advantage in continental climates, which could explain the very high frequency of rare heart-rot agents in the distinctly continental Hungarian sites. In addition, the Hungarian sites are situated at the southernmost part of the very important beech forest area of the northern Carpathians, which includes several virgin beech forests reserves. Similar importance is also clear for both studied sites in Slovenia (Rajhenavski Rog and Krokar), which represent just two out of several virgin forest reserves in this part of the Dinaric region, which is covered with huge expanses of partly CWD-rich beech-dominated forests. The slightly lower frequencies of SSI's in these forests, compared to the Hungarian sites, probably relate to the less stressful climate, with much higher rainfall and less differences in summer and winter temperatures.

The intermediate frequencies of SSI's in Denmark most likely reflect the higher degree of naturalness of the included study sites than that of the true Atlantic countries. Under natural conditions we would expect the frequency of SSI's in the Atlantic sites to be similar to the level in Slovenia, but not as high as in Hungary, for the reasons discussed above. More thorough investigations in other parts of East and South

Europe might show that some of the SSI A’s recorded exclusively in Hungary are rather frequent in continental beech forests. In this case their protection status could be reconsidered.

While the occurrence patterns of SSI’s clearly points to the Hungary and Slovenia as highly valuable sites for dead wood dwelling fungi, the overall patterns of species richness are more confusing. The observed average species richness per tree (alpha diversity) was clearly the highest in Belgium and the lowest in Slovenia. Thus, decaying beech trees in the Belgian site were found to be species rich (high alpha diversity), but with a low species turnover among trees (low beta-diversity). This is caused by the fact that this site contains a lot of large logs with high fungal alpha diversity, but covering a low variation in decay stages. This very clearly demonstrates that fungal species richness at tree level may be misleading in a conservation context, as this measure may be completely unrelated to the total species richness at the site level, as well as to the presence of rare and threatened species, as demonstrated by Heilmann-Clausen and Christensen (2003c) for a selection of Danish semi-natural forests.

Comparisons of rank abundance curves yield more insight in the textural characteristics of the fungal communities in the different countries. Species with very low frequency (1-3 occurrences per country) contribute significantly to the overall species richness in all countries, but most distinctly so in Denmark and to a lesser extent in Hungary and Slovenia. In the case of Denmark this may in part relate to the rather high number of sites representing different soil types, but it is notable that The Netherlands, where the number of included sites is even higher, has the lowest number of infrequent species. Also in Belgium the number of infrequent species is low. We therefore assume that a high number of infrequent species is a typical feature of more natural forests, while more human disturbed landscapes are characterized by a smaller species pool and in particular by a low number of infrequent species.

Bryophyte community structure and species richness

While fungi communities were dominated by lignicolous species the distribution of bryophyte ecological groups was more heterogeneous. Four main types were distinguished: a) obligate epixylic species are specialized in the dead wood habitat, b) epiphytes are adapted to live on the bark of living trees, c) terricol species are adapted to grow on humus or mineral soil, which is often exposed on the root-plates of uprooted trees, and d) more or less ruderal, opportunistic species, which grow in a variety of habitat types with equally frequency, in the absence of ecological factors benefiting the substrate specialized species (Stefureac 1969, Söderström 1988a, Ódor and van Hees in press).

The decay gradient expressed along DCA2 of the bryophyte-based ordination is distinct in all countries, but the details differ considerably. Along the full range of DCA1 most species with high DCA2 scores are epiphytes, pointing to this group to be most important on weakly decayed trees in all countries. Species with low DCA2 scores, on the other hand, show a distinct grouping along DCA1. Thus, a majority of epixylic species has low DCA1 scores, while opportunistic and terricol species tend to have high DCA1 scores. This points to notable differences in the bryophyte succession among countries: well decayed trees are dominated by terricol and opportunistic species in Belgium and The Netherlands, whereas in the Slovenian sites obligate epixylic species dominate.

It is clear from the results that Slovenian virgin forests are biodiversity hotspots of dead wood living bryophytes. Both the tree level species richness (alpha diversity) and the whole species pool (beta diversity) is very high, and there are some species occurring in these site, which are extremely rare elsewhere in Europe. The proportions of relatively frequent, sub-ordinate species are very high, and there are many obligate epixylic liverworts among them (e.g. *Nowellia curvifolia, Riccardia multifida, R. palmata, R. latifrons, Cephalozia catenulata, Calypogeia suecica, Lepidozia reptans, Jungermannia leiantha, Blepharostoma trichophyllum,* Hocevar et al. 1995, Ódor and van Dort 2003). Although most of these epixylic liverworts are broadly distributed in boreal and montane regions, they are generally rare and have been suggested to be good indicators of old growth forests (Gustafsson and Hallingbäck 1988, Söderström 1988b, Samuelsson et al. 1994, Ódor and Standovár 2001). They require a continuous presence of logs in intermediate decay and high and stable air humidity.

The two Slovenian sites are rather different in species composition. The proportion of epixylic species is lower in Krokar than in Rajhenav, although the amount and quality of substrate (well decayed large logs) are comparable. It is supposed that the background of this phenomenon is that a considerable effect of wind causes the mesoclimate to be much dryer in Krokar, which is situated close to an exposed cliff edge (Hocevar et al. 1995). It is well known that dry climate can act as an effective limiting factor for a lot of epixylic bryophytes, especially liverworts (Clausen 1964, Proctor 1982).

In Hungary the distribution of obligate epixylic liverworts is limited by climate rather than substrate availability. In most of the continental beech stands air humidity is too low for these species, independently of the presence of dead wood. In this region rich epixylic communities can exist only in more humid ravines and exposed northfacing slopes (Ódor and van Hees in press). It is supposed that the local frequency of epixylic species would be relatively low in this region even if more natural conditions prevailed, but definitely it would be higher than nowadays if more natural forest structures were recreated.

The studied Atlantic beech forests have a modified, reduced bryoflora, almost lacking several important functional groups including obligate epixylic species. This is partly a result of habitat fragmentation in time and space that leaded to the extinction of dispersal limited species (Söderström and Jonsson 1992, Rose 1992). In addition, the amount and quality of dead wood is not suitable for species rich epixylic bryophyte vegetation in most of the remaining stands. In some parts of Western Europe (e.g. Denmark, The Netherlands) the majority of forests have experienced a dramatic desiccation during the last 150 yr, although it is not valid for historically dry sites. The possible reasons for this development are drainage, planting of exotic coniferous tree species and increased water extraction that altogether deteriorate a moist forest microclimate. Based on investigation of Danish forests the most important factors influencing bryophyte composition of beech forests were identified to be the management regime and stand structure (Aude and Lawesson 1998, Aude and Poulsen 2000). Most of the epixylic liverworts are widely distributed in Europe and we suppose that they used to be richly represented in the natural Atlantic forested landscape, but that they have vanished after centuries of deforestation and other human activities (Rose 1992). Several of the Danish sites are rather small and situated in a matrix of cultural forests and/or arable land causing rather windy conditions, which may be detrimental to many epixylic bryophytes. Some sites, especially the most natural sites, Suserup, are further characterized by very good tree growth conditions causing the forest to be very dense and dark, thereby preventing extensive bryophyte growth in suitable habitats of the forest floor. In Belgium and mainly in the Netherlands the amount of dead wood is relatively low and large trees and later decay stages are underrepresented. Current forest management in Atlantic countries takes efforts to reconstruct more natural forest conditions (e.g. higher amount of dead wood, multi-layered canopy) and it is probable, that some epixylic species will be able to recolonize the region. New records of formerly extinct *Riccardia latifrons* in The Netherlands (van Dort 2002), and *Nowellia curvifolia* in Belgium (van Dort and van Hees 2002) support this possibility. Both because of the absence of well-decayed trees and the reduced species pool, the effect of decay stage on species composition was less pronounced in Atlantic stands than in the more natural Slovenian and Hungarian sites. In conclusion, the large differences among regions in the species composition seem to be explained more by management-influenced factors than the climatic conditions.

Implications for conservation

Summing up, it can be stated that the Slovenian and partly the Hungarian sites represent hotspots for saproxylic biodiversity in Europe. Hence, these sites are extremely valuable in a European conservation perspective Thus, the Slovenian sites are characterized by a) low alpha and intermediate beta diversity of fungi, partly reflecting a rather high fraction of very infrequent species, b) high alpha and beta diversity of bryophytes not least reflecting a high presence of epiphytic and epixylic species while opportunistic and terricol species are scarce, and c) a high fraction of rare and threatened fungal and bryophyte species. The high diversity of these stands are due to their long history of preservation as unmanaged forest reserves supporting a continuous presence of dead wood and the uneven aged forest stand with high structural heterogeneity.

The Hungarian sites are characterized by a) intermediate levels of fungal alpha and beta diversity, b) intermediate to rather high levels of bryophyte alpha and beta diversity, with epiphytes being especially abundant, c) very high fractions of rare and threatened fungal species, not least heart-rot agents. These characteristics reflect the relatively high naturalness of the study sites as well as the continental climate. The lignicolous bryophyte and fungi communities are only weakly degraded and the study sites hence represent important core areas from which threatened species hopefully can spread to new-formed forest reserves in more degraded regions.

The Danish sites are characterized by a) high levels of fungal alpha and beta diversity, not least reflecting a very high number of infrequent species, b) very low levels of bryophyte alpha diversity, but intermediate levels of bryophyte beta diversity, reflecting a high number of infrequent epixylic, epiphytic and terricol species, and c) an intermediate level of rare and threatened fungal species present. These characteristics reflect a combination of forest history, present forest structure and climatic traits. The high beta diversity indicate that there is still a potential for a rich bryophyte flora in several of the study sites, and that enlargement of forest reserves may have a big potential for restoring a rich bryophyte vegetation on decaying wood. The intermediate frequency of fungal SSI's similarly indicates that the Danish sites are valuable for fungal biodiversity in a European context and have a good potential for protecting rare species, if more or bigger forest reserves are declared.

The Belgium site is characterized by a) high alpha, but low fungal beta diversity, reflecting a relative scarcity of infrequent species, b) intermediate alpha, but low bryophyte beta diversity, reflecting a dominance of rather few, frequent species, and c) a rather low frequency of fungal SSI's. The high bryophyte alpha diversity probably relate to the Atlantic character of the Belgium study site, with high precipitation and high winter temperatures allowing growth in wintertime, where light conditions of the forest floor are favourable for bryophyte growth. The low beta diversity, especially the scarcity of epixylic species, as well as the low frequency of fungal SSI's on the other hand, points to a severe impact from past human disturbance.

Finally the Netherlands sites are characterized by a) low fungal alpha and beta diversity, b) low bryophyte alpha but intermediate beta diversity, reflecting rather rich communities of species associated with uprooted soil and c) very low frequencies of fungal SSI's. These characteristics clearly relate to the low naturalness of the beech forests in The Netherlands. It is probable that the frequency of rare wood inhabiting fungi and bryophyte species depending on special conditions for establishment and propagation (i.e. very old, naturally dying trees) will increase in the region. With increasing age of the forest stands and the availability of new substrates a higher diversity may be expected in the future, especially if the area of protected forests increases in the Netherlands and surrounding countries. For both bryophytes and fungi the distinctly altered community composition may however slow down this process, because of the competitive advantage gained by unspecialized opportunists, which have benefited from centuries of human disturbance.

At site level the major factor influencing alpha diversity of the trees is their size. This size effect is less pronounced in the bryophyte communities of Atlantic countries, probably because the species pool is limited, rare and specialized species are extinct at landscape scale. Other studies also emphasized the importance of tree size for the diversity of cryptogamic vegetation (Andersson and Hytteborn 1991, Humprey et al. 2002, Kruys and Jonsson 1999, Kruys et al. 1999, Söderström 1988a, Heilmann-Clausen 2003, Bader et al. 1995, Ódor and Standovár 2001, Ódor and van Hees in press). The importance of large trees for species richness seems to involve several different factors. Most simply, large trees simply provide more space for species. Secondly, large trees decay slower, which allows more time for colonisation and the development of more microhabitat types. Thirdly, small trees can be buried fast into the soil and litter, or colonized by fast growing forest floor bryophytes, which may prevent the development of species-rich epixylic communities. Finally, and with special respect to fungi, large trees are more likely to be old trees with a long infection history as living trees, which may be crucial for the establishment of certain specialized heart-rot agents.

