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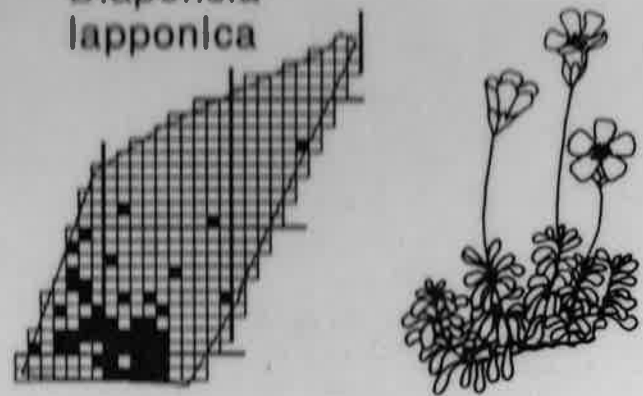
Diapensia lapponica



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Cover: *Diapensia lapponica* (drawn by Saini Heino)

The vascular plants of the Kevo Nature Reserve (Finland); an ecological-environmental approach

Risto K. Heikkinen and Risto J. Kalliola

Department of Botany, University of Turku, SF-20500 TURKU 50, FINLAND

The study area (original Kevo Nature Reserve, area 363 sq. km, extension in 1982 excluded) is located in Utsjoki, northernmost Finland. On the basis of floristic mapping lists made from the entire 363 sq. km, a complete list and distribution maps of the vascular plants - 313 species or subspecies altogether - is given, together with information on abundance and main habitat, and some morphological-ecological characteristics (e.g. leaf longevity, life form, pollination and diaspore type, tendency to vegetative expansion). The relative proportions of species showing different ecological characteristics were calculated for each square kilometre, and the distribution compared with several environmental factors. Correlation analyses between changes in average values in the study area and changes in the environmental factors and cover of some vegetation type groups revealed several ecological-environmental relationships, although clear potential misinterpretation was acknowledged. The number of species in one sq. km and the variation throughout the reserve were also calculated and tested with the changes in environmental-vegetational factors.

Keywords: distribution groups, floristic mapping, Inari Lapland, plant autecology, subarctic vegetation

1. Introduction

The Kevo Nature Reserve is located in Utsjoki commune, in the NW part of Inari Lapland, northernmost Finland (Fig. 1). It lies in the subarctic zone north of the (present) northern limit of the continuous pine forests (Hustich 1960, 1966, Kallio et al. 1969), or in the orohemiarctic zone according to Ahti et al. (1968). The vegetation of the reserve is characterized by large subalpine mountain birch (*Betula pubescens* subsp. *tortuosa)* forests, shallow-peated mires and gently sloping fells with alpine heaths (Kalela 1958, Ruuhijärvi 1960, Hämet-Ahti 1963). A detailed description of the main vegetation types (28 altogether), as well as a general introduction to the area is given by Heikkinen & Kalliola (1989, see also Kallio et al. 1969, Laine 1970 and Seppälä & Rastas 1980).

Damaged and undamaged (damage refers to the results of birch defoliation by *Epirrita autumnata* larvae in 1964-65, see Kallio & Lehtonen 1975) xeric and mesic birch forest (sELiT, sELiPIT, sEMT) are the prevailing vegetation types in most areas below 400 m a.s.l. (see Fig. 3 in Heikkinen & Kalliola 1989: 9). Damaged birch forests cover about 44 % of the study area, and in most of these sites, birch recovery is so weak that the vegetation will gradually turn into alpine heaths. Moister forest types (mountain birch forest of low herb type, meadow forest) and wooded mire types (herb and grass birch mire, birch mire with rich fen features), usually rich in species, only occur as small stands along rivers and larger brooks or in fairly deep valleys and gorges. Mires cover about 12 % of the reserve, and they mostly occur between 200-350 m a.s.l. Areas above 400 m a.s.l. are characterized by alpine heaths.

This paper presents a complete list and distribution maps of the vascular plant species found in the reserve (extension in 1982 excluded) up to 1984. This information is based on comprehensive species lists made for the whole area of 363 square kilometers (Grid 27° E: 7708-35:473-99, see Heikinheimo & Raatikainen 1981). The information was collected for the project "Vascular flora of Inari Lapland", and the first five flora volumes have been published (Kallio et al. 1969, 1971, Kallio & Mäkinen 1975, 1978, Mäkinen et al. 1982). The taxonomical order and style of this work follows the check-list "The vascular plants of Inari Lapland, Finland" (Mäkinen & Kallio 1979), whereas the nomenclature follows Hämet-Ahti et al. (1986). However, all the hybrids observed in the reserve were excluded from this study.

The ecological information given with the species lists is based on our own experience and on various published sources. The distribution of the different ecological factors of plant species was tested with various environmental factors and the results are given in chapter 4. These analyses will be continued in later studies.

