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Patterns of diversity in boreal mire margin vegetation

Boreaalisen reunavaikutteisen suokasvillisuuden monimuotoisuuden analyysia

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Mire margin communities are mosaics of forest and mire vegetation which consist of several ecological guilds (forest, spruce mire, marsh and spring vegetation). Diversity patterns of undrained forested mire margin communities were examined by using numerical classification (TWINSPAN) and ordination (DCA) techniques. The understorey vegetation was tested for both alfa (species richness, Shannon H' and Pielou J diversity indices) and beta diversity (DCA dimensions). The structural diversity of the overstorey was examined by producing structural (TWINSPAN) clusters based on the percentage cover of tree and shrub species in six canopy layers and in one shrub layer. The study was based on the systematic sample plot data collected from permanent plots of the 8th Finnish National Forest Inventory (1985–86). The material consisted of 92 plots of undrained forested mire margin sites in south and central Finland (60°–66°N). The alfa diversities between the seven site clusters differed more clearly than those between the site types. A considerable variety of species of different ecological guilds were found that represented the ecological sources of high beta diversity. Structural diversity varied between clusters formed from overstorey data.

Key words: boreal forest, peatland, structural diversity, vegetation diversity,

INTRODUCTION

The vegetation gradient between mire margin and mire expanse communities is important in the ecology and classification of boreal mires in Finland (Heikurainen & Pakarinen 1982, Ruuhijärvi 1983). The position of plant species and vegetation site types along this gradient has been studied in several investigations (e.g.Tuomikoski 1942, Sjörs 1948, Pakarinen 1982, Reinikainen et al. 1984, Eurola & Holappa 1985, Malmer 1985, Hotanen 1989, Hotanen & Nousiainen 1990, Jeglum 1991). In Finland 422 plant taxa (415 species), including vascular plants, *Bryidae*, *Sphagnum* mosses and ground lichens occur frequently on mire sites (Eurola et al. 1994). About 70% of these species favour mire margin influenced sites (Fig. 1), which have thin peat layer (Ilvessalo 1956, Ruuhijärvi 1960, Eurola 1962) and receive supplementary input of mineral nutrients from surrounding mineral soil (Heikurainen 1954, Eurola & Holappa 1985). This group can be divided into two main components, namely forest species and wetland species. In the latter group the

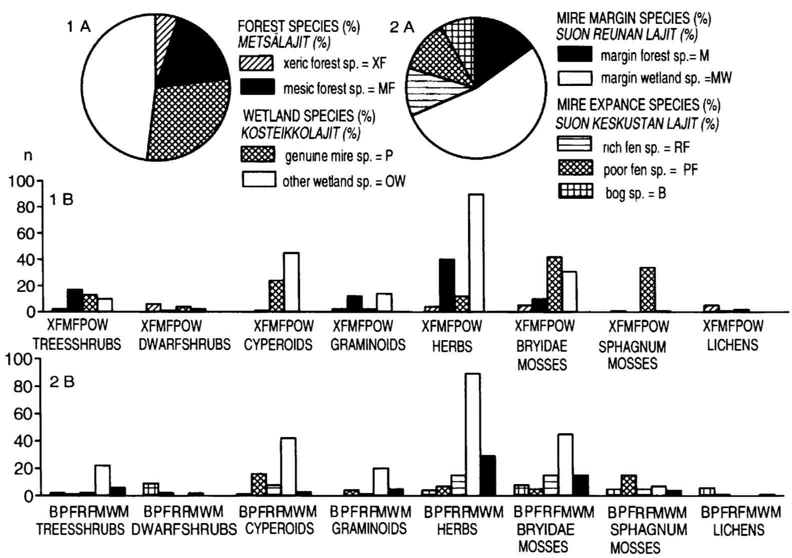

Fig. 1. Distribution of the Finnish mire flora (422 taxa) between different ecological guilds (1A, 1B) and the number of species of the ecological guilds in different life forms (2A, 2B). Drawn according to Eurola et al. (1994).

Kuva 1. Suomen suokasvilajiston (422 taksonia) jakautuminen ekologisiin ryhmiin (1A, 2A) ja ekologisten ryhmien lajimäärät elomuodoittain (1B, 2B). 1 A) Metsälajit: kuivien = XF ja tuoreiden = MF kankaiden lajit, Kosteikkojen lajit: aidot suolajit = P ja muut kosteikkolajit = OW. 2A) Reunavaikutteiset lajit: metsä- = M ja kosteikkolajit = MW. Keskustavaikutteiset lajit: meso-eutrofiset nevalajit = RF, oligotrofiset nevalajit = PF ja rämelajit = B. Piirretty Eurolan ym. (1994) mukaan.