On this basis we conclude that the presence of large trees in different stage of decay is very important for the diversity of both organism groups, although even fine woody debris can indeed support species rich bryophyte and fungal communities (Kruys and Jonsson 1999, Ódor and Standovár 2001, Christensen and Heilmann-Clausen 2002, Nordén et al. in press). Still, several specialist heart-rot causing fungi and epixylic bryophytes are unable to thrive on such substrates (Söderström 1988b, Ódor and Standovár 2001, Ódor and van Hees in press, Heilmann-Clausen 2003) and habitats in which large logs are scarce or missing are, accordingly, completely unable to conserve the full range of saproxylic biodiversity.

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References

Andersson, L.I. and Hytteborn, H. 1991. Bryophytes and decaying wood - a comparison between managed and natural forest. Holarctic Ecology 14: 121-130.

Arnolds, E.J.M. and van Ommering, G. 1996. Bedreigde en kwetsbare paddestoelen in Nederland. Toelichting op de Rode Lijst. Rapport IKC Natuurbeheer 24, Wageningen.

Aude, E. and Lawesson, J.E. 1998. Vegetation in Danish beech forest: the importance of soil, microclimate and management factors, evaluated by variation partitioning. Plant Ecology 134: 53-65.

Aude, E. and Poulssen, R.S. 2000. Influence of management on the species composition of epiphytic cryptogams in Danish Fagus forest. Applied Vegetation Science 3: 81-88.

Bader, P., Jansson, S.Jonsson, B.G. 1995. Wood-inhabiting fungi and substratum decline in selectively logged boreal spruce forests. Biological Conservation 72: 355-362.

Barkmann, J.J. 1958. Phytosociology and Ecology of Cryptogamic Epiphytes. Van Gorcum, Assen.

Benkert, D., Dörfelt, H., Hardtke, H.J., Hirsch, G., Kreisel, H., Krieglsteiner, G.J., Lüderitz, M., Runge, A., Schmid, H., Schmitt, J. A., Winterhoff, W., Wöldecke, K., Zehfuß, H.D., Einhellinger, A., Groß, G., Große-Brauckmann, H., Nuss, I. and Wölfel, G. 1992. Rote Liste der gefährdeten Großpilze in Deutschland. Deutsche Gesellschaft für Mykologie e.V. & Naturschutzbund Deutschland e.V. (NABU) (Hrsg.), IHW-Verlag, Eching.

Boddy, L. 2001. Fungal community ecology and wood decomposition processes in angiosperms: from standing tree to complete decay of course woody debris. Ecological Bulletins 49: 43-56.

Boncina, A. 1999. Stand dynamics in the virgin forest Rajhenavski Rog (Slovenia) during the past century. In: Diaci, J. (ed.). Virgin Forests and Forest Reserves in Central and East European Countries. Department of Forestry and Renewable Forest Resources, Ljubljana, pp. 95-110.

Christensen, M. and Emborg, J. 1996. Biodiversity in natural versus managed forest in Denmark. Forest Ecology and Management 85: 47-51.

Christensen, M. and Heilmann-Clausen, J. 2002. Habitat preferences and management of macrofungi on beech CWD in Danish forests. In: Bjørk, L. (ed.), Sustainable Forestry in Temperate Regions, Proceedings of the SUFOR International Workshop, Lund, Sweden. pp. 98-106.

Christensen, M., Hahn, K., Mountford, E., Ódor, P., Standovár, T., Rozenbergar, D., Diaci, J., Wijdeven, S., Meyer, P., Winter, S. and Vrska, T. 2004. Dead wood in European beech forest reserves. Manuscript.

Clausen, E. 1964. The tolerance of hepatics to desiccation and temperature. Bryologist 67: 411-17.

Corley M.F.V., Crundwell A.C., Düll R., Hill M.O. and Smith A.J.E. 1981. Mosses of Europe and the Azores; an annotated list of species, with synonyms from the recent literature. Journal of Bryology 11: 609-689.

Corley M.F.V. and Crundwell A.C. 1991. Additions and amendments to the mosses of Europe and the Azores. Journal of Bryology 16: 337-356.

Crawley, M.J. 1993. GLIM for Ecologist. Blackwell Scientific Publications, Oxford.

Csóka, Gy. 2000. Az elpusztult, korhadó fa szerepe az erdei biodiverzitás fenntartásában. In: Frank, T. (ed.). Természet – erdo – gazdálkodás. MME és Pro Silva Hungária Egyesület, Eger, pp. 85-96.

Dierssen, K. 2001. Distribution, Ecological Amplitude and Phytosociological Characterization of European Bryophytes. J. Cramer, Berlin.

ECCB (European Comitee for Conservation of Bryophytes). 1995. Red Data Book of European Bryophytes. ECCB, Trondheim.

Eckloff, W. and Ziegler, W. 1991. Über den Wert toter Bäume in der Waldlebensgemeinschaft. Forstarchiv 62: 105-107.

Emborg, J., Christensen, M. and Heilmann-Clausen, J. 2000. The structural dynamics of Suserup Skov, a near-natural temperate deciduous forest in Denmark. Forest Ecology and Management 126: 173-189.

Esseen, P.-A., Ehnström, B., Ericson, L. and Sjöberg, K. 1997. Boreal forests. Ecological Bulletins 46: 16-47.

Ferris-Kaan, R., Lonsdale, D., and Winter, T. 1993. The Conservation Management of Dead Wood in Forests. Research Information Note 241. Research Publication Officer, The Forestry Authority, Research Division, Alice Holt Lodge.

Frey, W. and Frahm, J.P. 1995. Kleine Kryptogamenflora IV. Die Moos- und Farnpflanzen Europas. Gustav Fischer Verlag, Stuttgart.

Gärdenfors, U. (ed.). 2000. Rödlistade Arter i Sverige 2000. Artdatabanken, Uppsala.

Grolle R. 1983. Hepatics of Europe including the Azores: an annotated list of species, with synonims from the recent literature. Journal of Bryology 12: 403-459.

Gustafsson, L. and Hallingbäck, T. 1988. Bryophyte flora and vegetation of managed and virgin conifrous forest in South-West Sweden. Biological Conservation 44: 283-300.

Hansen. L. and Knudsen, H. (eds.) 1992. Nordic Macromycetes, Vol 2. Polyporales, Boletales, Agaricales, Russulales. Nordsvamp, Copenhagen.

Hansen. L. and Knudsen, H. (eds.) 1997. Nordic Macromycetes, Vol 3. Heterobasidioid, Aphyllophoroid and Gastromycetoid Basidiomycetes. Nordsvamp, Copenhagen.

Hansen. L. and Knudsen, H. (eds.) 2000. Nordic Macromycetes, Vol 1. Ascomycetes. Nordsvamp, Copenhagen, Harmon, M.E., Franklin, J.F., Swanson, F.J., Sollins, P., Gregory, S.V., Lattin, J.D., Anderson, N.H., Cline, S.P., Aumen, N.G., Sedell, J.R., Lienkaemper, G.W., Cromack, K. and Cummins, K.W. 1986. Ecology of coarse woody debris in temperate ecosystems. Advances in Ecological Research 15: 133-276.

Hartman, T. 1999. Hundred years of virgin forest conservation in Slovenia.- In. Diaci, J. (Ed.) Virgin Forests and Forestreserves in Central and East European Countries. Ljubljana, Department of Forestry and Renewable Forest Resources, pp. 111-120.

Heilmann-Clausen 2003. Wood-inhabiting Fungi in Danish Deciduous Forests - Diversity, Habitat Preferences and Conservation. PhD thesis, Royal Veterinary and Agricultural University, Frederiksberg, Denmark.

Heilmann-Clausen, J. 2001. A gradient analysis of communities of macrofungi and slime moulds on decaying beech logs. Mycological Research 105: 575-596.

Heilmann-Clausen, J. and Christensen, M. 2003a. Fungal diversity on decaying beech logs – implications for sustainable forestry. Biodiversity and Conservation 12: 953-973.

Heilmann-Clausen, J. and Christensen, M. 2003b. Does size matter? – Tree part and size preferences of red-listed fungi in Danish beech forests. Paper V In: Heilmann-Clausen 2003. Wood-inhabiting Fungi in Danish Deciduous Forests - Diversity, Habitat Preferences and Conservation. PhD thesis, Royal Veterinary and Agricultural University, Frederiksberg, Denmark.

Heilmann-Clausen, J. and Christensen, M. 2003c. Diversity patterns and community structure of wood-inhabiting macrofungi on beech in the Danish landscape. Paper VI. In: Heilmann-Clausen 2003. Wood-inhabiting Fungi in Danish Deciduous Forests - Diversity, Habitat Preferences and Conservation. PhD thesis, Royal Veterinary and Agricultural University, Frederiksberg, Denmark.

Heilmann-Clausen, J., Aude, E. and Christensen, M. 2003. Cryptogam communities on decaying deciduous wood – does tree species diversity matter? Paper IV. In: Heilmann-Clausen 2003. Wood-inhabiting Fungi in Danish Deciduous Forests - Diversity, Habitat Preferences and Conservation. PhD thesis, Royal Veterinary and Agricultural University, Frederiksberg, Denmark.

Hill, M.O. and Gauch, H.G. 1980. Detrended correspondence analysis, an improved ordination technique. Vegetatio 42: 47-58.

Hocevar, S., Batic, F., Piskernik, M. and Martincic, A. 1995. Glive v pragozdovih Slovenije. 3. Dinarski gorski pragozdovi na Kocevskem in v Trnovskem gozdu. Strokovna in znanstvena dela. 117: 1-320.

Høiland, K., Bendiksen, E., 1996. Biodiversity of wood-inhabiting fungi in a boreal coniferous forest in Sør-Trøndelag County, Central Norway. Nordic Journal of Botany 16: 643-659.

Hübschmann, A. 1986. Prodromus der Moosgesellschaften Zentraleuropas. J. Cramer, Berlin, Stuttgart.

Humprey, J.W., Davey, S., Peace, A.J., Ferris, R. and Harding, K. 2002. Lichens and bryophyte communities of planted and semi-natural forests in Britain: the influence of site type, stand structure and deadwood. Biological Conservation 107: 165-180.

Jongmann, R.H.G., ter Braak, C.J.F., van Tongeren, O.F.R. 1987. Data Analysis in Community and Landscape Ecology. Pudoc, Wageningen.

Keizer, P.J., Arnolds, E.J.M. 1990. Mycocoenology of marshy forest and scrubs. I. Host range of wood-decomposing Aphyllophorales and Heterobasidiomycetes. Wageningen Agricultural University Papers 90(6): 77-91.

Kirby, K.J., Reid, C.M., Thomas, R.C. and Goldsmith, F.B. 1997. Preliminary estimates of fallen dead wood and standing dead trees in managed and unmanaged forests in Britain. Journal of Applied Ecology 35: 148-155.

Korpel, S. 1995. Die Urwalder der Westkarpaten. Gustav Fischer Verlag. Stuttgart.

Kraigher, H., Jurc, D., Kalan, P., Kutnar, L., Levanic, T., Rupel, M., Smolej, I. 2003. Beech coarse woody debris characteristics in two virgin forest reserves in Southern Slovenia. Zbornik Gozdarstva in Lesarstva 69: 91-134.

Kruys, N. and Jonsson, B.G. 1999. Fine woody debris is important for species richness on logs in managed boreal spruce forests in northern Sweden. Canadian Journal of Forest Research 1295-1299.

Kruys, N., Fries, C., Jonsson, B.G., Lämäs, T. and Stähl, G. 1999. Wood inhabiting cryptogams on dead norway spruce (Picea abies) trees in managed Swedish boreal forests. Canadian Journal of Forest Research 29: 178-186.

Lindblad, I., 1998. Wood-inhabiting fungi on fallen logs of Norway Spruce: relations to forest management and substrate quality. Nordic Journal of Botany 18: 243-255.

Lindblad, I., 2001. Diversity of poroid and some corticoid wood-inhabiting fungi along the rainfall gradient in tropical forests, Costa Rica. Journal of Tropical Ecology 17, 353-369.

Marstaller, R. 1986. Die Moosgesellschaften auf morschem Holz und Rohhumus. Gleditschia 15: 73-138.

Martincic, A. 1992. The red list of threatened mosses in Slovenia (in Slovenian). Varstvo Narave 18: 1-190.