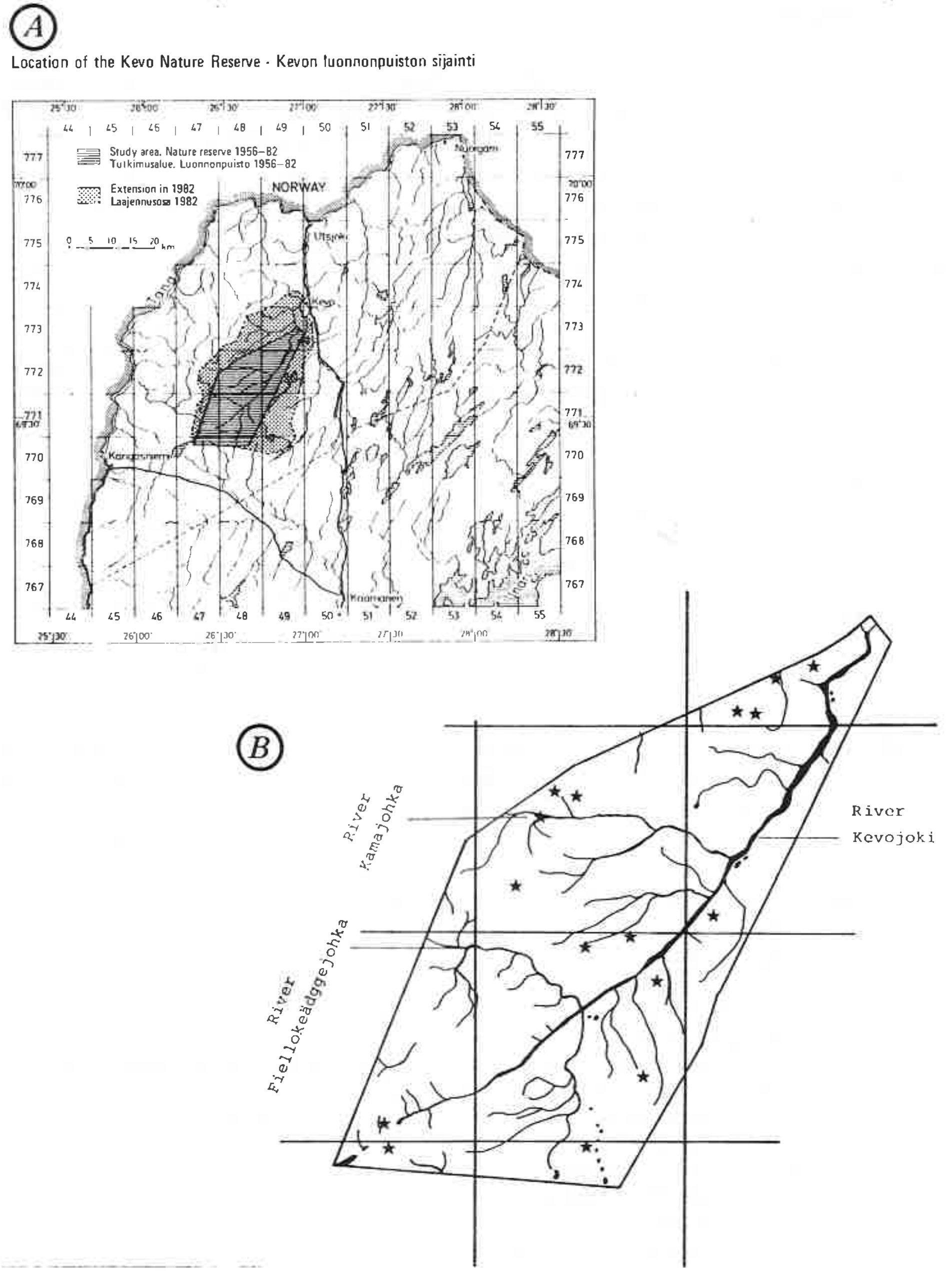


Fig. 1. (A) Location of the Kevo Nature Reserve. (B) Main rivers, brooks and springs (*) in the Kevo Reserve.

2. Methods

Floristic mapping lists were made from 363 square kilometers (from now on referred to as squares) during 1954-1984 by the following persons: S. Heino, H. Hurme, P. Kallio, T. Laine (Lammes), U. Laine (most of the squares occurring in cliff habitats), L. Lindgren, L. & E. T. Linnaluoto, Y. Mäkinen, J. Nurmi and by the authors. It should be noted that two different lists were compiled for so-called boundary squares, which might comprise equal amounts of alpine belt vegetation and birch forest belt vegetation. Therefore the total number of lists included in the study is greater than the number of squares concerned.

The occurrence of different *environmental factors* was measured for each square from the 1:20000 topographic maps. The factors included were (see also Fig. 2):

Maximum elevation (m a.s.l.)
Minimum elevation (m a.s.l.)
Elevation range (m); maximum elevation - minimum elevation
Mean elevation (m); lowest elevation of half of the square
Length of cliffs (m); horizontal length of the high cliffs (over 2.5 m high)
Area of watercourses (ha)
Area of lakes (ha)
Length of rivers (m)
Length of brooks (m)

The occurrence of different *vegetation types* (Heikkinen & Kalliola 1989) in the squares (Fig. 3) was measured from the vegetation map. The following vegetation types were included - total areas in percentage of the reserve area are given in brackets:

* Pine forest (Mäntymetsä; coverage 0.26 % of the total reserve area)
* Mountain birch forest of subalpine *Empetrum-Lichenes* type (sELiT-tunturikoivikko; 4 %)
\# sELiT damaged by *Epirrita* (sELiT-tuhokoivikko; 29 %)
* Mountain birch forest of subalpine *Empetrum-Lichenes-Pleurozium* type (sELiPlT-tunturikoivikko; 0.7 %)
\# sELiPlT damaged by *Epirrita* (sELiPlT-tuhokoivikko; 15 %)
* Mountain birch forest of subalpine *Empetrum-Myrtillus* type (sEMT-tunturikoivikko; 1.3 %)
\# sEMT damaged by *Epirrita* (sEMT-tuhokoivikko; 1.4 %)
\+ Mountain birch forest of low herb type (Matalaruohoinen tunturikoivikko; 0.4 %)
\+ Meadow forest (Lehto; 0.3 %)
Heathy hummock bog (Kangasräme; 3.7 %)
Salix-Betula nana bog (Paju-vaivaiskoivuräme; 2.4 %)
Dwarf shrub bog (Aitoräme; 2.5 %)
Eriophorum vaginatum bog (Tupasvillaräme; 0.07 %)
Minerotrophic short sedge fen (Lyhytkorsineva; 0.05 %)
Sphagnum flark fen (Rahkasammalrimpineva; 0.6 %)
Drepanocladus flark fen (Sirppisammalrimpineva; 1.1 %)
Poor mud bottom flark fen (Ruopparimpineva; 0.12 %)
Springy fell fen (Lähteinen tunturisuo; 0.5 %)
Swampy sedge fen (Luhtaneva; 0.3 %)
Grey willow swamp (Pajuviitaluhta; 0.2 %)
\+ Birch mire with rich fen features (Lettokorpi; 0.05 %)
\+ Herb and grass birch mire (Ruoho-heinäkorpi; 0.4 %)
Springs (Lähteikkö)
Empetrum heath (Variksenmarjatunturikangas; 24.6 %)
Betula nana heath (Vaivaiskoivutunturikangas; 2.9 %)
Snowbed brookside (Lumenviipymäpuronvarsi; <0.05 %)
Brookside meadow (Puronvarsiruohosto; 0.1 %)
Boulder-rich brookside (Rakkapuronvarsi; <0.05 %)
Gravelly brookside (Puronvarsisomerikko; <0.01 %)
Frost ground sites (Kuviomaa; 0.5 %)
Secondary alpine heaths (Sekundaarinen tunturipaljakka; 5.8 %)

* xeric(/mesic) forests
\# xeric(/mesic) forests damaged by *Epirrita autumnata*
\+ moist species-rich forests and wooded mires

On the basis of the vegetation type coverage, a Simpson diversity index was calculated for every square: $D' = 1 - \Sigma (n_i/N)^2$, where N is the total coverage of the vegetation types and n_i the coverage of vegetation type i in one square. The values of these diversity indices varied between 0.002 and 0.88 (mean 0.44).

Data was computed using (1) programs written by Mr. L. Iso-Iivari, (2) BMDP programs BMDP6D, BMDP3S and BMDP2R (see Dixon 1983), and (3) the SYSTAT statistical package (Wilkinson 1987). The first-mentioned programs are written in FORTRAN and were used to calculate species frequencies in different vegetation belts and to test statistical differences (paired t-test) in species occurrence between the belts. BMDP programs were used in the measurement of correlation and regression between species richness and environmental factors, and SYSTAT programs for correlation analyses between environmental variables and changes in the relative proportions of ecological characteristics of the plant species (e.g. life form, pollination type) in the reserve. Non-parametric tests were used when the data was noticeably skewed, which happened in particular with many environmental factors.

In the description that follows (chapter 3), the floristic composition of the reserve is presented in two ways. (1) The heading "Total flora" refers to the complete species list of the reserve and (2) "per sq." refers to the average percentage values of species representing certain ecological characterictics; for example, the average value for wind-pollinated species is the mean of the percentages of those species in each of the 363 squares studied.