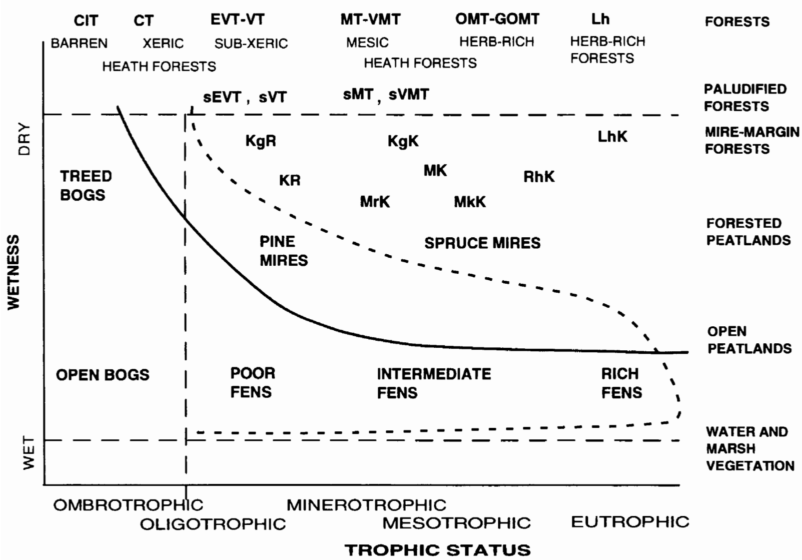

Fig. 2. An idealized two-dimensional ordination of boreal forest and wetland sites with location of the studied types. Site types with Finnish symbols (see Table 1 and Appendix 2). Dotted line = border between mire margin and mire expanse influenced site types. Solid line = border between types suitable and not suitable for forest drainage.

Kuva 2. Idealisoitu kaksisuuntainen ordinaatio Suomen metsä- ja suotyyppien esiintymisestä trofian ja vesitalouden mukaan. Katkoviivakäyrä = raja reuna- ja keskustavaikutteisten tyyppien välillä, yhtenäinen käyrä = raja metsäojituskelpoisten ja -kelvottomien suotyyppien välillä.

species other than genuine mire plants (= plants which grow on peat) are more frequent. The majority of genuine mire plants seem to prefer mire expanse influenced bog and fen sites (Fig. 1).

With respect to diversity, site types situated on the border zones of different ecological influences are of special interest (Fig. 2). It can be assumed that due to the ecological multi-source origin of the flora and to the location of the sites on topographic gradients (e.g. Lumiala 1937) the mire margin communities could show high species richness. In order to test that simple hypothesis the species and structural diversity on sites typically situated on the transition zone between forest and mire was examined.

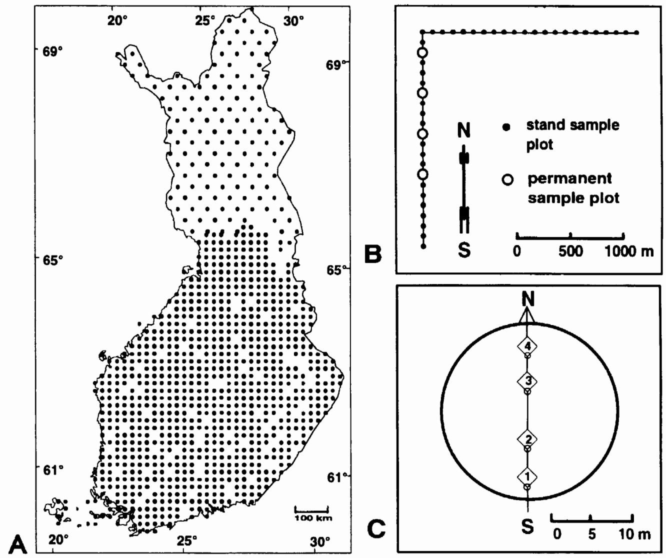

Fig. 3. Sampling frame-work. A) = tracts of the National Forest Inventory with permanent sample plots, B) = a sample tract with four permanent sample plots, C) = a sample plot with four 2 m^2 vegetation sample squares.

Kuva 3. A) = Valtakunnan metsien inventoinnin pysyvien koealojen lohkot, B) = inventoinnin lohko, jolla neljä pysyvää koealaa, C) = pysyvä koeala, jolla neljä 2 m^2 kasvillisuusruutua.

MATERIAL AND METHODS

The vegetation data of this study were derived from permanent sample plots of the 8th National Forest Inventory (NFI) 1985–86 (Reinikainen & Nousiainen 1985, Reinikainen 1990) (Fig. 3). Sample plots were chosen according to the following criteria: (1) appropriate site type inside the categories paludified forests (= paludified mineral soil forests), mire margin forests and forested pine and spruce mires, (2) plot homogenous for the type; (3) at least four vegetation sample squares on the plot; (4) site not drained; (5) tree stand untreated at least for two years before inventory. Altogether, 92 plots fulfilling these criteria were found (Table 1, Figs. 2 and 4).

The field data were collected by 12 biologists of the NFI crews during late may-september 1985–86. The field and bottom layer vegetation was recorded by estimating the percentage cover of species on four 2 m^2 sample squares on each plot. The overstorey cover of tree and shrub species was estimated on the whole 300 m^2 sample plot (Fig. 3).