Maser, C. and Trappe, J.M. 1984. The seen and unseen world of the fallen tree. Gen. Tech. Rep. PNW-164. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station, Portland, OR: U.S.

Mathiassen, G., 1993. Corticolous and lignicolous Pyrenomycetes s. lat. (Ascomycetes) on Salix along a mid-Scandinavian transect. Sommerfeltia 20: 1-180.

McAlister, S. 1997. Cryptogam communities on fallen logs in the Duke Forest, North Carolina. Journal of Vegetation Science 8: 115-124.

McCullagh, P. and Nelder, J.A. 1983. Generalized Linear Models. Chapman and Hall Ltd., London.

McCullough, H.A. 1948. Plant succession on fallen logs in a virgin spruce-fir forest. Ecology 29: 508-513.

Muhle, H. and LeBlanc, F. 1975. Bryophyte and lichen succession on decaying logs. I. Analysis along an evaporational gradient in Eastern Canada. Journal of Hattori Botanical Laboratory 39: 1-33.

Nordén, B., Paltto, H. 2001. Wood-decay fungi in hazel wood: species richness correlated to stand age and dead wood features. Biological Conservation 101, 1-8.

Nordén, B., Ryberg, M., Götmark, F. and Olausson, B. in press. Relative importance of coarse and fine woody debris for the diversity of wood-inhabiting fungi in temperate broadleaf forests. Biological Conservation.

Ódor, P. and Standovár, T. 2001. Richness of bryophyte vegetation in a near-natural and managed beech stands: The effects of management-induced differences in dead wood. Ecological Bulletins 49: 219-229.

Ódor, P. and van Dort, K. 2003. Dead wood inhabiting bryophyte vegetation in two Slovenian beech forest reserve. Zbornik Gozdarstva in Lesarstva 69: 155-169.

Ódor, P. and van Hees, A.F.M. in press. Preferences of dead wood inhabiting bryophytes to decay phase, log size and habitat types in Hungarian beech forests. Journal of Bryology.

Økland, R.H. 1990. Vegetation ecology: theory, methods and applications with reference to Fennoscandia. Sommerfeltia, Supplement 1: 5-233.

Papp, B., Ódor, P. and Szurdoki, E. 2001. An overview of options and limitations in the monitoring of endangered bryophytes in Hungary. Novitates Botanicae Universitas Carolinae 15: 45-58.

Peterken, G.F. 1996. Natural Woodland. Ecology and Conservation in Northern Temperate Regions. Cambridge University Press, Cambridge.

Philippi, G. 1965. Moosgesellschaften der morschen Holzes und des Rohhumus in Schwarzwald, in der Rhön, im Weserbergland und im Harz. Nova Hedwigia 9: 185-233.

Proctor, M.C.F. 1982. Physiological ecology: water relations, light and temperature responses, carbon balance. In: Smith, A.J.E. (ed.), Bryophyte Ecology, pp. 333-382.

Qian, H., Klinka, K. and Song, X. 1999. Cryptogams on decaying wood in old-growth forests on southern coastal British Columbia. Journal of Vegetation Science 10: 883-894.

Raschendorfer, I. 1949. Beobachtungen über die Besiedlung von modernem Holz mit besonderer Berüchsichtigung der adnaten Vereine. Österreichische Botanische Zeitschrift 96: 232-280.

Renvall, P. 1995. Community structure and dynamics of wood-rotting Basidiomycetes on decomposing conifer trunks in northern Finland. Karstenia 35: 1-51.

Rimóczi, I., Siller, I., Vasas, G., Albert, L., Vetter, J. Bratek, Z. 1999. Magyarország nagygombáinak javasolt Vörös Listája. Clusiana 38(1-3): 107-132.

Rose, F. 1992. Temperate forest management: its effect on bryophyte and lichen floras and habitats. In: Bates, J.W. and Farmer, A.M. (eds.). Bryophytes and Lichens in a Changing Environment. pp. 223-245.

Ryvarden, L., Gilbertson, R.L. 1994. European Polypores, Vol. I-II. Synopsis Fungorum 6-7, Fungiflora, Oslo, Norway.

Samuelsson, J., Gustafsson, L. and Ingelög, T. 1994. Dying and Dead Trees - a Review of Their Importance for Biodiversity. Swedish Threatened Species Unit, Sw. Univ. of Agricult. Sci., Uppsala.

Saunders, D.A., Hobbs, R.J. and Margules, C.R. 1991. Biological consequences of ecosystem fragmentation – a review. Conservation Biology 5: 18-32.

Siitonen, J. 2001. Forest management, coarse woody debris and saproxylic organisms: Fennoscandian boreal forests as an example. Ecological Bulletins 49: 11-41.

Sippola, A.-L., Renvall, P. 1999. Wood-decomposing fungi and seed-tree cutting: A 40 year perspective. Forest Ecology and Management 115: 183-201.

Smith, A.J.E. (1978): The mossflora of Britain and Ireland. - Cambridge Univ. Press, Cambridge, pp. 706.

Smith, A.J.E. (1990): The liverworts of Britain and Ireland. - Cambridge Univ. Press, Cambridge, pp. 362.

Söderström, L. 1988a. Sequence of bryophytes and lichens in relation to substrate variables of decaying coniferous wood in Northern Sweden. Nordic Journal of Botany 8: 89-97.

Söderström, L. 1988b. The occurence of epxylic bryophyte and lichen species in an old natural and a managed forest stand in Northeast Sweden. Biological Conservation 45: 169-178.

Söderström, L. 1993. Substrate preference in some forest bryophytes: a quantitative study. Lindbergia 18: 98-103.

Söderström, L. and Jonsson, B.G. 1992. Fragmentation of old-growth forests and bryophytes on temporary substrates. Svensk Bot. Tidskr. 86: 185-198.

Standovár, T. and Kenderes, K. 2003. A review on natural stand dynamics in beechwoods of East Central Europe. Applied Ecology and Environmental Research 1: 19-46.

Stefureac, T.I. 1969. Studii briologice in unele formatiuni de vegetatie din Romania. Acad. Repub. Soc. Romania, Bucaresti.

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.

Stoltze M. and Pihl, S. 1998. Rødliste 1997 over Planter og Dyr i Danmark [Red List of Plant and Animal Species in Denmark]. Miljø- og Energiministeriet, Copenhagen, Denmark.

Strid, Å., 1975. Wood-inhabiting fungi of alder forests in north-central Scandinavia 1. Aphyllophorales (Basidiomycetes). Taxonomy, ecology and distribution. Wahlenbergia 1: 1-237.

ter Braak, C.J.F. and Šmilauer, P. 2002. Canoco 4.5. Biometris, Wageningen and Ceske Budejovice.

van Dort, K.W. 2002. Riccardia latifrons (Lindb.) Lindb. nog steeds in Nederland. Buxbaumiella 60: 17-20.

van Dort, K.W. and van Hees, A.F.M. 2002. Mossen en vaatplanten op dood beukenhout in bosreservaat Kersselaerspleyn (Zoniënwoud, Vlaanderen). Alterra-rapport 418.

Zar, J.H. 1999. Biostatistical Analysis. Prentice Hall, Upper Saddle River, New Jersey.

Appendix 1.

Number of occurrences of bryophytes in different countries and in the whole data set (Total). Tax.: Taxonomical groups (A-acrocarp, P-pleurocarp, H-hepatics), Ecol.: Ecological groups (X-epixylic, E-epyphytic, O-opportunistic, T-terricol, U-uproot species (mineral soil), L-epilythic). Countries are Slovenia (S), Hungary (H), The Netherlands (N), Belgium (B), Denmark (D).

SPECIES	CODE	TAX.	ECOL.	S	H	N	B	D	TOTAL
Amblystegium riparium (Hedw.) Br. Eur.	AMBRIP	P	O	1	1	0	0	0	2
Amblystegium serpens (Hedw.) Br. Eur.	AMBSER	P	O	37	120	1	1	14	173
Amblystegium subtile (Hedw.) B., S. & G.	AMBSUB	P	O	0	1	0	0	0	1
Amblystegium varium (Hedw.) Lindb.	AMBVAR	P	O	0	1	0	0	2	3
Anacamptodon splachnoides (Brid.) Brid.	ANASPL	P	X	1	0	0	0	0	1
Anomodon attenuatus (Hedw.) Hüb.	ANOATT	P	E	0	11	0	0	0	11
Anomodon longifolius (Brid.) Hartm.	ANOLON	P	E	0	1	0	0	0	1
Anomodon viticulosus (Hedw.) Hook. & Tayl.	ANOVIT	P	E	1	8	0	0	3	12
Antitrichia curtipendula (Hedw.) Brid.	ANTCUR	P	E	6	0	0	0	1	7
Apometzgeria pubescens (Schrank) Kuwah.	APOPUB	H	L	1	0	0	0	0	1
Atrichum undulatum (Hedw.) Br. Eur.	ATRUND	A	U	20	4	15	104	14	157
Aulacomnium androgynum (Hedw.) Schwaegr.	AULAND	A	X	0	0	29	21	2	52
Barbula unguiculata Hedw.	BARUNG	A	U	0	1	1	0	0	2
Blepharostoma trichophyllum (L.) Dum.	BLETRI	H	X	33	0	0	0	0	33
Brachythecium populeum (Hedw.) B., S. & G.	BRAPOP	P	O	8	0	1	0	0	9
Brachythecium rutabulum (Hedw.) B., S. & G.	BRARUT	P	O	119	104	132	178	134	667
Brachythecium salebrosum (Web. & Mohr.) B., S. & G.	BRASAL	P	O	78	102	14	121	45	360
Brachythecium velutinum (Hedw.) B., S & G.	BRAVEL	P	O	126	161	1	1	10	299
Bryum argenteum Hedw.	BRYARG	A	U	0	0	1	0	0	1
Bryum erythrocarpum aggr.	BRYERI	A	O	0	0	0	0	2	2
Bryum subelegans Kindb.	BRYSUB	A	O	94	146	8	57	22	327
Buxbaumia viridis Brid. ex Moug. & Nestl.	BUXVIR	A	X	2	0	0	0	0	2
Calliergonella cuspidata (Hedw.) Loeske	CALCUS	H	O	0	0	1	6	2	9
Calypogeia azurea Stotler et Crotz	CALAZU	H	T	4	0	0	0	0	4
Calypogeia muellerana (Schiffn.) K. Müll.	CALMUE	H	O	1	0	0	0	0	1
Calypogeia suecica H. Am et J. Press.) K. Müll.	CALSUE	H	X	17	0	0	0	0	17
Campylopus flexuosus (Hedw.) Brid.	CAMFLE	A	O	0	0	17	0	1	18
Campylopus introflexus (Hedw.) Brid.	CAMINT	A	O	0	0	28	7	3	38
Campylopus pyriformis (K. F. Schultz) Brid.	CAMPYR	A	O	0	0	9	0	0	9
Cephalozia bicuspidata (L.) Dum.	CEPBIC	H	O	4	0	0	0	11	15
Cephalozia catenulata (Hüb.) Lindb.	CEPCAT	H	X	18	0	0	0	0	18
Cephaloziella divaricata (Sm.) Schiffn.	CEPDIV	H	O	0	0	0	1	0	1
Cephaloziella hampeana (Nees) Schiffn.	CEPHAM	H	X	1	0	0	0	0	1
Cephaloziella rubella (Nees) Warnst.	CEPRUB	A	X	15	0	0	0	0	15
Ceratodon purpureus (Hedw.) Brid.	CERPUR	A	O	5	19	13	10	9	56
Chiloscyphus polyanthos (L.) Corda	CHYPOL	H	X	3	0	0	0	0	3
Climacium dendroides Web. et Mohr.	CLIDEN	P	T	0	1	0	0	0	1
Ctenidium molluscum (Hedw.) Mitt.	CTEMOL	P	L	69	0	0	0	1	70
Cynodontium polycarpon (Hedw.) Schimp.	CYNPOL	A	L	0	1	0	0	0	1
Dicranella heteromalla (Hedw.) Schimp.	DICHET	A	E	0	2	26	46	4	78
Dicranodontium denudatum (Brid.) Britt.	DICDEN	A	X	2	0	0	0	0	2
Dicranoweisia cirriata (Hedw.) Lindb. Ex Milde	DICCIR	A	U	0	0	74	50	12	136
Dicranum montanum Hedw.	DICMON	A	E	12	17	106	8	0	143
Dicranum scoparium Hedw.	DICSCO	A	O	40	22	74	35	71	242
Dicranum tauricum Sap.	DICTAU	A	E	0	1	16	53	0	70
Dicranum viride (Sull. and Lesq.) Lindb.	DICVIR	A	E	61	3	0	0	0	64
Didymodon vinealis (Brid.) Zander	DIDVIN	A	U	0	0	1	0	0	1