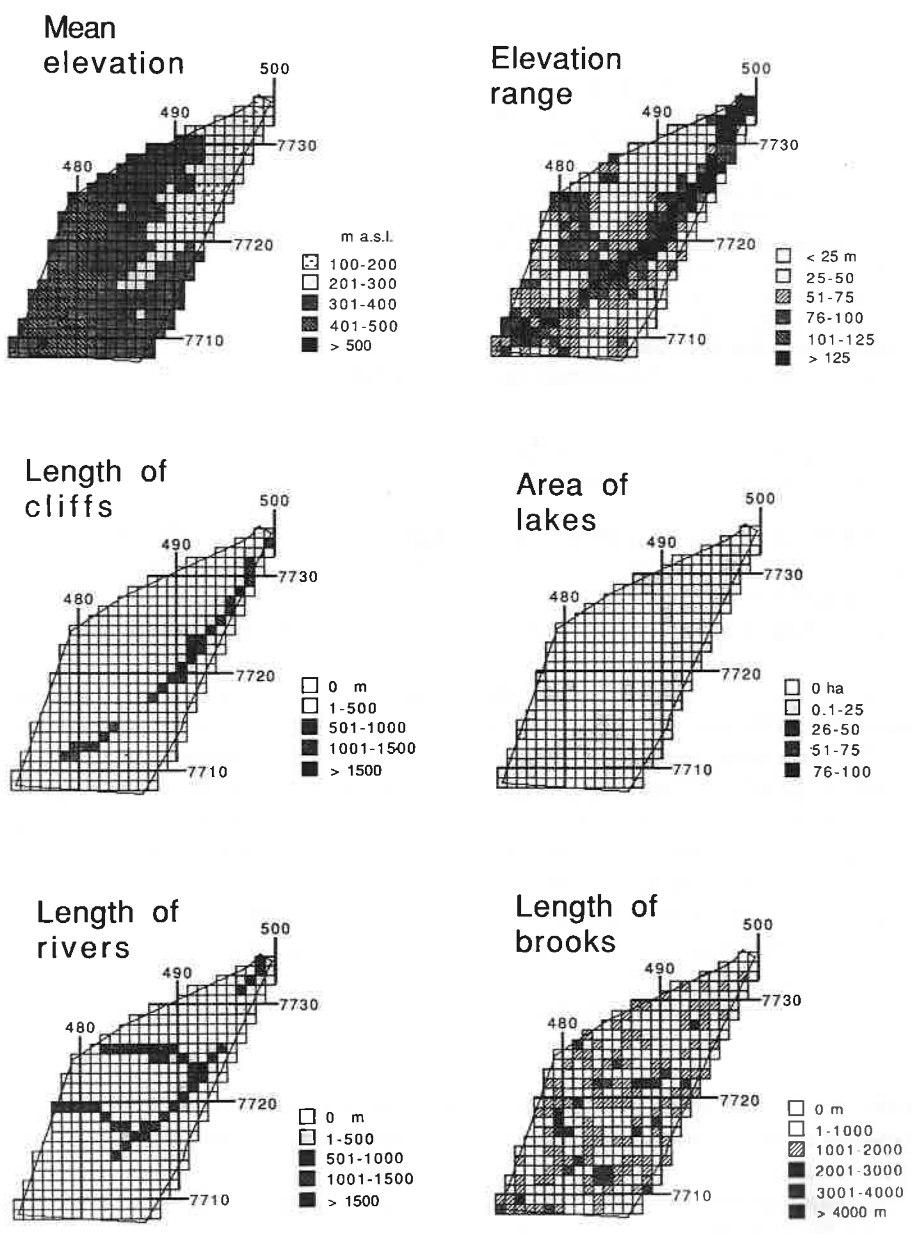


Fig.2. Variation of some environmental factors in the 1 x 1 sq. km (n=362) in the Kevo Nature Reserve.

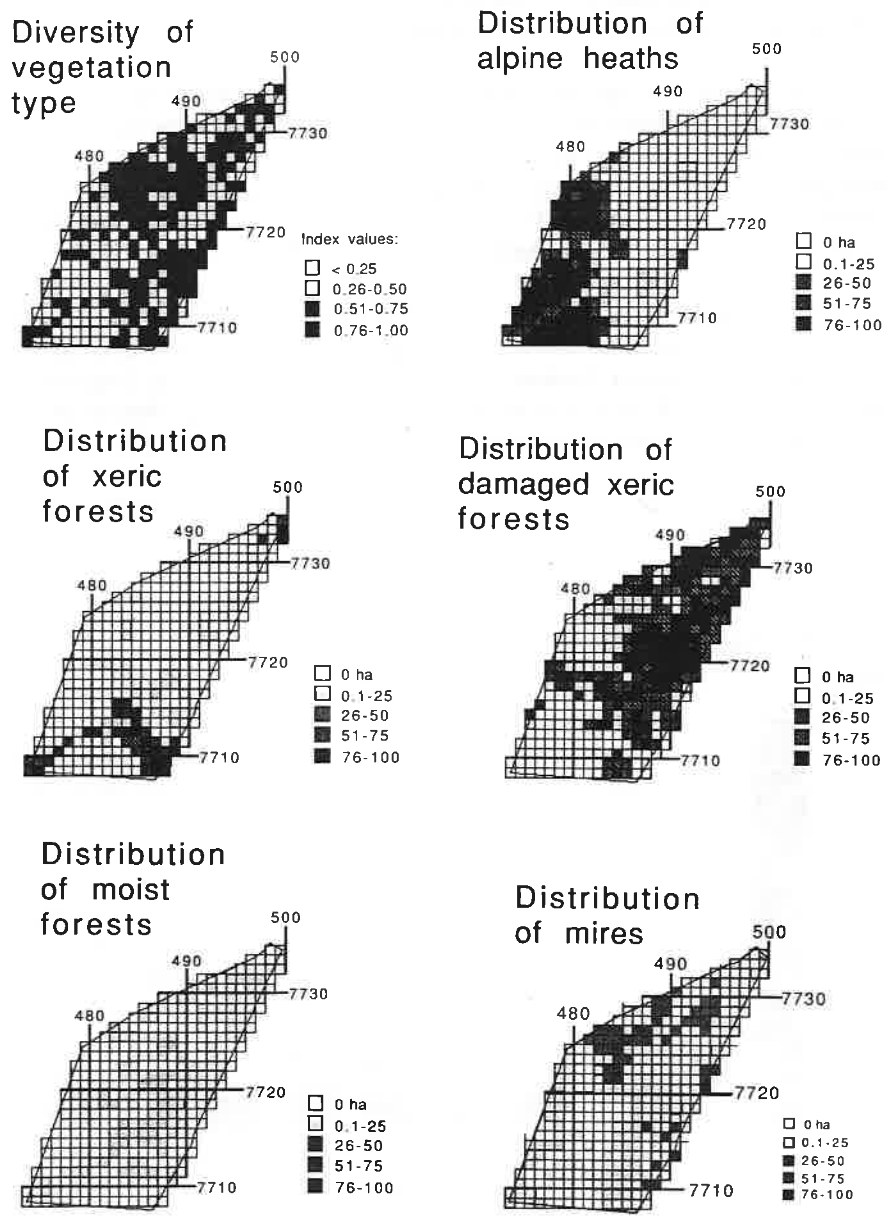


Fig. 3. Diversity of vegetation type (see text for further information) and cover of some vegetation type groups in the study area.