In the data processing the basic variables were mean cover percentage values for the field and bottom layer species and the cover percentages of tree species in six vertical canopy layers (according to the instructions of NFI, see e.g. Yli-Kojola 1995) and tree and shrub species in one shrub layer for the overstorey species. The data were analyzed with TWINSPAN classification (Hill 1979) by default options and with DCA ordination by using CANOCO program with detrending by segments and downweighting of rare species (ter Braak 1987). Average species richness, diversity indices (Shannon H', Shannon & Weaver 1949) and evenness indices (Pielou J, Pielou 1966) were calculated. The species were arranged into ecological guilds according to Eurola et al. (1994).

The site types and their Finnish symbols are according to Kalela (1961) for paludified forests and according to Heikurainen & Pakarinen (1982) for mires (Fig. 2, Table 1, Appendix 2). The nomenclature follows Hämet-Ahti et al. (1986) for vascular plants, Koponen et al. (1977) for bryophytes and Santesson (1993) for lichens.

RESULTS

The species diversity of understorey communities

In TWINSPAN analysis a group of six sample plots was first separated to form cluster G. From the rest 86 sample plots clusters A–F were generated on the second and third levels of division (Fig. 5). The size of TWINSPAN clusters and their parity with site types are presented in Table 1.

The species richness did not vary much between site types. Only the most fertile site type LhK (eutrophic paludified hardwood-spruce forest) showed higher species number than the other site types. The site type variation had a nearly significant effect on the H' and the J values but the cluster division had much clearer effect on species richness and the J value (Table 1). The variation of H' values between clusters was smaller than between site types. There were correlations of H' (r = 0.46) and J (r = –0.89*) for the species number in clusters (n = 7) but not in site types (n =13, r = 0.30 and r = –0.01).

Composition of gradient diversity

Long axes (1st axis 7.7 and 2nd axis 9.7 S.D.-units) of species ordination (Fig. 6) and sample plot ordination (1st axis 4.2 and 2nd axis 3.2 S.D.-units) (Fig. 7) displayed the dissimilarity of the ecological origin in the floristic composition. From a potential species number of about 200 for the sites and study area (according to the list of Eurola et al. 1994) a total of 135 species was found of which 88 had a frequency of > 2 /92. In the two-dimensional species ordination (Fig. 6) islets

Table 1. Distribution of studied paludified forest (1., according to Kalela 1961), mire margin forest and forested pine and spruce mire site types (2. and 3., according to Heikurainen & Pakarinen 1982) within TWINSPAN vegetation clusters. The mean species richness, Shannon (H') diversity and Pielou (J) evenness indices for types and clusters are presented. All 135 species of 92 plots are included (cf. Fig. 6). The full English site type names for the Finnish site type symbols are presented in Appendix 2.

Taulukko 1. Aineiston soistuneiden kangasmetsätyyppien (1., Kalelan 1961 mukaan) ja metsäisten, reunavaikutteisten suotyyppien (2. ja 3., Heikuraisen & Pakarisen 1982 mukaan) esiintyminen TWINSPAN-kasvillisuusryhmissä. Keskimääräiset lajimäärät, Shannon diversiteetti- (H') ja Pieloun (J) tasaisuusindeksit on ilmaistu tyypeittäin ja ryhmittäin (indeksit on laskettu 135 lajia/92koealaa mukaan).

Site types	Trophic status	TWINSPAN clusters A	B	C	D	E	F	G	n	Species n (mean)	H' (mean)	J (mean)
1. sEVT	oligo	1	2	6					9	18.4	2.09	0.74
1. sVT	oligo	3	1	1	3				8	21.8	1.90	0.62
1. sVMT	oligo-meso		3	9	2	2			16	17.9	1.87	0.66
1. sMT	oligo-meso				3	3	5		11	18.7	1.73	0.60
1. sDeMT	oligo-meso				1		1		2	21.5	2.23	0.73
2. KgR	oligo	1	5	3					9	17.6	1.93	0.68
2. KgK	oligo-meso				2	5	3	1	11	17.8	1.83	0.64
2. LhK	eutrophic							2	2	33.0	2.59	0.74
3. MrK	(oligo)-meso		1						1	22.0	2.08	0.67
3. KR	oligo-(meso)		5	2	1				8	18.7	1.88	0.65
3. MK	oligo-meso			1	1	4	3		9	19.1	1.85	0.63
3. MkK	oligo-meso						3	2	5	21.4	1.52	0.50
3. RhK	meso-eu							1	1	20.0	1.61	0.54
Sample plots n		5	17	22	13	14	15	6	92	F=1.63	F=2.15*	F=2.37*
Species n (mean)		25.2	18.7	18.3	19.2	15.3	19.9	26.8		F=5.43***		
Shannon H' (mean)		2.03	1.91	1.95	1.90	1.87	1.67	2.00		F=1.32		
Pielou J (mean)		0.63	0.66	0.68	0.65	0.69	0.56	0.60		F=3.11**		

corresponding to different ecological guilds could be distinguished. Mire margin species seem to associate with fertile forest species and mire expanse species with xeric forest species. As the mire margin species occur sporadically they only slightly increase the average species richness per site or plot. The vector of increasing species number was not parallel with any of the ordination axes and increased slightly towards the mesic forest and herb-rich spruce mire sites. The evenness of communities (according to H' and J) seemed to increase along the 1st axis towards the bog and xeric forest vegetation communities (Fig. 7).