SPECIES	CODE	TAX.	ECOL.	S	H	N	B	D	TOTAL
Ditrichum pallidum (Hedw.) Hampe	DITPAL	A	U	0	1	0	0	0	1
Drepanocladus aduncus (Hedw.) Warnst.	DREADU	P	T	0	0	0	0	1	1
Drepanocladus sp.	DRESPE	P	T	0	0	0	0	2	2
Encalypta streptocarpa Hedw.	ENCSTR	A	L	2	1	0	0	0	3
Eucladium verticillatum (Brid.) B., S. & G.	EUCVER	A	L	0	0	0	0	1	1
Eurhynchium angustirete (Broth.) T. Kop.	EURANG	P	T	27	2	0	0	0	29
Eurhynchium hians (Hedw.) Sande Lac.	EURHIA	P	U	2	0	1	0	0	3
Eurhynhium praelongum (Hedw.) B., S. & G.	EURPRA	P	L	2	0	58	117	11	188
Eurhynhium striatulum Spruce (B., S. & G.	EURLUM	P	O	0	0	0	0	1	1
Eurhynhium striatum (Hedw.) Schimp.	EURSTR	P	T	6	0	13	23	0	42
Fissidens adianthoides Hedw.	FISADI	A	O	0	0	0	0	1	1
Fissidens bryoides Hedw.	FISBRY	A	U	0	0	1	1	0	2
Fissidens dubius P. Beauv	FISDUB	A	L	54	0	0	0	0	54
Fissidens taxifolius Hedw.	FISTAX	A	U	12	0	0	2	0	14
Frullania dilatata (L.) Dum.	FRUDIL	H	E	65	3	0	0	0	68
Frullania tamarisci (L.) Dum.	FRUTAM	H	E	5	0	0	0	0	5
Funaria hygrometrica Hedw.	FUNHYG	A	T	0	0	0	2	0	2
Grimmia hartmanii Schimp.	GRIHAR	A	L	1	2	0	0	0	3
Grimmia species	GRISPE	A	L	1	0	0	0	0	1
Hedwigia ciliata (Hedw.) P. Beauv.	HEDCIL	A	L	1	1	0	0	0	2
Herzogiella seligeri (Brid.) Iwats.	HERSEL	P	X	87	118	20	84	34	343
Homalia besseri Lob.	HOMBES	P	E	0	7	0	0	0	7
Homalia trichomanoides (Hedw.) Brid.	HOMTRI	P	L	2	0	0	0	0	2
Homalothecium philippeanum (Spruce.) B., S. & G.	HOMPHI	P	L	7	4	0	0	0	11
Homalothecium sericeum (Hedw.) B., S. & G.	HOMSER	P	E	62	13	0	0	18	93
Homomallium incurvatum (Brid.) Loeske	HOMINC	P	E	0	0	0	0	1	1
Hygrohypnum luridum (Hedw.) Jenn.	HYGLUR	P	L	1	0	0	0	0	1
Hylocomium splendens (Hedw.) Br. Eu.	HYLSPL	P	T	0	0	0	0	2	2
Hypnum cupressiforme Hedw.	HYPCUP	P	O	199	184	144	154	162	843
Hypnum jutlandicum Holmen & Warncke	HYPJUT	P	U	0	0	18	1	0	19
Isothecium alopecuroides (Dubois) Isov.	ISOALO	P	E	157	38	0	0	7	202
Isothecium myosuroides Brid.	ISOMYO	P	E	1	0	22	3	66	92
Jungermannia leiantha Grolle	JUNLEI	H	X	22	0	0	0	0	22
Lejeunea cavifolia (Ehrh.) Lindb.	LEJCAV	H	E	30	0	0	0	0	30
Lepidozia reptans (L.) Dum.	LEPREP	H	X	30	0	0	1	0	31
Leucobryum glaucum (Hedw.) Angstr.	LEUGLA	A	X	0	0	42	0	1	43
Leucodon sciuroides (Hedw.) Schwaegr.	LEUSCI	P	E	32	7	0	0	0	39
Lophocolea bidentata (L.) Dum.	LOPBID	H	X	0	0	0	14	8	22
Lophocolea heterophylla (Schrad.) Dum.	LOPHET	H	T	143	146	61	125	40	515
Lophocolea minor Nees	LOPMIN	H	X	1	10	0	0	0	11
Lophozia ascendens (Warnst.) Schust.	LOPASC	H	X	0	2	0	0	0	2
Marchantia polymorpha L.	MARPOL	H	T	0	0	0	1	0	1
Metzgeria conjugata Lindb.	METCON	H	E	42	0	0	0	0	42
Metzgeria furcata (L.) Dum.	METFUR	H	E	134	54	12	0	53	253
Mnium hornum Hedw.	MNIHOR	A	U	0	0	23	98	34	155
Mnium marginatum (Dicks) P. Beauv.	MNIMAR	A	X	13	0	0	0	0	13
Mnium stellare Hedw.	MNISTE	A	X	3	1	0	0	1	5
Mnium thomsonii Schimp.	MNITOM	A	X	1	0	0	0	0	1
Neckera complanata (Hedw.) Hüb.	NECCOM	P	E	41	2	0	0	29	72
Neckera crispa Hedw.	NECCRI	P	E	52	0	0	0	1	53
Neckera pumila Hedw.	NECPUM	P	E	11	0	0	0	0	11
Nowellia curvifolia (Dicks.) Mitt. in Godman	NOWCUR	H	X	55	3	0	2	1	61

SPECIES	CODE	TAX.	ECOL.	S	H	N	B	D	TOTAL
Odontoschisma denudatum (Mart.) Dum.	ODODEN	H	X	1	0	0	0	0	1
Orthodontium lineare Schwaegr.	ORTLIN	A	E	0	0	0	0	1	1
Orthotrichum affine Brid.	ORTAFF	A	E	2	0	8	5	5	20
Orthotrichum diaphanum Brid.	ORTDIA	A	E	0	1	7	1	0	9
Orthotrichum lyellii Hook. & Tayl.	ORTLYE	A	E	10	1	3	0	0	14
Orthotrichum speciosum Nees	ORTSPE	A	E	0	0	0	0	3	3
Orthotrichum stramineum Hornsch. ex Brid.	ORTSTR	A	E	67	35	3	0	11	116
Paraleucobryum longifolium (Hedw.) Loeske	PARLON	A	E	115	36	0	0	0	151
Pellia epiphylla (L.) Corda	PELEPI	H	T	0	0	0	1	0	1
Plagiochila porelloides (Torrey ex Nees) Lindenb.	PLAPOR	A	T	113	6	0	0	0	119
Plagiomnium affine (Bland.) T. Kop.	PLAAFF	P	U	4	0	0	0	0	4
Plagiomnium cuspidatum (Hedw.) Kop.	PLACUS	A	O	46	70	0	0	3	119
Plagiomnium ellipticum (Brid.) Kop.	PLAELL	P	X	44	0	0	0	0	44
Plagiomnium rostratum (Schrad.) T. Kop.	PLAROS	A	O	1	1	0	0	0	2
Plagiomnium undulatum (Hedw.) Kop.	PLAUND	P	E	40	0	0	3	2	45
Plagiothecium cavifolium (Brid.) Iwats.	PLACAV	P	E	14	5	0	0	12	31
Plagiothecium denticulatum (Hedw.) Br. Eur.	PLADEN	P	X	4	45	2	0	4	55
Plagiothecium laetum Br. Eur.	PLALAE	H	O	1	1	10	0	3	15
Plagiothecium latebricola Br. Eur.	PLALAT	P	E	0	0	0	0	1	1
Plagiothecium nemorale (Mitt.) Jaeg.	PLANEM	A	O	84	9	0	12	5	110
Plagiothecium undulatum (Hedw.) Br. Eur.	PLTUND	A	T	0	0	1	0	0	1
Platygyrium repens (Brid.) B., S. & G.	PLAREP	P	T	16	51	1	0	3	71
Pleurozium schreberi (Brid.) Mitt.	PLESCH	P	T	1	2	0	0	1	4
Pogonatum aloides (Hedw.) P. Beauv.	POGALO	A	U	0	0	1	0	0	1
Pohlia melanodon (Brid.) Shaw	POHMEL	A	U	0	1	0	0	0	1
Pohlia nutans (Hedw.) Lindb.	POHNUT	A	U	0	1	2	0	3	6
Polytrichum formosum Hedw.	POLFOR	A	U	9	0	57	80	20	166
Polytrichum longisetum Brid.	POLLON	A	O	0	0	15	0	0	15
Polytrichum piliferum Hedw.	POLPIL	A	U	0	0	1	0	1	2
Porella platyphylla (L.) Pfeiff.	PORPLA	H	E	13	0	0	0	12	25
Pottia species	POTSPE	A	U	0	0	0	0	1	1
Pseudoleskeella nervosa (Brid.) Nyh.	PSENER	P	U	3	100	0	0	0	103
Pseudoscleropodium purum (Hedw.) Fleisch.	PSEPUR	P	E	0	0	1	2	0	3
Pseudotaxiphyllum elegans (Brid.) Iwats.	PSEELE	P	T	0	0	2	22	0	24
Pterigynandrum filiforme Hedw.	PTEFIL	P	E	148	129	0	0	0	277
Ptilidium pulcherrimum (G. Web.) Vainio	PTIPUL	H	O	0	0	2	1	0	3
Pylaisia polyantha (Hedw.) Schimp.	PYLPOL	P	E	4	5	0	0	2	11
Radula complanata (L.) Dum.	RADCOM	H	E	119	14	0	0	0	133
Rhizomnium punctatum (Hedw.) Kop.	RHIPUN	A	X	105	51	0	5	2	163
Rhynchostegium confertum (Dicks.) B., S. & G.	RHYCON	P	E	0	0	25	48	0	73
Rhynchostegium murale (Hedw.) B., S. & G.	RHYMUR	P	T	17	0	0	0	0	17
Rhytidiadelphus loreus (Hedw.) Warnst.	RHYLOR	P	L	8	0	1	1	4	14
Rhytidiadelphus squarrosus (Hedw.) Warnst.	RHYSQU	P	T	0	0	0	2	4	6
Rhytidiadelphus triquetrus (Hedw.) Warnst.	RHYTRI	P	T	4	0	0	0	0	4
Riccardia latifrons (Lindb.) Lindb.	RICLAT	H	X	11	0	2	0	0	13
Riccardia multifida (L.) S. Gray	RICMUL	H	X	14	0	0	0	0	14
Riccardia palmata (Hedw.) Carruth.	RICPAL	H	X	62	0	0	0	0	62
Sanionia uncinata (Hedw.) Loeske	SANUNC	P	O	51	27	0	1	0	79
Scapania umbrosa (Schrad.) Dum.	SCAUMB	H	X	1	0	0	0	0	1

SPECIES	CODE	TAX.	ECOL.	S	H	N	B	D	TOTAL
Tetraphis pellucida Hedw.	TETPEL	A	X	11	1	17	0	1	30
Thamnobryum alopecurum (Hedw.) Gang.	THAALO	P	E	6	0	0	0	0	6
Thuidium tamariscinum (Hedw.) B., S. & G.	THUTAM	P	T	41	0	1	8	0	50
Tortella tortuosa (Hedw.) Limpr.	TORTOR	A	L	35	0	0	0	1	36
Tortula ruralis (Hedw.) Gaertn.	TORRUR	A	U	1	5	0	0	0	6
Tortula subulata Hedw.	TORSUB	A	O	0	5	0	0	0	5
Ulota bruchii Hornsch. Ex Brid.	ULOBRU	A	E	0	0	13	4	1	18
Ulota crispa (Hedw.) Brid.	ULOCRI	A	E	49	0	0	0	9	58
Weissia condensa (Voit.) Lindb.	WEICON	A	U	2	0	0	0	0	2
Zygodon conoideus (Dicks.) Hook. & Tayl.	ZYGCON	A	E	0	0	12	0	6	18
Zygodon rupestris Schimp. Ex Lor.	ZYGRUP	A	E	37	0	0	0	6	43
Zygodon viridissimus (Dicks.) Brid.	ZYGVIR	A	E	0	0	0	2	0	2

Appendix 2.