3. The floristic composition of the reserve
3.1. Species frequencies and characteristics

A complete list of plant species and their characteristics is given in appendix 1, and species distribution maps are in appendix 2. In order to give some idea of the frequency, distribution and ecological characteristics of all the floral species, the most pronounced features in each of the columns of appendix 1 (referred to by heading) are presented here and briefly discussed. Submerged waterplants have been excluded from most of the descriptions.

(1) "FR". The frequencies (relative percentage value) of the species occurrences in the reserve are given under this heading (Fig. 4). Over 50 % (173 of 313) of the species/subspecies have a frequency of less than 10 %; those with frequencies of between 40 and 50 % or 80 and 90 % are few. This kind of distribution fits quite well with the distribution diagram presented by Mäkinen & Kallio (1979: 5).

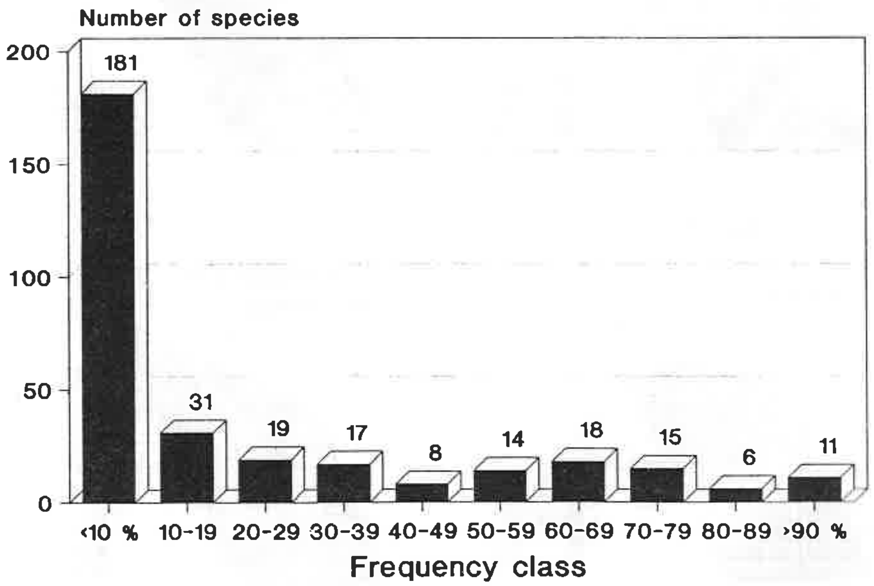


Fig. 4. Distribution of the species into frequence classes. (Percentage of the squares where a species has been observed).

The most common vascular plants are the following (the "InL" column includes the corresponding values in Inari Lapland):

	Reserve	InL
Vaccinium vitis-idaea	99.2 %	95 %
Betula nana	98.9 %	97 %
Vaccinium myrtillus	98.3 %	94 %
Vaccinium uliginosum	98.1 %	95 %
Empetrum nigrum hermaphroditum	98.1 %	96 %
Festuca ovina	97.0 %	95 %
Deschampsia flexuosa	95.6 %	94 %
Phyllodoce caerulea	95.3 %	76 %
Solidago virgaurea	95.3 %	95 %
Juniperus communis	93.4 %	95 %
Carex bigelowii	92.6 %	76 %
Carex vaginata	89.5 %	94 %
Juncus trifidus	89.5 %	72 %
Diphasiastrum alpinum	85.7 %	72 %
Pedicularis lapponica	84.8 %	81 %
Salix glauca	84.6 %	91 %
Betula pubescens	84.3 %	98 %

These species are among the most common in Inari Lapland (Mäkinen & Kallio 1979: 6), although some alpine species such as *Carex bigelowii, Juncus trifidus, Diphasiastrum alpinum* and *Pedicularis lapponica* are represented here but do not feature on the list of the most common species in Inari Lapland. On the other hand, several forest belt species abundant elsewhere in Inari Lapland (e.g. *Ledum palustre, Andromeda polifolia, Cornus suecica, Pinus sylvestris)* are rare in the reserve.

(2) "BELT". Information about the vertical distribution of the species in relation to the two vegetation belts, birch forest and alpine belt is included under this heading. Two different species lists were usually made for squares composed more or less evenly of these belts (11 squares featuring alpine and birch forest belts, and 5 squares featuring birch and coniferous belts). The following subcolumns were drawn up on the basis of the species occurrences on different lists:

A frequency of the species in alpine squares or subsquares
B frequency of the species in birch forest squares or subsquares
A-B statistical difference between the frequencies in the two belts (paired t-test; * = $P<0.05$, ** = $P<0.01$, *** = $P<0.001$).

Frequencies in coniferous squares/lists were not taken into account separately in the study because of the statistically low floristic data collected from this belt.