Overstorey diversity

For the structural TWINSPAN classification from the actual 16 tree and shrub species, occurring in six canopy layers and in one shrub layer, a total of 91 'layer species' was generated. On the third division level TWINSPAN produced six structurally different clusters when one outlier plot was eliminated on the second division level (Fig. 8).

There emerged clear differences between the clusters in species composition, canopy structure and species distribution. The first division between clusters 1–2 and 3–6 was determined by dominant species of the stand (spruce/pine), regularity of canopy structure (regular/more irregular), and species number (13 woody species against 9–11 species). Among the final clusters cl 1 was spruce-dominated and rich in species, cl 2 differed from cl 1 only by the dominance of pine in upper canopy, cl 3 and 4 were pine-dominated but having different distribution of species into layers, cl 5 was the only with birch (*Betula pubescens*) dominated upper canopy and cl 6 was characterized by purest pine dominance and lowest tree species number.

The parity between the described structural clusters and site types or vegetational clusters was rather poor. The majority of mesic forest types and mesotrophic mire types and the corresponding vegetation clusters D, E, F and G belonged to the structural clusters cl 1 and cl 2. Respectively, the bulk of xeric forest types and oligotrophic mire types fell into structural clusters cl 4 and cl 6.

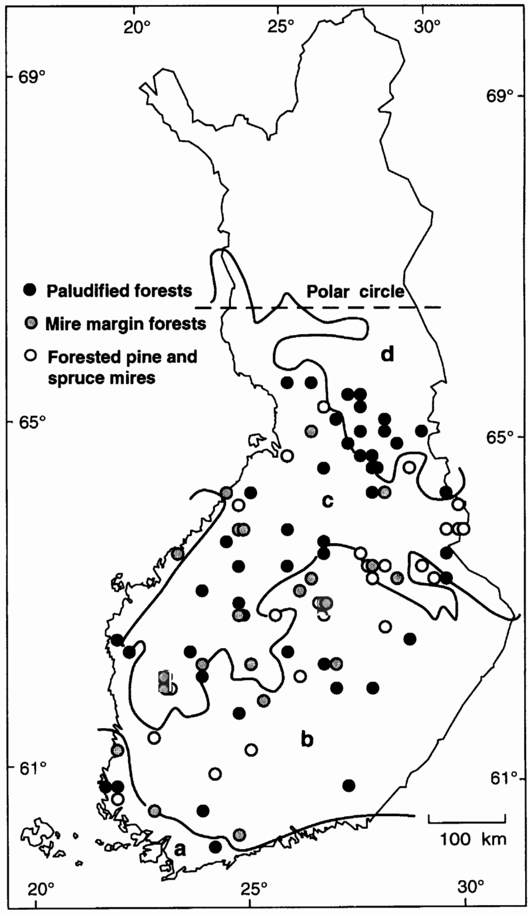

Fig. 4. Distribution of sample plots within a = hemiboreal, b = southern boreal, c = middle boreal and d = northern boreal subzones. The boreal subzones are drawn according to Ahti et al. (1968).

Kuva 4. Koealojen esiintyminen a = hemi-, b = etelä-, c = keski- ja d = pohjoisboreaalisella kasvillisuusvyöhykkeellä. Kasvillisuusvyöhykkeet Ahti ym. (1968) mukaan.

DISCUSSION AND CONCLUSIONS

As far as we know rather few studies among the extensive literature on vegetation of boreal mires and forests have particularly concentrated on the diversity of communities (e. g. Helliwell 1978, Kuusipalo 1984, Vasander 1984, Oksanen 1986, Vasander 1987a,b, Tonteri et al. 1990, Økland 1990, Tonteri 1994, Vasander et al. 1996). Site