Number of occurrences of fungi in different countries and in the whole data set (Total). Ecol.: Ecological groups (B-bryophile, L-lignicolous, T-terricol (litter or soil), M-mycorrhiza species). SSI: Categories of “Species of Special Interest” (A- very rare and severely threatened everywhere in Europe, B- rare all over Europe and threatened in several countries, C- locally rare and threatened species). Countries are Slovenia (S), Hungary (H), The Netherlands (N), Belgium (B), Denmark (D).

SPECIES	CODE	ECOL.	SSI	S	H	N	B	D	TOTAL
Abortiporus biennis (Bull.: Fr.) Singer	abobie	L	C	0	0	1	1	0	2
Agaricus langei (F.H.Moeller) F.H.Moeller	agalan	T	-	0	2	0	0	0	2
Agaricus sylvicola (Vitt.) Peck	agasyl	T	-	0	0	0	0	1	1
Agrocybe erebia (Fr.) Singer	agrerb	T	C	0	1	0	0	0	1
Agrocybe praecox (Pers.: Fr.) Fayod	agrpra	T	-	1	3	0	0	0	4
Amanita pantherina (DC.: Fr.) Krombh.	amapan	M	-	1	0	0	0	0	1
Amanita rubescens Pers.: Fr.	amarub	M	-	0	0	1	0	0	1
Antrodia xantha (Fr.: Fr.) Ryvarden	antxan	L	-	0	0	0	0	1	1
Antrodiella aff. hoehnelii (Bres.) Niemelä	antsp	L	-	0	0	0	0	1	1
Antrodiella hoehnelii (Bres.) Niemelä	anthoe	L	-	1	12	5	0	0	18
Antrodiella onynchoides (Egeland) Niemela	antony	L	C	0	0	0	1	0	1
Antrodiella semisupina (Berk. & Curt.) Ryvarden & Johans.	antsem	L	-	0	4	13	1	12	30
Armillaria lutea Gillet	armlut	L	-	26	10	24	101	52	213
Armillaria mellea (Vahl: Fr.) P.Kumm.	armmel	L	-	0	18	0	8	1	27
Armillaria ostoyae (Romagn.) Herink	armost	L	-	0	0	11	0	0	11
Arrhenia retiruga (Bull.: Fr.) Redhead	arrret	B	-	0	0	0	0	1	1
Ascocoryne cylichnium (Tul.) Korf	asccyl	L	-	45	6	46	83	59	239
Ascocoryne sarcoides (Jacq.: Fr.) Groves & Wilson	ascsar	L	-	18	5	29	27	20	99
Ascotremella faginea (Peck) Seaver	ascfag	L	-	0	0	4	2	0	6
Aurantioporus fissilis (Berk. & Curt.) Jahn	aurfis	L	A	0	0	0	1	0	1
Auricularia auricula-judae (Bull.: Fr.) Wettst.	auraur	L	-	0	5	0	2	6	13
Auricularia mesenterica (Dicks.) Pers.	aurmes	L	-	0	15	0	0	0	15
Biscogniauxia nummularia (Bull.: Fr.) O.K.	bisnum	L	C	7	3	7	0	0	17
Bjerkandera adusta (Willd.: Fr.) P.Karst.	bjeadu	L	-	66	43	50	34	41	234
Bjerkandera fumosa (Pers.: Fr.) P.Karst.	bjefum	L	-	0	0	2	2	0	4
Bolbitius reticulatus (Pers.: Fr.) Rick.	bolret	L	-	0	6	1	8	4	19
Boletus pascuus (Pers.) Krombh.	bolpas	M	-	0	1	2	10	0	13
Boletus pruinatus Fr.	bolpru	M	-	0	0	0	4	1	5

SPECIES	CODE	ECOL.	SSI	S	H	N	B	D	TOTAL
Boletus pulverulentus Opat.	bolpul	M	-	0	0	0	0	1	1
Boudiera tracheia (Gamundi) Dissing & T. Schum.	boutra	T	-	0	0	0	0	1	1
Bulgaria inquinans (Pers.: Fr.) Fr.	bulinq	L	-	2	2	5	0	9	18
Callistosporium luteoolivaceum (Berk. & Curtis) Singer var. minor	callut	L	C	0	0	0	1	0	1
Calocera cornea (Batsch: Fr.) Fr.	calcor	L	-	32	38	15	16	26	127
Calocybe falax (Sacc.) Sing. ex Redhead & Sing.	calfal	T	-	0	3	0	0	0	3
Camarops lutea (Alb. & Schw.) Nannf.	camlut	L	-	0	0	1	0	2	3
Camarops polysperma (Mont.) Miller	campol	L	-	0	0	0	0	4	4
Camarops tubulina (Alb. & Schw.) Shear	camtub	L	B	3	0	0	0	8	11
Cantharellus tubaeformis (Bull.: Fr.) Fr.	cantub	M	-	2	0	0	0	2	4
Catinella olivacea (Batsch) Boud.	catoli	L	C	0	0	0	0	1	1
Ceriporia excelsa (Lund.) Parm.	cerexc	L	C	11	3	6	3	7	30
Ceriporia purpurea (Fr.) Donk	cerpur	L	C	1	5	0	0	0	6
Ceriporia reticulata (Hoffm.: Fr.) Dom.	cerret	L	C	9	7	0	0	6	22
Ceriporiopsis gilvescens (Bres.) Dom.	cergil	L	B	12	12	3	22	0	49
Ceriporiopsis mucida (Pers.:Fr.) Gilb. & Ryvarden	cermuc	L	B	1	0	0	0	0	1
Ceriporiopsis pannocincta (Rom.) Gilb. & Ryvarden	cerpan	L	A	0	3	1	1	0	5
Cerrena unicolor (Bull.: Fr.) Murr.	ceruni	L	B	1	3	0	0	0	4
Chlorociboria aeruginascens (Nyl.) Kanouse	chlaer	L	-	3	0	0	0	11	14
Chondrostereum purpureum (Pers.: Fr.) Pouz.	chopur	L	-	0	0	5	6	8	19
Clavariadelphus fistulosus (Holmskj.: Fr.) Corner	clafis	T	-	0	1	0	0	0	1
Clavicorona pyxidata (Pers.: Fr.)	clapyx	L	A	0	2	0	0	0	2
Clavulina cinerea (Bull. : Fr.) J. Schroet.	clacin	M	-	1	0	0	0	0	1
Clavulina coralloides (L. : Fr.) J. Schroet.	clacor	M	-	2	3	0	10	2	17
Clitocybe candicans (Pers.: Fr.) P.Kumm.	clican	T	-	0	4	0	0	0	4
Clitocybe cfr. obsoleta	cliobs	T	-	0	8	0	0	0	8
Clitocybe clavipes (Pers.: Fr.) P.Kumm.	clicla	T	-	0	0	0	2	0	2
Clitocybe diatreta (Fr.: Fr.) P.Kumm.	clidia	T	-	0	0	0	0	8	8
Clitocybe fragrans (With.: Fr.) P.Kumm.	clifra	T	-	0	16	0	2	0	18
Clitocybe gibba (Pers.: Fr.) P.Kumm.	cligib	T	-	0	4	0	2	1	7
Clitocybe metachroa (Fr.: Fr.) P.Kumm.	climet	T	-	0	1	0	0	8	9
Clitocybe nebularis (Batsch: Fr.) P.Kumm.	clineb	T	-	1	5	1	0	1	8
Clitocybe odora (Bull.: Fr.) P.Kumm.	cliodo	T	-	0	3	0	0	0	3
Clitocybe phaeophtalma (Pers.) Kuyper	clipha	T	-	0	14	0	0	0	14
Clitocybe phyllophila (Pers.: Fr.) P.Kumm.	cliphy	T	-	0	6	0	0	4	10
Clitocybe trulliformis (Fr.) P.Karst.	clitru	T	-	0	3	0	0	2	5
Clitocybe truncicola (Peck) Sacc.	clitra	L	C	0	0	0	0	1	1
Clitopilus hobsonii (Berk.) P.D.Orton	clihob	L	C	0	0	5	18	27	50
Clitopilus prunulus (Scop.: Fr.) P.Kumm.	clipru	T	-	1	0	0	0	0	1
Clitopilus scyphoides (Fr.: Fr.) Singer	cliscy	L	-	0	0	0	5	0	5
Collybia butyracea (Bull.: Fr.) P.Kumm.	colbut	T	-	1	11	1	0	0	13
Collybia confluens (Pers.: Fr.) P.Kumm.	colcon	T	-	0	4	1	0	0	5
Collybia cookei (Bres.) J.D.Arnold	colcoo	T	-	1	5	0	9	15	30
Collybia dryophila (Bull.: Fr.) P.Kumm.	coldry	T	-	1	7	0	0	2	10
Collybia erythropus (Pers.: Fr.) P.Kumm.	colery	T	-	0	2	0	0	0	2
Collybia hariolorum (DC.: Fr.) Quél.	colhar	T	-	0	7	0	0	0	7

SPECIES	CODE	ECOL.	SSI	S	H	N	B	D	TOTAL
Collybia peronata (Bolt.: Fr.) P.Kumm.	colper	T	-	1	22	0	0	0	23
Conocybe aporus Kits Wav.	conapo	T	-	9	0	0	0	0	9
Conocybe appendiculata (J.E.Lange & Kühner) ex Watling	conapp	T	-	0	0	0	1	0	1
Conocybe arrhenii (Fr.) Kits	conarr	T	-	0	1	0	0	0	1
Conocybe blattaria (Fr.: Fr.) Kühn.	conbla	T	-	0	1	0	0	1	2
Conocybe brunnea (J.E.Lange & Kühner) ex Watling	conbru	L	-	0	0	0	4	3	7
Conocybe filaris (Fr.) Kühner	confil	T	-	0	0	1	0	0	1
Conocybe semiglobata (Kühner ex) Kühner & Watling	consem	T	-	0	0	0	2	3	5
Conocybe subpubescens P.D.Orton	consub	L	-	12	4	0	47	22	85
Conocybe tenera (Schaeff.: Fr.) Fayod	conten	T	-	0	0	0	0	1	1
Conocybe tetraspora Singer	contet	T	-	0	0	0	0	2	2
Coprinus alopecia Lasch	copalo	L	C	0	0	0	0	1	1
Coprinus disseminatus (Pers.: Fr.) Gray	copdis	L	-	2	0	2	1	1	6
Coprinus domesticus (Bolt.: Fr.) Gray	copdom	L	-	0	0	0	0	1	1
Coprinus lagopides P.Karst.	coplag	L	-	0	2	0	5	0	7
Coprinus lagopus (Fr.: Fr.) Fr.	coplau	L	-	0	15	0	0	0	15
Coprinus laanii Kits	coplaa	L	-	0	0	0	5	0	5
Coprinus micaceus (Bull.: Fr.) Fr.	copmic	L	-	30	9	23	89	53	204
Coprinus radians (Desm.: Fr.) Fr.	coprad	L	-	1	5	1	0	0	7
Coprinus silvaticus Peck	copsil	L	B	0	27	0	0	0	27
Coprinus spelaiophilus Ulje & Bas	copspe	L	-	0	0	0	1	0	1
Coprinus tuberosus Quél.	coptub	T	-	0	0	0	1	0	1
Cortinarius aff. decipiens (Pers.: Fr.) Fr.	cordec	M	-	0	0	0	0	1	1
Cortinarius anomalus (Fr.: Fr.) Fr.	corano	M	-	0	0	0	1	0	1
Cortinarius atrovirens Kalchbr.	coratr	M	-	1	0	0	0	0	1
Cortinarius battailei (Moser) HZiland	corbat	M	-	2	0	0	0	0	2
Cortinarius bulbiger (Alb. & Schw.: Fr.) J.E.Lange	corbul	M	-	0	1	0	0	0	1
Cortinarius casimiri (Velen.) Huijsman	corcas	M	-	0	0	0	1	0	1
Cortinarius delibutus Fr.	cordel	M	-	0	0	2	1	0	3
Cortinarius diasemospermus D. Lam.	cordia	M	-	0	0	0	0	5	5
Cortinarius flexipes (Pers.: Fr.) Fr.	corfle	M	-	0	0	0	0	1	1
Cortinarius olivaceofuscus Kuhner	coroli	M	-	0	0	0	0	1	1
Crepidotus applanatus (Pers.) P.Kumm.	creapp	L	B	18	10	0	0	0	28
Crepidotus cesatii Rabenh.	creces	L	C	0	2	0	0	0	2
Crepidotus epibryus (Fr.: Fr.) Quél.	creepi	T	-	1	3	0	0	1	5
Crepidotus lundellii Pilat	crelun	L	-	0	7	0	0	0	7
Crepidotus mollis (Schaeff.: Fr.) Staude	cremol	L	-	2	3	1	8	0	14
Crepidotus variabilis (Pers.: Fr.) Kumm.	crevar	L	-	1	0	1	0	0	2
Crepidotus versutus (Peck) Sacc.	crever	L	-	1	0	0	2	0	3
Cyathus striatus (Huds.) Willd.: Pers.	cyastr	L	-	0	1	0	1	0	2
Cystoderma carcharias (Pers.) Konr. & Maubl.	cyscar	T	-	2	0	0	0	3	5
Cystoderma jasonis (Cooke & Mass.) Harm.	cysjas	T	-	0	0	1	0	1	2
Cystolepiota seminuda (Lasch) Bon	cyssem	T	-	1	4	0	4	2	11
Daedaleopsis confragosa (Bolt.: Fr.) Schroet.	daecon	L	-	0	2	0	0	0	2
Datronia mollis (Sommerf.: Fr.) Donk	datmol	L	-	12	26	10	10	16	74
Delicatula integrella (Pers.: Fr.) Pat.	delint	L	B	0	0	0	4	0	4
Dentipellis fragilis (Pers.: Fr.) Donk	denfra	L	B	9	4	0	0	0	13
Discina parma J.Breitenb. & Maas Geest.	dispar	L	A	3	2	0	0	0	5