The results of the paired t-test revealed statistically very significant ($P<0.001$; ***) differences in almost 80 species between occurrences in alpine and birch forest belts. Typical alpine or alpike species include *Salix herbacea*, *Dryas octopetala*, *Sibbaldia procumbens*, *Diapensia lapponica*, *Cassiope hypnoides*, *Gnaphalium supinum*, *Luzula arcuata* subsp. *arcuata* and *Carex glacialis*. On the other hand, *Equisetum fluviatile*, *Gymnocarpium dryopteris*, *Trollius europaeus*, *Parnassia palustris*, *Rubus arcticus*, *Vaccinium microcarpum*, *Menyanthes trifoliata*, *Melampyrum pratense*, *Galium uliginosum*, *Cirsium helenioides*, *Melica nutans* and *Poa nemoralis* are characteristic of the birch forest belt.

Somewhat surprisingly, there are also significant differences in vertical occurrences between belts with some abundant ubiquitous species (species occurring in all vertical belts), e.g. *Juniperus communis*, *Salix glauca*, *Polygonum viviparum* and *Solidago virgaurea*. On the other hand, where there were very few observations of a species, the results frequently revealed hardly any statistical difference, even though a certain species occurred in only one vegetation belt. This applied, for example, to *Equisetum scirpoides*, *Cystopteris montana*, *Stellaria longifolia*, *Ranunculus peltatus*, *Chrysosplenium tetrandrum*, *Polemonium acutiflorum* and *Paris quadrifolia*.

Several species regarded as alpine - e.g. *Diphasiastrum alpinum*, *Salix herbacea*, *Loiseleuria procumbens* and *Juncus trifidus* - also occur quite frequently in the birch forest belt. This may be understood in terms of the sparse structure of the mountain birch forests, especially in subalpine *Empetrum-Lichenes* type forest (Hämet-Ahti 1963: 37-49, Heikkinen & Kalliola 1989: 10, see also Seppälä & Rastas 1980: 52-53 and Haapasaari 1988: 150-160).

(3) "HEIG". The average maximum height (cm) of the species in the area according to our field experience is described here. More than 2/3 of the species have a maximum height lower than 30 cm. This is connected with vegetative adaptation which is needed for survival in northern and alpine habitats (cf. Crawford 1989: 52-54).

(4) "LEAF". This covers the wintering stage of the leaves; the symbols are:

E evergreen

S seasonal; deciduous woody plants, herbaceous plants with green leaves not persisting over winter

Only 31 (10.5 %) of the total flora in the reserve are evergreen, while 265 (89.5 %) belong to the seasonal category (submerged waterplants excluded). However, the

average proportion of evergreen species per square is higher (21.8 %) because, although seasonal species clearly prevail in number, there are more which occur infrequently. Furthermore, the average coverage of evergreen species is even higher as many evergreen dwarf shrubs are among the dominant species especially in high level areas - alpine heaths, sparse mountain birch forests etc. (Hämet-Ahti 1963, Heikkinen & Kalliola 1989: 10, 20, see also Bliss 1971: 422).

(5) "LIFE FORM". This includes the life form of the species, according to the classification of Raunkiaer (1904, see Crawford 1989: 37). Species classification into different categories is based largely on Gelting (1934), Sørensen (1941) and, in particular, Hansen (1988), and it contains the following alternatives:

PHAN phanerophyte;	species with their terminal buds exposed freely, more than 25 cm above the ground
CHAM chamaephyte;	low growing species with buds above ground surface, yet still below 25 cm
HEMI hemicryptophyte;	species with aerial shoots degenerated to ground level during winter
GEOP geophyte;	species with buds or shoot apices buried under the earth during the adverse season
HELO helophyte;	species with buds or shoot apices buried under water or in mud during the adverse season
THER therophyte;	species which survive the adverse season as seeds

The distribution pattern of species into different categories is as follows:

	Total flora	Per sq.
PHAN	7.1 %	8.2 %
CHAM	16.2 %	28.0 %
HEMI	56.2 %	49.5 %
GEOP	15.5 %	12.4 %
HELO	2.0 %	1.2 %
THER	3.0 %	0.7 %

The abundance of chamaephytes, geophytes and, in particular, hemicryptophytes, as well as the scarcity of phanerophytes and therophytes, are common features in the subarctic study area. This distribution pattern of total flora approaches that in arctic (Gelting 1934: 320-321, Sørensen 1941: 185) and alpine regions (Bliss 1971: 421), although phanerophytes and therophytes are more rare and chamaephytes more frequent in the areas mentioned.

In fact, a comparison of total flora and per square values reveals that chamaephytes are more abundant in the reserve than might have been expected given the total flora occurence; similarly, most of geophytes and therophytes are rather rare in the study area.

(6) "POLLINATION". The main pollination syndrome of the species. The following categories are included:

IN insect pollination
WI wind pollination
SE self pollination
VA various pollination syndromes
AP apomixis - the production of seeds without fertilization (agamospermy) or dispersion through vegetative bulbils
? pollination mechanism unknown in the study area

The distribution of species into different categories is similar for total flora and average values per square:

	Total flora	Per sq.
IN	44.5 %	45.3 %
WI	37.2 %	38.2 %
SE	3.9 %	1.0 %
VA	4.7 %	7.4 %
AP	9.7 %	8.1 %

The abundance of wind-pollinated species coincides quite well with that in arctic areas in general, better than that in alpine areas (see Billings & Mooney 1968: 518). However, in the most severe habitats of the high arctic, self pollination and apomixis are even more frequent than in the study area. Moreover, it is advantageous to have more than one possible pollination mechanism in arctic regions, especially because of the uncertainty of insect pollination (Crawford 1989: 72).