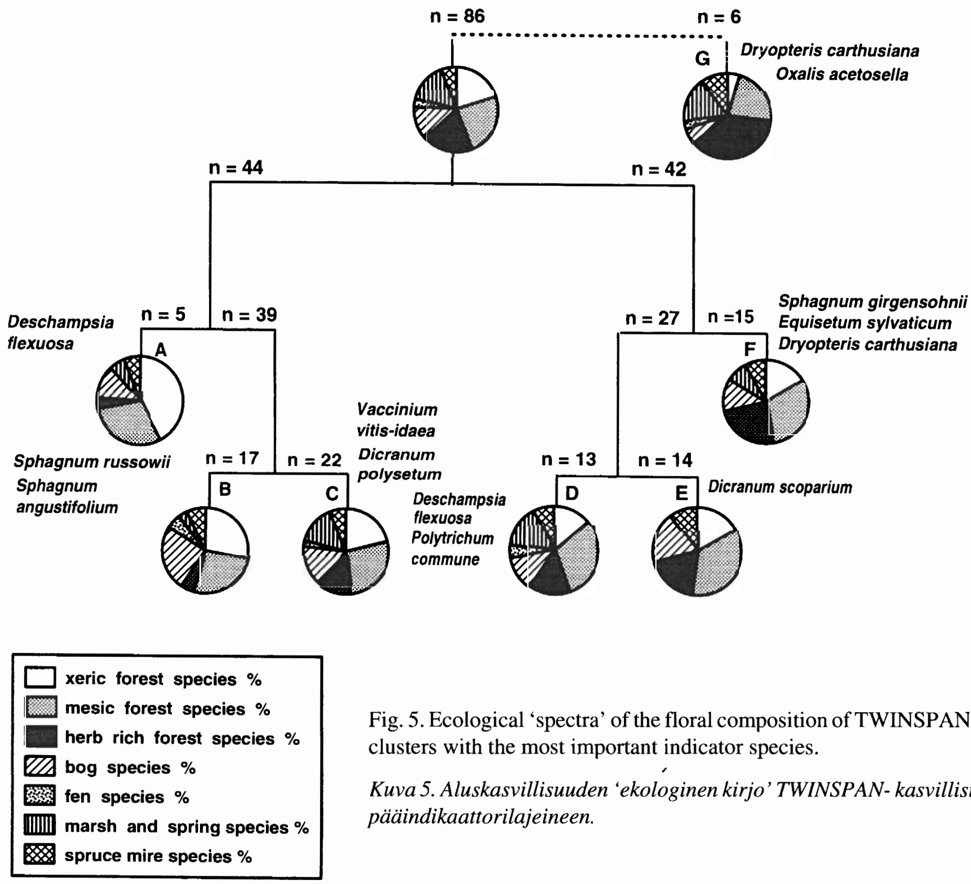

Fig. 5. Ecological 'spectra' of the floral composition of TWINSPAN understorey clusters with the most important indicator species.

Kuva 5. Aluskasvillisuuden 'ekologinen kirjo' TWINSPAN- kasvillisuusryhmissä pääindikaattorilajeineen.

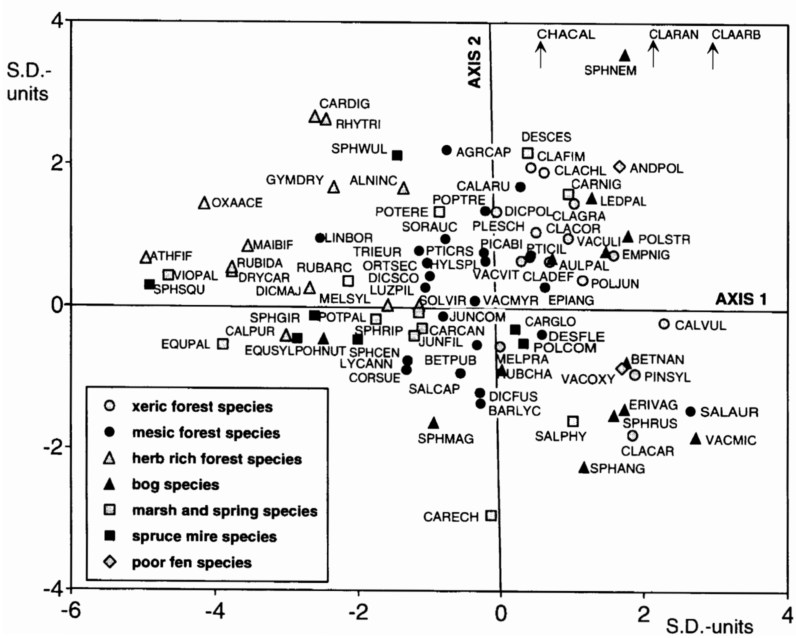

Fig. 6. DCA ordination for the understorey species with more than two occurrences (88 species). For full species names in each ecological guild, see Appendix 1.

Kuva 6. DCA-ordinaatio aluskasvillisuuden lajeille, jotka esiintyvät useammalla kuin kahdella koealalla (88 lajia). Lajinimet ja ekologinen ryhmittely on esitetty Liitteessä 1.