SPECIES	CODE	ECOL.	SSI	S	H	N	B	D	TOTAL
Entoloma albotomentosum Noordel. & Hauskn.	entalb	T	-	0	0	0	0	1	1
Entoloma cephalotrichum (P.D.Orton) Noordel.	entcep	T	-	0	0	0	0	1	1
Entoloma cetratum (Fr.: Fr.) Moser	entcet	T	-	0	0	0	0	2	2
Entoloma conferendum (Britz.) Noordel.	entcon	T	-	0	0	1	0	0	1
Entoloma dichroum (Pers.: Fr.) P.Kumm.	entdic	L	C	0	2	0	0	0	2
Entoloma papillatum (Bres.) Dennis	entpap	T	-	0	2	0	0	0	2
Entoloma rhodopolium (Fr.: Fr.) P.Kumm.	entrho	T	-	4	2	0	0	2	8
Entoloma subradiatum (Kuhn. & Romagn.) Moser	entsub	T	-	0	0	0	0	1	1
Entoloma tjallingiorum Noordel.	enttja	L	C	0	0	0	0	2	2
Eutypa spinosa (Pers.: Fr.) Tul. & C.Tul.	eutspi	L	-	88	150	117	160	123	638
Exidia glandulosa (Bull: Fr.) Fr.	exigla	L	-	17	18	0	7	8	50
Exidia nucleata (Schwein.) Burt.	exinuc	L	-	0	0	2	16	9	27
Femsjonia peziziformis (Lév.) P.Karst.	fempez	L	B	0	0	2	0	0	2
Flammulaster carpophilus (Fr.) Earle	flacar	T	-	0	0	0	1	2	3
Flammulaster limulatus (Fr.) Watling	flalim	L	C	6	8	0	0	1	15
Flammulaster muricatus (Fr.: Fr.) Watling	flamur	L	A	0	0	0	0	1	1
Flammulina velutipes (Curt.: Fr.) P.Karst.	flavel	L	-	3	1	0	0	1	5
Fomes fomentarius (L.: Fr.) Fr.	fomfom	L	-	108	118	77	58	96	457
Fomitopsis pinicola (Swartz: Fr.) P.Karst.	fompin	L	-	26	5	1	1	36	69
Galerina atkinsoniana A.H.Smith	galatk	B	-	0	0	0	1	6	7
Galerina calyptrata P.D.Orton	galcal	B	C	0	0	0	0	1	1
Galerina camerina (Fr.) Kühn.	galcam	L	-	4	0	0	0	0	4
Galerina cerina Smith & Sing.	galcer	B	-	4	0	0	0	0	4
Galerina heimansii Reijnders	galhei	T	-	0	0	0	1	0	1
Galerina hypnorum (Schrank: Fr.) Kuhner	galhyp	B	-	0	0	5	10	14	29
Galerina marginata (Batsch) Kuhner	galmar	L	-	37	33	3	6	81	160
Galerina mniophila (Lasch) Kühn.	galmni	B	-	3	0	0	0	0	3
Galerina nana (Petri) Kuhner	galnan	L	-	0	0	1	1	0	2
Galerina pallida (Pilát) Horak & Moser	galpal	L	-	1	0	0	0	0	1
Galerina stylifera (Atk.) Smith & Sing.	galsty	L	-	1	0	0	0	0	1
Galerina triscopa (Fr.) Kuhner	galtri	L	B	3	0	0	0	11	14
Galerina vittaeformis (Fr.) Singer	galvit	B	-	0	0	2	0	14	16
Ganoderma lipsiensis (Batsch) Atk.	ganlip	L	-	23	50	88	99	38	298
Ganoderma lucidum (Curt.: Fr.) P.Karst.	ganluc	L	C	0	0	1	0	0	1
Ganoderma pfeifferi Bres.	ganpfe	L	C	0	0	0	0	3	3
Geastrum fimbriatum Fr.	geafim	T	-	0	2	0	0	1	3
Geastrum triplex Jungh.	geatri	T	-	0	2	0	0	1	3
Gloeophyllum sepiarium (Wulfen: Fr.) P.Karst.	glosep	L	C	0	0	0	0	2	2
Gymnopilus sapineus (Fr.: Fr.) Maire	gymsap	L	-	0	0	4	4	1	9
Hebeloma cfr. edurum Métr. ex Bon	hebedu	M	-	0	0	1	0	0	1
Hebeloma radicosum (Bull.: Fr.) Ricken	hebrad	M	-	1	0	0	0	0	1
Helvella elastica Bull.	helela	T	-	1	0	0	0	0	1
Helvella lacunosa Afz.: Fr.	hellac	T	-	0	0	0	0	1	1
Helvella nigricans Pers.	helnig	T	-	1	0	0	0	0	1
Helvella pezizoides Afz.: Fr.	helpez	T	-	0	1	0	0	0	1
Henningsomyces candidus (Pers.: Fr.) O.K.	hencan	L	-	1	2	0	7	10	20
Hericium coralloides (Scop.: Fr.) Pers.	hercor	L	B	0	4	0	0	1	5
Heterobasidion annosum (Fr.) Bref.	hetann	L	-	0	0	1	0	0	1

SPECIES	CODE	ECOL.	SSI	S	H	N	B	D	TOTAL
Hohenbuehelia auriscalpium (Maire) Singer	hohaur	L	C	0	0	4	2	1	7
Hohenbuehelia fluxilis (Fr.: Fr.) P.D. Orton	hohflu	L	C	4	0	0	0	0	4
Hohenbuehelia mastrucata (Fr.: Fr.) Singer	hohmas	L	B	1	0	1	0	0	2
Humaria hemisphaerica (Wigg.: Fr.) Fuckel	humhem	T	-	1	1	0	0	1	3
Hydnum rufescens Fr.	hydruf	M	-	0	1	0	0	0	1
Hydropus subalpinus (Hšhn.) Singer	hydsub	L	C	0	2	0	0	0	2
Hygrophoropsis aurantiaca (With.: Fr.) Maire	hygaur	T	-	0	0	0	0	5	5
Hyphodontia flavipora (syn. Schizpora f.)	hypfla	L	-	1	0	42	30	0	73
Hyphodontia paradoxa (Schrad.: Fr.) E.Langer & Vesterh.	hyppar	L	-	1	18	33	0	14	66
Hyphodontia radula (Pers.: Fr.) E.Langer & Vesterh.	hyprad	L	-	0	0	0	8	6	14
Hypholoma capnoides (Fr.: Fr.) P.Kumm.	hypcap	L	-	4	0	0	0	0	4
Hypholoma fasciculare (Huds.: Fr.) P.Kumm.	hypfas	L	-	19	14	94	118	55	300
Hypholoma lateritium (Schaeff.: Fr.) P.Kumm.	hyplat	L	-	0	4	6	0	2	12
Hypocrea albofulva Berk. & Broome	hypalb	L	-	1	0	0	0	0	1
Hypocrea aureoviridis Plowr. & Cooke	hypaur	L	-	0	0	0	2	0	2
Hypocrea citrina (Pers.: Fr.) Fr.	hypcit	L	-	0	0	14	2	1	17
Hypocrea gelatinosa (Tode: Fr.) Fr.	hypgel	L	-	3	2	0	1	2	8
Hypocrea lutea (Tode) Petch	hyplut	L	-	2	0	0	0	0	2
Hypocrea rufa (Pers.) Fr.	hypruf	L	-	10	6	6	1	6	29
Hypoxylon cohaerens (Pers.: Fr.) Fr.	hypcoh	L	-	17	0	58	32	22	129
Hypoxylon fragiforme (Pers.: Fr.) Kickx	hypfra	L	-	36	16	46	37	27	162
Hypoxylon macrocarpum Pouz.	hypmac	L	-	1	0	0	0	11	12
Hypoxylon multiforme (Fr.: Fr.) Fr.	hypmul	L	-	2	18	0	0	9	29
Hypoxylon rubiginosum (Pers.: Fr.) Fr.	hyprub	L	-	2	3	31	3	8	47
Hypsizygus tessulatus (Bull.: Fr.) Sing.	hyptes	L	C	1	0	0	0	0	1
Inocybe cincinnata (Fr.: Fr.) Quél.	inocin	M	-	0	0	0	0	2	2
Inocybe erubescens Blytt	inoeru	M	-	0	1	0	0	0	1
Inocybe lanuginosa (Bull.: Fr.) P.Kumm.	inolan	M	-	0	0	0	0	1	1
Inocybe petiginosa (Fr.: Fr.) Gillet	inopet	M	-	1	0	0	2	4	7
Inocybe pusio P.Karst.	inopus	M	-	0	0	0	0	1	1
Inonotus cuticularis (Bull.: Fr.) P.Karst.	inocut	L	B	0	3	1	0	0	4
Inonotus nodulosus (Fr.) P.Karst.	inonod	L	C	20	24	13	1	14	72
Inonotus obliquus (Pers.: Fr.) Pilat	inoobl	L	-	0	5	0	0	0	5
Ischnoderma resinosum (Schrad.: Fr.) P.Karst.	iscres	L	B	9	26	0	0	6	41
Kavinia himantia (Schw.) J.Erikss.	kavhim	L	B	0	0	0	0	3	3
Laccaria amethystina Cooke	lacame	M	-	10	2	5	28	32	77
Laccaria laccata (Scop.: Fr.) Berk. & Br.	laclac	M	-	1	2	2	8	8	21
Laccaria proxima (Boud.) Pat.	lacpro	M	-	0	0	2	0	0	2
Laccaria tortilis (Bolt.) Cooke	lactor	M	-	1	0	0	0	0	1
Lactarius blennius (Fr.: Fr.) Fr.	lacble	M	-	2	1	0	0	5	8
Lactarius camphoratus (Bull.: Fr.) Fr.	laccam	M	-	0	0	0	0	1	1
Lactarius glutinopallens Britzelm.	lacglu	M	-	1	0	0	0	0	1
Lactarius salmonicolor R.Heim & Lecl.	lacsal	M	-	2	0	0	0	0	2
Lactarius serifluus (DC.:Fr.) Fr.	lacser	M	-	0	3	0	0	0	3
Lactarius subdulcis (Bull.: Fr.) Gray	lacsub	M	-	19	55	1	20	29	124
Lactarius tabidus Fr.	lactab	M	-	0	0	9	2	0	11
Laxitextum bicolor (Pers.: Fr.) Lentz	laxbic	L	-	1	1	2	1	3	8
Lentaria epichnoa (Fr.) Corner	lenepi	L	C	2	0	0	0	3	5
Lentaria mucida (Pers.: Fr.) Corner	lenmuc	L	C	18	0	0	0	0	18