(7) "DIASPORE". The diaspore type. This classification follows that presented by Dansereau & Lems (1957), which was established on the basis of the visual adaptational features of diaspores. The categories are:

AUXOC	auxochore;	diaspore without obvious adaptations to any external agent, deposited by the parent-plant (no examples in the Kevo Nature Reserve)
CYCLO	cyclochore;	diaspore largely consisting of accessory parts, forming a voluminous spherical frame (no examples in the Kevo Nature Reserve)
PTERO	pterochore;	diaspore with scarious, thin, wing-like appendages (e.g. *Pinus sylvestris, Oxyria digyna)*
POGON	pogonochore;	diaspore with long, thin, hairlike or plumose appendages (e.g. *Dryas octopetala)*
DESMO	desmochore;	diaspore with short, stiff, spiny or glandular appendages (adhering to rough surfaces; e.g. *Lappula deflexa, Plantago major)*
SACRO	sacrochore;	diaspore with juicy or fleshy outer layers (e.g. *Rubus chamaemorus)*
SPORO	sporochore;	very minute and light diaspore (light enough to be carried by the breeze) without obvious external adaptations (e.g. Orchidaceae)
SCLER	sclerochore;	light diaspores without obvious external adaptations (e.g. Caryophyllaceae)
BAROC	barochore;	very heavy diaspores without obvious adaptations (no examples in the Kevo Nature Reserve)
BALLO	ballochore;	diaspore without obvious adaptations, forcibly ejected from the parent-plant (e.g. *Geranium sylvaticum)*

Small and light diaspore types prevail in the study area, and sacrochores are also common (e.g. Ericaceae) in most of the squares.

	Total flora	Per sq.
PTERO	5.1 %	5.1 %
POGON	15.5 %	17.7 %
DESMO	11.8 %	9.3 %
SACRO	6.1 %	13.7 %
SPORO	13.9 %	10.3 %
SCLER	46.3 %	42.9 %
BALLO	1.3 %	1.0 %

Many researchers have classified plant species on the basis of dispersing agents (e.g. Pijl 1969). That approach was not used here, because of insufficient direct field observations and consequent lack of knowledge about the study area. However, it is obvious that most of the sporochores, pogonochores and pterochores, as well as some of the sclerochores fall into the category of anemochores (wind-dispersed, see Pijl 1969: 52-60, Fenner 1985: 42-44). Therefore it can be stated that at least one third of the species in the area are wind-dispersed. Endozoochory (dispersal by animals internally; Fenner 1985: 49) mainly coincides with sacrochory and only a few obvious cases of this syndrome (e.g. *Polygonum viviparum)* can be picked up from other categories. Epizoochory (Pijl 1969: 66) or ectozoochory (dispersal of diaspore outside animals; Fenner 1985: 44) are represented at least in desmochores (e.g. *Lappula deflexa*, *Galium* spp.) and partly in sclerochores. Some desmochores (*Juncus* spp., *Luzula* spp.), however, are also spread by water.

As already pointed out by Pijl (1969: 8), sclerochores are a rather heterogeneous group of species, dispersed by ants, other animals or even the wind. For example, *Urtica dioica* and *Stellaria media* seeds have often been found in the muddy legs of birds (Fenner 1985: 45). Therefore the exact percentages in the categories based on dispersing agents cannot be judged from the above values. It is equally obvious, however, that placing the species into Pijl categories is somewhat dubious, because many of them may well have at least two different dispersing mechanisms in the study area.

(8) "VEG.EXP.". This concerns the tendency to lateral vegetative expansion and the development of clones through the formation of rhizomes, stolons or suckers (see Grime 1979: 80-81). The classification is based mainly on field observations in the study area, but also on Lid (1979) and Hämet-Ahti et al. (1986):

		Total flora	Per sq.
0	no vegetative expansion	30.3 %	22.0 %
1	some vegetative expansion	47.1 %	44.6 %
2	strong vegetative expansion	22.6 %	33.3 %

About 2/3 of the total flora species show some tendency towards vegetative expansion. This is even more pronounced in average values per square. Species with no such tendency occur more infrequently in the study area, often in open habitats such as cliffs and springs and at the edges of brooks and fens disturbed by frequent flooding. Even if agamospermy (reproduction through seeds without fertilization) is not taken into consideration, it can be stated that over 70 % of the flora in the study area has some sort of vegetative reproduction system (c.f. Crawford 1989: 69).

(9) "STRATEGY". This covers the primary or secondary strategies of the plants, according to Grime's (1979) grading. Species are classified into seven major categories according to their response to certain basic environmental factors (stress, disturbance and competition) in the established phase of their life-cycle. The information presented is mainly based on our subjective judgement:

		Total flora	Per sq.
C	competitors	6.2 %	7.2 %
CS	stress-tolerant competitors	27.0 %	44.2 %
S	stress-tolerators	14.8 %	15.3 %
SR	stress-tolerant ruderals	24.8 %	12.5 %
R	ruderals	2.1 %	0.2 %
CR	competitive-ruderals	4.8 %	2.9 %
CSR	'C-S-R' strategists	20.3 %	17.7 %

Almost all the species fall into categories in which some stress-tolerant features are present; stress-tolerant competitors (including many common dwarf shrubs, e.g. *Empetrum nigrum* subsp. *hermaphroditum)* are abundant in most of the squares, while stress-tolerant ruderals, as well as ruderals, are rather rare, often annual or otherwise short-lived.