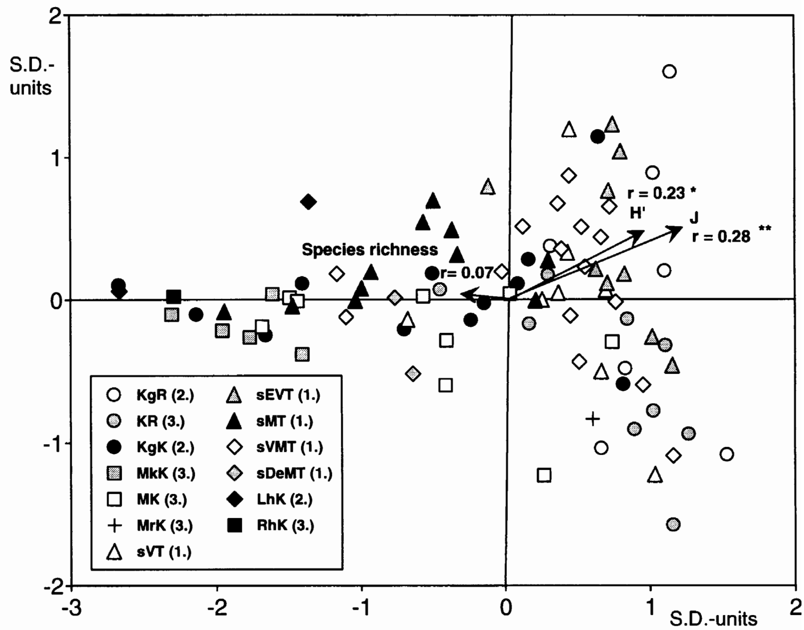

Fig. 7. Sample plot DCA ordination. The vectors of passive variables: species richness, H' and J indices with their correlations against DCA axis 1. For full English site type names see Appendix 2.

Fig. 7. Koealojen DCA ordinaatio. Nuolet kuvaavat passiivisia ympäristömuuttujia, lajimäärää, H'-ja J-indeksiä, ja niiden korrelaatioita DCA 1 akseliin.

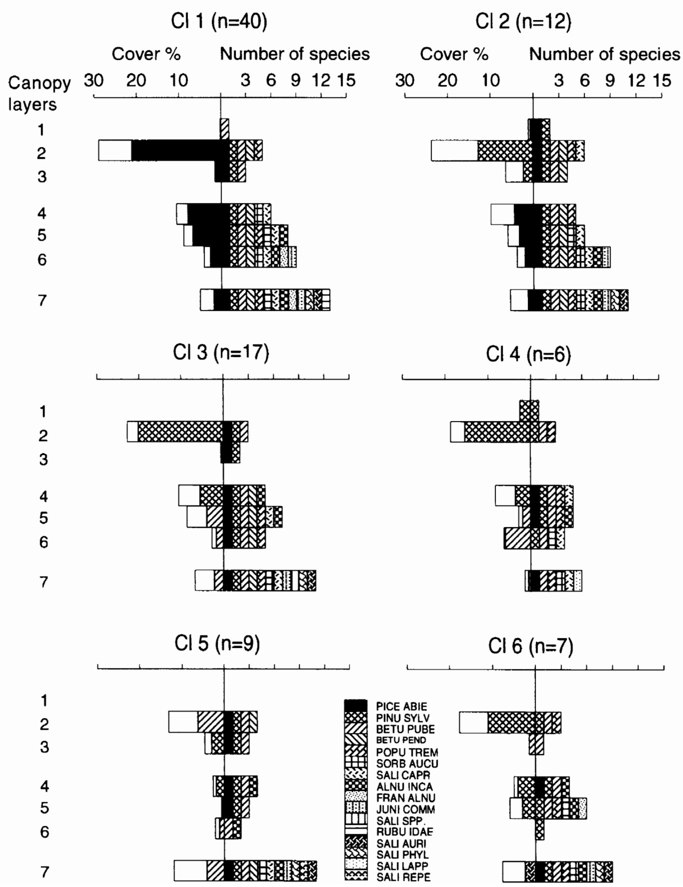

Fig. 8. The overstorey structure in TWINSPAN clusters obtained from the 'layer species' matrix. For each cluster the left side of the diagram presents the total cover (white) of the canopy layer and the cover of the dominant species (shaded) and the right side of the diagram describes the number and the names of the species on each layer.

Kuva 8. 'Latvuskerroslajeista' TWINSPAN-luokittelulla saadut rakenteelliset ryhmät. Vasemman puolen pylväät kuvaavat puu- tai pensaslajin kokonaispeittävyyttä (valkoinen alue) ja vallitsevan lajin osuutta (varjostettu) ja oikean puolen pylväät kuvaavat lajimäärää ja lajeja latvuskerroksittain.

classification, for instance, commonly operates with species numbers and distribution but rarely uses these criteria in the determination of site types. Only the extreme types (by trophic status) of boreal forests and mires are described to be especially rich or poor in species (e.g. Kalliola 1973). In the present analysis the parameters of diversity seemed to be significant characteristics of numerical vegetation clusters.

Although there were no mire margin site types or clusters displaying higher species number than the forest sites of corresponding fertility (see e.g. Tonteri 1994) the species assortment seemed to be more versatile (Figs. 5 and 6). The assumed sources of species diversity were found in the analysis of the understorey communities. The effect of mire margin factors (spruce mire, marsh and spring factors) (Eurola et al. 1984) seemed to be relatively weak. Most of the abundant species belonged to either forest or bog guilds. From a 'potential' of ca. 200 species (Eurola et al. 1994) for the studied site types about 2/3 were found. Most species of mire margin guilds seem to be rather rare on these sites. Consequently, the diversity value of these habitats is more on the community than on the species level.