SPECIES	CODE	ECOL.	SSI	S	H	N	B	D	TOTAL
Lentinellus cochleatus (Pers.: Fr.) P.Karst.	lencoc	L	B	0	2	1	0	0	3
Lentinellus vulpinus (Sowerby: Fr.) Kuhner & Maire	lenvul	L	A	0	0	0	0	1	1
Lentinus strigosus (Schw.) Fr.	lenstr	L	C	0	1	0	0	0	1
Lenzites betulinus (L.: Fr.) Fr.	lenbet	L	C	1	2	0	0	0	3
Leotia lubrica Scop.: Fr.	leolub	T	-	1	0	0	0	0	1
Lepiota aspera (Pers.: Fr.) Quél.	lepasp	T	-	0	4	0	0	1	5
Lepiota boudieri Bres.	lepbou	T	-	0	6	0	0	2	8
Lepiota castanea Quél.	lepcas	T	-	0	1	0	0	1	2
Lepiota clypeolaria (Bull.: Fr.) P.Kumm.	lepcly	T	-	0	14	0	0	0	14
Lepiota cristata (Bolt.: Fr.) P.Kumm.	lepcri	T	-	0	16	0	0	1	17
Lepiota felina (Pers.) P.Karst.	lepfel	T	-	0	0	0	1	0	1
Lepiota ventriosospora Reid	lepven	T	-	0	0	0	1	1	2
Lepista flaccida (Sow.: Fr.) Pat.	lepfla	T	-	0	2	0	1	2	5
Lepista nuda (Bull.: Fr.) Cooke	lepnud	T	-	0	1	0	1	2	4
Leucopaxillus giganteus	leugig	T	-	0	3	0	0	0	3
Lopharia spadicea (Pers.: Fr.) Boid.	lopspa	L	B	0	1	0	0	0	1
Lycoperdon echinatum Pers.: Pers.	lycech	T	-	2	2	0	0	0	4
Lycoperdon foetidum Bonord.	lycfoe	T	-	0	0	0	0	5	5
Lycoperdon perlatum Pers.: Pers.	lycper	L	-	3	1	3	32	27	66
Lycoperdon pyriforme Schaeff.: Pers.	lycpyr	L	-	26	62	7	14	52	161
Lycoperdon umbrinum Pers.: Pers.	lycumb	T	-	0	0	0	0	1	1
Lyophyllum confusum (P.D.Orton) Gulden	lyocon	T	-	0	0	0	1	0	1
Lyophyllum rancidum (Fr.) Singer	lyoran	T	-	0	2	0	0	0	2
Macrolepiota rhacodes (Vitt.) Singer	macrha	T	-	0	17	3	4	2	26
Marasmiellus ramealis (Bull.: Fr.) Singer	marram	L	-	0	0	1	0	0	1
Marasmius alliaceus (Jacq.: Fr.) Fr.	marall	L	-	41	98	0	0	93	232
Marasmius bulliardii Quel.	marbul	T	-	2	0	0	0	0	2
Marasmius cohaerens (Alb. & Schw.: Fr.) Cooke & Quél.	marcoh	T	-	0	0	0	0	2	2
Marasmius rotula (Scop.: Fr.) Fr.	marrot	L	-	0	56	4	0	11	71
Marasmius torquescens Quél.	martor	T	-	0	12	0	0	1	13
Marasmius wynnei Berk. & Br.	marwyn	T	-	1	5	0	0	3	9
Megacollybia platyphylla (Pers.: Fr.) Kotl. & Pouz.	megpla	L	-	1	4	24	11	7	47
Melanoleuca polioleuca (Fr.) Kuehn. et Mre.	melpol	T	-	0	2	0	0	0	2
Melanophyllum aimatospermum (Bull.: Fr.) Kreisel	melaim	T	-	0	4	0	4	3	11
Meripilus giganteus (Pers.: Fr.) P.Karst.	mergig	L	C	0	6	31	18	11	66
Merismodes anomalus (Pers.: Fr.) Singer	merano	L	-	0	0	0	0	1	1
Meruliopsis corium (Fr.) Ginns	mercor	L	-	0	3	0	0	1	4
Micromphale brassicolens (Romagn.) P.D.Orton	micbra	T	-	0	6	0	0	9	15
Micromphale foetidum (Sowerby: Fr.) Singer	micfoe	L	-	0	0	0	0	1	1
Mutinus caninus (Huds.: Pers.) Fr.	mutcan	L	C	1	1	5	7	4	18
Mycena abramsii (Murr.) Murr.	mycabr	L	-	0	0	4	7	2	13
Mycena acicula (Schaeff.: Fr.) P.Kumm.	mycaci	L	-	2	2	0	1	0	5
Mycena adscendens (Lasch) Maas Geest.	mycads	L	-	0	0	0	8	0	8
Mycena alba (bres.) Kühn.	mycalb	L	B	1	0	0	0	0	1
Mycena amicta (Fr.) Quél.	mycami	T	-	0	0	0	5	0	5
Mycena arcangeliana Bres.	mycarc	L	-	30	105	26	3	0	164
Mycena cinerella (P.Karst.) P.Karst.	myccin	T	-	0	0	3	0	3	6

SPECIES	CODE	ECOL.	SSI	S	H	N	B	D	TOTAL
Mycena crocata (Schrad.: Fr.) P.Kumm.	myccro	L	-	21	67	0	11	55	154
Mycena diosma Krieglsteiner & Schwöbel	mycdio	T	-	0	0	0	2	1	3
Mycena erubescens Höhn.	myceru	L	C	6	0	2	0	39	47
Mycena filopes (Bull.: Fr.) P.Kumm.	mycfil	T	-	0	0	1	21	3	25
Mycena flavescens Velen.	mycfla	T	-	0	0	0	0	1	1
Mycena galericulata (Scop.: Fr.) Quél.	mycgal	L	-	26	35	28	34	65	188
Mycena galopus (Pers.: Fr.) P.Kumm.	mycgau	T	-	0	17	7	8	3	35
Mycena haematopus (Pers.: Fr.) P.Kumm.	mychae	L	-	38	34	85	91	105	353
Mycena hiemalis (Osb.: Fr.) Qu? l.	mychie	L	-	4	0	1	1	4	10
Mycena leptocephala (Pers.: Fr.) Gillet	myclep	T	-	0	0	0	1	0	1
Mycena longiseta Hoehn	myclon	T	-	0	0	0	2	0	2
Mycena minutula (Peck) Sacc.	mycmin	L	B	0	6	1	0	16	23
Mycena pelianthina (Fr.) Quél.	mycpel	T	-	0	21	0	1	1	23
Mycena picta (Fr.: Fr.) Harm.	mycpic	L	B	0	0	0	3	6	9
Mycena polygramma (Bull.: Fr.) Gray	mycpol	L	-	1	0	0	0	2	3
Mycena pseudocorticola Kuhn.	mycpse	L	C	7	0	0	0	1	8
Mycena pura (Pers.: Fr.) P.Kumm.	mycpur	T	-	4	22	1	0	2	29
Mycena purpureofusca (Peck) Sacc.	mycpuf	L	C	0	0	0	1	0	1
Mycena renati Quél.	mycren	L	B	16	49	0	0	4	69
Mycena rosea Gramberg	mycros	T	-	0	13	0	1	2	16
Mycena sanguinolenta (Alb. & Schw.: Fr.) P.Kumm.	mycsan	T	-	1	1	0	8	10	20
Mycena speirea (Fr.: Fr.) Gillet	mycspe	L	-	5	0	4	36	13	58
Mycena tintinabulum (Fr.) Quél.	myctin	L	B	3	1	0	0	2	6
Mycena vitilis (Fr.) Quél.	mycvit	L	-	0	0	1	4	1	6
Mycenella lasiosperma (Bres.) Singer	myclas	L	C	0	0	0	0	1	1
Mycoacia aurea (Fr.) J.Erikss. & Ryvarden	mycaur	L	-	0	1	1	9	2	13
Mycoacia fuscoatra (Fr.: Fr.) Donk	mycfus	L	-	1	0	0	1	0	2
Mycoacia uda (Fr.) Donk	mycuda	L	-	0	0	4	6	0	10
Nemania atropurpurea (Fr.: Fr.) Pouzar	nematr	L	-	4	0	0	0	5	9
Nemania carbonacea Pouzar	nemcar	L	-	1	0	0	0	0	1
Nemania chestersii (Rogers & Whalley)	nemche	L	-	1	0	19	1	19	40
Nemania colliculosa (Schwein.: Fr.) Granmo	nemcol	L	-	1	0	0	0	0	1
Nemania confluens (Tode: Fr.) Laessoe & Spooner	nemcon	L	-	0	0	0	0	1	1
Nemania diffusa (Sowerby) Gray	nemdif	L	-	1	0	0	0	0	1
Nemania serpens (Pers.: Fr.) Gray	nemser	L	-	6	0	31	27	21	85
Neobulgaria pura (Fr.) Petrak	neopur	L	-	17	2	32	36	20	107
Omphalina epichysium (Pers.: Fr.) Quél.	ompepi	L	B	2	5	0	0	2	9
Ossicaulis lignatilis (Pers.: Fr.) Redhead & Ginns	osslig	L	B	1	10	0	0	0	11
Otidea onotica (Pers.: Fr.) Fuckel	otiono	T	-	0	0	0	0	1	1
Oudemansiella mucida (Schrad.: Fr.) Höhn.	oudmuc	L	-	50	23	27	15	27	142
Oxyporus latemarginatus (E.J.Durand & Mont.) Donk	oxylat	L	C	0	0	2	0	0	2
Pachykytospora tuberculosa (DC.: Fr.) Kotl. & Pouz.	pactub	L	B	0	2	0	0	0	2
Panaeolus acuminatus (Schaeff.) Quél.	panacu	T	-	0	0	0	1	0	1
Panellus serotinus (Pers.: Fr.) Kuhn.	panser	L	-	41	6	25	53	27	152