Beta diversity of understorey as measured by gradient lengths seemed to be higher in the sites in this study than in forests in general (cf. Tonteri et al. 1990) despite the fact that in our data the variation caused by site fertility and stand age (age succession) was reduced when compared to the main sources of beta diversity described by Tonteri et al. (1990) and Tonteri (1994). This difference was due both to the occurrence of wetland mire margin guilds and bog and fen guilds in our data.

A new approach for describing and analysing the layer structure of forest communities was introduced (cf. Lindholm & Tuominen 1989). We succeeded in separating interpretable groups, 'structural types' which should be later ecologically explained. More in general, the importance of mire margin forests for biotope and landscape diversity should be further analyzed by comparing their structure to other forested communities using different approaches (e.g. Lähde et al. 1991, Kuuluvainen, T., Penttinen, A., Leinonen, K. & Nygren, M. 1996, unpublished data). Our hypothesis for further studies is that stands growing on undrained wetland sites are under slight silvicultural treatment and thus relatively pristine, so they probably increase the diversity of local forest habitats.

Mire margin forest communities seem to conserve different components of diversity rather efficiently (see e.g. Ruuhijärvi 1983, Eurola & Holappa 1985). On the basis on this systematic but too small sample it remains unclear what is the ability of these biotopes to conserve species and mire type rareness and maintain threatened species. Having been popular and successful objects of forest drainage the remnants of these biotopes which represent less than 20% of the undrained wetland area in Finland (according to the permanent sample plot data of 8th National Forest Inventory 1985–86), now deserve at least management of diversity.

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TIIVISTELMÄ:

Boreaalisen reunavaikutteisen metsä- ja suokasvillisuuden monimuotoisuuden analyysia

Eurolan ym. (1994) luetteloimasta Suomessa soilla kasvavasta lajistosta (maksasammalet poisluettuna) n. 70% on kasvupaikan reunavaikutteisuutta suosivia. Tämä lajisto voidaan jakaa ekologian perusteella kahteen pääryhmään: mineraalimaan metsien kasveihin ja reunavesi- ja lisäravinnevaikutuksesta riippuvaisiin kosteikkokasveihin. Ehdottomat suokasvit näyttävät suosivan keskustavaikutteisuutta ja niitä on reunafloorassa niukasti (Kuva 1).

Esitetään oletus, että metsäisten reunavaikutteisten kasvupaikkojen lajistollinen ja rakenteellinen monimuotoisuus voi olla merkittävä. Oletusta testataan VMI:n pysyvien koealojen systemaattisesta koealaverkosta erotetun otoksen avulla (Kuva 3).

Otokseen kelpuutettiin 92 koealaa, jotka täyttivät seuraavat kriteerit: (1) metsä- ja suotyyppi (Taulukko1), (2) koeala oli tyypin suhteen homogeeninen, (3) koealalla oli vähintään neljä kasvillisuusnäyteruutua (Kuva 3), (4) koealakuvio oli ojittamaton, (5) kuviolla ei esiintynyt tuoreita harvennushakkuita (1–2 v.).

Kasvillisuusaineisto (lajien keskipeittävyydet koealalla) ja rakenneaineisto (puuston latvuskerrosten ja pensaskerroksen latvuspeittävyydet koealalla) käsiteltiin luokittelu- (TWINSPAN) ja ordinaatio- (DCA, CANOCO) menetelmin. Lisäksi operoitiin koealojen lajirunsauksilla ja Shannon diversiteetti-indekseillä (H') ja Pieloun tasaisuus-indeksillä (J).

Tutkittujen soistuneiden kankaiden ja metsäisten reunavaikutteisten suotyyppien alfadiversiteetti (inventaariodiversiteetti) oli lajimäärän, H'-indeksin ja J-indeksin perusteella samaa luokkaa kuin vastaavan viljavuustason kangasmetsissä, mutta lajivalikoima oli laajempi. Vain rehevimmät tyypit erottuivat muita lajirikkaampina. Kasvillisuusklusterit erottuivat selvästi lajimäärän ja J-indeksin perusteella. H'-indeksin vaihtelu klustereiden välillä oli vähäisempää kuin tyyppien välillä.

N. 200 lajiksi arvioidusta tutkittujen tyyppien potentiaalisesta kokonaislajimäärästä aineistoon sattui 135 lajia. DCA-ordinaatiot lajeille ja koealoille (Kuvat 6 ja 7) osoittivat korkeata betadiversiteettiä tutkitussa osassa ekologista vaihteluavaruutta (Kuva 2). Lajiordinaatio (Kuva 6) paljasti myös odotetusti monimuotoisuuden ekologiset lähteet: metsälajistoytimeen liittyvät yhtäällä hydrologista lisäravinnevaikutusta vaativat lajit ja toisaalla keskustavaikutteista rämeisyyttä ilmaisevat lajit. Lajimäärän vaihtelu ei korreloinut kumpaankaan vahvimmista ordinaatioakseleista. Yhteisöjen tasaisuus (H'- ja J-indeksi) kasvoi lähes 1. akselin suunnassa karuuden ja rämeisyyden lisääntyessä (Kuva 7).