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Panellus stipticus (Bull.: Fr.) P.Karst.	pansti	L	-	15	14	1	2	1	33
Paxillus involutus (Fr.) Fr.	paxinv	M	-	0	0	4	0	2	6
Peniophora cinerea (Pers.: Fr.) Cooke	pencin	L	-	0	0	2	0	0	2
Peniophora incarnata (Pers.: Fr.) P.Karst.	peninc	L	-	1	3	0	0	0	4
Perenniporia fraxinea (Bull.: Fr.) Ryvarden	perfra	L	A	0	1	0	0	0	1
Perenniporia medulla-panis (Jacq.: Fr.) Donk	permed	L	B	1	0	0	0	0	1
Peziza arvernensis Boud.	pezarv	T	-	9	0	0	0	2	11
Peziza cfr. retrocurvata	pezret	L	-	0	0	0	0	1	1
Peziza michelii (Boud.) Dennis	pezmih	T	-	1	0	0	0	1	2
Peziza micropus Pers.: Fr.	pezmic	L	-	0	25	1	10	20	56
Peziza saniosa Schrad.: Fr.	pezsan	T	-	0	0	0	0	2	2
Phallus impudicus L.: Pers.	phaimp	L	-	0	5	14	0	4	23
Phellinus ferreus (Pers.) Bourd. & Galz.	phefer	L	-	0	0	0	0	3	3
Phellinus ferruginosus (Schrad.: Fr.) Pat.	phefeu	L	-	1	8	0	3	5	17
Phlebia livida (Pers.: Fr.) Bres.	phlliv	L	-	5	7	0	1	10	23
Phlebia radiata Fr.: Fr.	phlrad	L	-	18	12	37	15	24	106
Phlebia rufa (Pers.: Fr.) M.P.Christ.	phlruf	L	-	0	0	19	7	3	29
Phlebia tremellosa (Schrad.: Fr.) Burds. & Nakas.	phltre	L	-	4	4	31	24	12	75
Phleogena faginea (Fr.: Fr.) Link	phlfag	L	C	9	0	1	35	20	65
Pholiota aurivellus (Fr.) P.Kumm.	phoaur	L	-	0	3	8	1	5	17
Pholiota flammans (Batsch: Fr.) P.Kumm.	phofla	L	B	0	1	0	0	0	1
Pholiota gummosa (Lasch: Fr.) Singer	phogum	L	-	0	0	0	1	0	1
Pholiota lenta (Pers.: Fr.) Singer	pholen	L	-	0	0	0	0	2	2
Pholiota mutabilis (Scop.: Fr.) Kumm.	phomut	L	-	5	1	9	53	8	76
Pholiota squarrosa (Weigel: Fr.) P.Kumm.	phosqu	L	-	0	4	1	0	0	5
Pholiota squarrosoides (Peck) Sacc.	phosqo	L	B	7	0	0	0	0	7
Pholiota tuberculosa (Schaeff.: Fr.) P.Kumm.	photub	L	B	0	1	0	0	0	1
Phyllotopsis nidulans (Pers.: Fr.) Singer	phynid	L	B	8	1	0	0	0	9
Physisporinus vitreus (incl. P. sanguinolentus)	phyvit	L	-	5	0	23	94	39	161
Pleurotus cornucopiae Paul.: Fr.	plecor	L	C	0	0	0	0	1	1
Pleurotus dryinus (Pers.: Fr.) P.Kumm.	pledry	L	C	0	0	2	0	1	3
Pleurotus ostreatus (Jacq.: Fr.) P.Kumm.	pleost	L	-	2	5	28	13	7	55
Pleurotus pulmonarius (Fr.) Quél.	plepul	L	-	29	30	1	3	0	63
Plicaturopsis crispa (Pers.: Fr.) Reid	plicri	L	-	7	0	0	3	0	10
Pluteus cervinus (Batsch) Singer	plucer	L	-	12	46	72	101	73	304
Pluteus chrysophaeus (Schaeff.) Quél.	pluchr	L	-	16	7	9	0	0	32
Pluteus cyanopus Quél.	plucya	L	B	0	8	0	0	0	8
Pluteus exiguus (Pat.) Sacc.	pluexi	L	C	1	0	0	0	0	1
Pluteus hispidulus (Fr.: Fr.) Gillet	pluhis	L	-	4	0	4	34	2	44
Pluteus insidiosus Vellinga & Schreurs	pluins	L	-	1	0	0	25	0	26
Pluteus leoninus (Schaeff.: Fr.) P.Kumm.	pluleo	L	B	0	0	0	12	0	12
Pluteus luctuosus Boud.	pluluc	L	-	0	2	0	0	8	10
Pluteus nanus (Pers.: Fr.) P.Kumm.	plunan	L	-	1	28	0	27	1	57
Pluteus petasatus (Fr.) Gillet	plupet	L	B	0	2	0	0	0	2
Pluteus phlebophorus (Dittm.: Fr.) P.Kumm.	pluphl	L	-	10	11	5	31	21	78
Pluteus plautus (Weinm.) Gillet	plupla	L	B	2	2	3	14	9	30
Pluteus podospileus Sacc. & Cub.	plupod	L	-	6	4	1	48	5	64
Pluteus romellii (Britz.) Sacc.	plurom	L	-	6	0	0	0	4	10
Pluteus salicinus (Pers.: Fr.) P.Kumm.	plusal	L	-	0	7	4	10	12	33
Pluteus thomsonii (Berk. & Br.) Dennis	plutho	L	-	2	4	1	1	12	20

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Pluteus umbrosus (Fr.) P.Kumm.	pluumb	L	B	1	1	1	5	7	15
Polyporus arcularius Batsch.: Fr.	polarc	L	-	1	0	0	0	0	1
Polyporus badius (Pers.) Schw.	polbad	L	C	0	1	3	7	0	11
Polyporus brumalis (Pers.) Fr.: Fr.	polbru	L	-	11	1	4	1	4	21
Polyporus ciliatus Fr.: Fr.	polcil	L	-	3	0	0	0	0	3
Polyporus squamosus (Huds.: Fr.) Fr.	polsqu	L	-	7	8	0	1	1	17
Polyporus tuberaster (Pers.: Fr.) Fr.	poltub	L	C	0	1	1	0	1	3
Polyporus varius (Pers.) Fr.: Fr.	polvar	L	-	20	38	33	39	22	152
Postia caesia (Schrad.: Fr.) P. Karst.	poscae	L	-	2	0	0	0	0	2
Postia leucomallella (Murrill) Jülich	posleu	L	-	0	0	1	0	0	1
Postia stiptica (Pers.: Fr.) Jülich	possti	L	-	0	0	0	5	0	5
Postia subcaesia (David) Jülich	possub	L	-	1	10	20	3	7	41
Postia tephroleuca (Fr.: Fr.) Jülich	postep	L	-	1	6	32	16	0	55
Psathyrella artemisiae (Pass.) Konr. & Maubl.	psaart	T	-	0	0	4	0	1	5
Psathyrella candolleana (Fr.: Fr.) Maire	psacan	L	-	0	9	0	0	1	10
Psathyrella cernua (Vahl.: Fr.) Hirsch	psacer	L	-	0	0	0	0	1	1
Psathyrella cfr. murcida (Fr.) Kits	psamur	T	-	0	1	0	0	0	1
Psathyrella cfr. panaeoloides (Maire) Arnolds	psapaa	T	-	0	0	0	3	0	3
Psathyrella cotonea (Quél.) Konr. & Maubl.	psacot	L	-	0	0	1	6	0	7
Psathyrella fusca (Schum.) A.Pears.	psafus	T	-	0	3	2	2	0	7
Psathyrella laevissima (Romagn.) Sing.	psalae	L	-	0	0	0	2	0	2
Psathyrella lutensis (Romagn.) Bon	psalut	T	-	0	0	0	0	2	2
Psathyrella multicystidiata	psamul	L	B	0	0	0	3	0	3
Psathyrella obtusata (Pers.: Fr.) A.H.Smith	psaobt	L	-	0	0	0	0	2	2
Psathyrella pannuciodes (Lange) Moser	psapan	L	-	0	0	0	0	1	1
Psathyrella piluliformis (Bull.: Fr.) P.D.Orton	psapil	L	-	4	1	25	91	44	165
Psathyrella populina (Britz.) Kits.	psapop	L	A	0	2	0	0	0	2
Psathyrella pyrotricha (Holmskj. : Fr.) Moser	Psapyr	T	-	1	2	0	0	0	3
Psathyrella rostellata Örstadius	psaros	L	-	0	0	0	0	7	7
Psathyrella scobinacea (Fr.) Sing.	psamac	L	-	0	0	0	4	0	4
Pseudoclitocybe cyathiformis (Bull.: Fr.) Singer	psecya	L	B	14	7	0	3	24	48
Psilocybe horizontalis (Bul) Vellinga & Noordel.	psihor	L	C	0	0	3	6	0	9
Psilocybe inquilina (Fr.: Fr.) Bres. var. crobula	psiinq	T	-	0	5	0	0	0	5
Pycnoporellus fulgens (Fr.) Donk	pycful	L	A	1	0	0	0	0	1
Pycnoporus cinnabarinus (Jacq.: Fr.) P.Karst.	pyccin	L	C	2	1	6	0	2	11
Ramaria stricta (Pers.: Fr.) Quél.	ramstr	L	-	0	1	2	2	28	33
Resupinatus applicatus (Batsch: Fr.) Gray	resapp	L	-	2	1	0	0	2	5

SPECIES	CODE	ECOL.	SSI	S	H	N	B	D	TOTAL
Rhodocybe nitellina (Fr.) Sing.	rhonit	T	-	1	0	0	0	0	1
Rhodotus palmatus (Bull.: Fr.) Maire	rhopal	L	B	0	1	0	0	0	1
Rickenella fibula (Bull.: Fr.) Raith.	ricfib	B	-	10	1	18	131	34	194
Rickenella swartzii (Fr.: Fr.) Kuyper	ricswa	B	-	1	0	0	57	3	61
Ripartites tricholoma (Alb. & Schw.: Fr.) P.Karst.	riptri	T	-	1	7	0	0	2	10
Russula anthracina Romagn.	rusant	M	-	1	0	0	0	0	1
Russula cavipes Britz.	ruscav	M	-	4	0	0	0	0	4
Sphaerobolus stellatus Tode: Pers.	sphste	L	-	0	0	0	1	0	1
Spongipellis delectans (Peck) Murrill	spodel	L	A	0	5	0	0	0	5
Spongipellis pachyodon (Pers.) Kotlaba & Pouzar	spopac	L	A	0	7	0	0	0	7
Steccherinum bourdotii Saliba & David	stebou	L	-	0	0	1	0	0	1
Steccherinum fimbriatum (Pers.: Fr.) J.Erikss.	stefim	L	-	0	0	0	0	5	5
Steccherinum nitidum (Pers.: Fr.) Vesterh.	stenit	L	-	1	1	0	0	1	3
Steccherinum ochraceum (Pers.: Fr..) Gray	steoch	L	-	8	17	0	1	12	38
Stereum hirsutum (incl. S. ochraceoflavum)	stehir	L	-	40	74	59	37	48	258
Stereum rugosum (Pers.: Fr.) Fr.	sterug	L	-	0	0	41	10	36	87
Stereum sanguinolentum (Alb. & Schwein.: Fr.) Fr.	stesan	L	-	1	0	0	0	0	1
Stereum subtomentosum Pouz.	stesub	L	-	1	4	53	37	9	104
Stigmatolemma urceolata (Wallr.: Fr.) Donk	stiurc	L	-	1	0	0	0	0	1
Stropharia aeruginosa (Curt.: Fr.) Quél.	straer	T	-	0	0	0	0	1	1
Stropharia aurantiaca (Cooke) P. D. Orton	straur	L	-	0	1	0	0	0	1
Stropharia cyanea (Bull.) Tuomikoski	strcya	T	-	1	6	0	0	0	7
Tarzetta spurcata (Pers.) Harmaja	tarspu	T	-	1	0	0	0	0	1
Trametes cervina (Schwein.) Bres.	tracer	L	C	0	5	0	0	0	5
Trametes gibbosa (Pers.: Fr.) Fr.	tragib	L	-	21	25	66	43	6	161
Trametes hirsuta (Wulfen: Fr.) Pilat	trahir	L	-	21	19	4	6	13	63
Trametes pubescens (Schumach.: Fr.) Pilát	trapub	L	-	1	0	0	0	0	1
Trametes versicolor (L.: Fr.) Quel.	traver	L	-	45	19	67	77	20	228
Tremella foliacea Pers.	trefol	L	-	0	0	0	1	5	6
Tremella mesenterica Retz: Fr.	tremes	L	-	3	1	0	0	10	14
Trichaptum abietinum (Pers.: Fr.) Ryvarden	triabi	L	-	0	0	3	0	0	3
Trichaptum pergamenum (Fr.) G. Cunn.	triper	L	C	6	0	0	0	0	6
Tricholoma atrosquamosum (Chev.) Sacc.	triatr	M	-	1	0	0	0	0	1
Tricholoma lascivum (Fr.) Gillet	trilas	M	-	0	0	0	0	3	3
Tricholoma stiparophyllum (Lund.) Karst.	tristi	M	-	0	2	0	0	0	2
Tricholoma ustale (Fr.: Fr.) P.Kumm.	triust	M	-	0	0	0	0	1	1
Tubaria conspersa (Pers.: Fr.) Fayod	tubcon	L	-	0	0	0	4	0	4
Tubaria furfuracea (Pers.: Fr.) Gillet	tubfur	T	-	0	2	0	2	1	5
Tyromyces chioneus (Fr.: Fr.) P.Karst.	tyrchi	L	-	1	0	6	0	17	24
Ustulina deusta (Hoffm.: Fr.) Lind	ustdeu	L	-	33	118	61	124	96	432
Volvariella bombycina (Schaeff.: Fr.) Singer	volbom	L	C	0	0	0	0	1	1
Xerula melanotricha Dörfelt	xermel	L	C	1	0	0	0	0	1
Xerula radicata (Relhan: Fr.) Dörfelt	xerrad	L	-	11	35	0	10	9	65
Xylaria hypoxylon (L.: Fr.) Grev.	xylhyp	L	-	40	40	92	126	140	438
Xylaria longipes Nitschke	xyllon	L	-	1	2	1	0	2	6
Xylaria polymorpha (Pers.: Fr.) Grev.	xylpol	L	-	20	18	8	36	15	97
Xylobolus frustulatus (Pers.: Fr.) Boidin	xylfru	L	A	1	0	0	0	0	1