Puiden ja pensaiden nk. kerroslajeilla suoritettu TWINSPAN-luokitus antoi lupaavan tuloksen. Muodostui luokkia, jotka pohjautuivat eroihin lajimäärässä, latvuskerrosjakaumassa ja lajien suhteessa siihen.

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Appendix 1. List of understorey species in each ecological guild. The numbers indicate the order in which they occur on the first DCA axis (according to the species scores) from left to right (see Fig. 6).

Liite 1. Aluskasvillisuuden ekologisten ryhmien lajilista. Numero ilmoittaa missä järjestyksessä laji esiintyy ensimmäisellä DCA-akselilla (pistearvon mukaan) vasemmalta oikealle (ks. Kuva 6).

Species

Xeric forest species

49 Melampyrum pratense
53 Vaccinium vitis-idaea
57 Cladonia fimbriata
59 Pleurozium schreberi
61 Cladonia chlorophaea
63 Cladonia deformis
65 Cladonia cornuta
68 Cladonia gracilis
69 Polytrichum juniperinum
73 Empetrum nigrum
82 Cladonia rangiferina
83 Cladonia cariosa
84 Pinus sylvestris
85 Cladonia arbuscula
86 Calluna vulgaris

Mesic forest species

14 Linnea borealis
24 Cornus suecica
25 Lycopodium annotinum
28 Trientalis europea
31 Luzula pilosa
32 Orthilia secunda
33 Dicranum scoparium
36 Juniperus communis
37 Sorbus aucuparia
38 Agrostis capillaris
39 Salix caprea
40 Vaccinium myrtillus
41 Betula pubescens
42 Dicranum fuscescens
43 Barbilophozia lycopodioides
44 Ptilium crista-castrensis
45 Populus tremula
46 Hylocomium splendens
52 Calamagrostis arundinacea
56 Picea abies
58 Ptilidium ciliare
60 Deschampsia flexuosa
62 Epilobium angustifolium
87 Salix aurita

Herb rich species

1 Athyrium filix-femina
4 Oxalis acetosella
7 Rubus idaeus
6 Dryopteris carthusiana
8 Maianthemum bifolium
11 Dicranum majus
13 Carex digitata
16 Rhytidiadelphus triquetrus
17 Gymnocarpium dryopteris
21 Melampyrum sylvaticum
23 Alnus incana
29 Solidago virgaurea

Bog species

15 Pohlia nutans
34 Sphagnum magellanicum
50 Rubus chamaemorus
64 Aulacomnium palustre
70 Sphagnum angustifolium
71 Ledum palustre
72 Vaccinium uliginosum
74 Sphagnum russowii
75 Chamaedaphne calyculata
78 Sphagnum nemoreum
79 Eriophorum vaginatum
80 Betula nana
81 Polytrichum strictum
88 Vaccinium microcarpum

Marsh and spring water species

3 Viola palustris
5 Equisetum palustre
9 Calamagrostis purpurea
18 Rubus arcticus
20 Potentilla palustris
26 Juncus filiformis
27 Sphagnum riparium
30 Carex canescens
35 Potentilla erecta
47 Carex echinata
55 Deschampsia cespitosa
66 Carex nigra
67 Salix phylicifolia

Spruce mire species

2 Sphagnum squarrosum
10 Equisetum sylvaticum
12 Sphagnum girgensohnii
19 Sphagnum centrale
22 Sphagnum wulfianum
51 Carex globularis
54 Polytrichum commune

Poor fen species

76 Andromeda polifolia
77 Vaccinium oxycoccus

Appendix 2. The Finnish site type symbols of paludified forests (1., Kalela 1961), mire margin forests and forested pine and spruce mires (2. and 3., Heikurainen & Pakarinen 1982) and their English names.

Liite 2. Soistuneiden kangasmetsätyyppien (1, Kalela 1961) ja metsäisten, reunavaikutteisten suotyyppien (2. ja 3., Heikurainen & Pakarinen 1982) suomalaisten tyyppilyhenteiden vastaavat englanninkieliset nimet

1. Paludified forest site types	
sEVT	Paludified Empetrum Vaccinium - type
sVT	Paludified Vaccinium - type
sVMT	Paludified Vaccinium Myrtillus - type
sMT	Paludified Myrtillus - type
sDeMT	Paludified Deschampsia Myrtillus - type
2. Mire margin forest site types	
KgR	Paludified pine forest
KgK	Paludified spruce forest
LhK	Eutrophic paludified hardwood-spruce forest
3. Pine and spruce mire site types	
MrK	Rubus chamaemorus spruce swamp
KR	Spruce-pine swamp
MK	Vaccinium myrtillus spruce swamp
MkK	Equisetum sylvaticum spruce swamp
RhK	Herbrich hardwood-spruce swamp