(9) "HABITAT". This column indicates the most typical habitats for each of the species.

ALPINE alpine heaths (tunturikankaat)
BOULDERS large boulder screens in the Kevojoki valley, usually below the cliffs
CLIFFS cliff habitats in the Kevojoki valley (pahdat)
FOREST common in all forest types (metsät)
  CONIFER pine forest (mäntymetsät)
  MOIST FOR. moist, species rich forests and wooded mires along brooks and rivers (kosteat, runsaslajiset metsät, lettokorvet sekä ruohoheinäkorvet)
  XER/MES FOR. both in xeric and mesic mountain birch forests (sELiT, sELiPIT, sEMT) and pine forests (kuivat-tuoreet kangasmetsät)
MEADOWS different kinds of meadows (niityt)
MIRES common in all mire types (suot)
  BOGS different bog types (rämeet)
  FENS different fen types (nevat)
  SPRINGS springs (lähteiköt)
WATERCOURSES lakes, rivers and major brooks (vesistöt)
  LAKES lakes (järvet)
  POOLS little pools, usually isolated from the major watercourses (lätäköt, pienet lammet)
  SHORES shores of brooks, rivers and lakes (vesistöjen rannat)
  GRAVEL gravelly or boulder-rich brook sides or lake shores (rantasomerikot)
  SHRUBBERIES dense willow thickets usually at river banks (rantapensaikot)
SNOWBEDS snowbeds in alpine areas, including solifluction sites (lumenviipymät, solifluktioalueet)
SLOPES steep slopes especially in the Kevojoki valley (cliffs excluded) (Kevojoen kanjonin rinteet)
VALLEY ± plain bottom areas of the Kevojoki valley (Kevojoen laakso)

WIDE AMPL. various habitats, a species with very wide ecological amplitude (laaja-alainen)

RARE	few observations of the species in the study area (vähälukuinen)
CASUAL	introduced species occurring casually in places with human influence (satunnainen)

3.2. Distribution groups

Mäkinen & Kallio (1979, see also Kallio et al. 1969) classified the plant species of Inari Lapland in 11 distribution groups, 5 vertical distribution groups and 6 acidity requirement categories. Those columns are not repeated in the species list presented here, although the distribution of the species found in the study area fits into the categories.

The distribution categories are as follows (Mäkinen & Kallio 1979: 8):

		Total flora	Per sq.
ATLAN	atlantic southern	1.3 %	0.1 %
DISJU	disjunctive occurrence	1.3 %	0.0 %
EASTE	eastern	1.0 %	0.0 %
LOWLA	lowland	30.6 %	10.6 %
MONTA	montane	9.5 %	5.6 %
?HCHO	hemerochore (origin ?)	0.7 %	0.1 %
NHCHO	northern hemerochore	0.3 %	0.1 %
NORTH	northern	16.3 %	8.3 %
SHCHO	southern hemerochore	2.6 %	0.0 %
SOUTH	southern	6.8 %	1.0 %
WHOLE	whole area	29.6 %	74.2 %

The category distribution of the species differs somewhat from that throughout Inari Lapland where southern hemerochores are most common (Mäkinen & Kallio 1979: 9). Most of those found in the study area represent lowland or northern species or plants occurring over the whole area. The favourable local microclimate in the River Kevojoki valley (Kallio et al. 1969) explains the abundance of southern species. However, in terms of average values per square, those occurring over the whole area clearly give the highest, and lowland, southern and northern species are rare.

The vertical distribution of species includes five categories:

		Total flora	Per sq.
ALPIK	alpike; mainly in the alpine belt	8.1 %	10.7 %
ALPIN	alpine; only in the alpine belt	1.0 %	0.1 %
SLVIK	silvike; mainly in the forest belts	32.5 %	35.6 %
SLVIN	silvine; only in the forest belts	44.5 %	7.8 %
UBIQU	ubiquitous; in all vertical belts	13.9 %	45.9 %

Silvike and silvine species clearly prevail in the total flora of the reserve but, judging by the average values per square, they are unevenly distributed; silvine species are in fact rare, whereas ubiquitous very common. The distribution patterns for the whole of Inari Lapland (Mäkinen & Kallio 1979: 9) are basically similar to those for total flora, although there are more silvine and fewer silvike species in Inari Lapland. However, many silvine species, e.g. *Salix borealis, Stellaria calycantha, Ranunculus reptans, Arabis alpina, Rubus arcticus, Angelica archangelica* subsp. *archangelica, Achillea millefolium, Triglochin palustre, Luzula parviflora, L. pilosa* and *Poa nemoralis*, also occur in the alpine belt squares of the reserve. Whether this calls for revision of the original list or whether it is caused by too rough categorization of the squares (small forest fragments also occur in many alpine squares) remains open to debate.

Correlation between species and acidity of habitat (Mäkinen & Kallio 1979: 9) gave rise to the following categories:

		Total flora	Per sq.
ACOLE	acidocole; requiring acid substrate	1.0 %	0.5 %
ACLIN	acidocline; preferring acid substrate	7.2 %	17.0 %
AMPHI	amphicline; not depending on the acidity of the habitat	60.4 %	76.1 %
BCLIN	basocline; preferring basic or neutral substrate	28.8 %	6.2 %
BCOLE	basocole; requiring basic substrate	2.6 %	0.2 %
-	correlation with soil acidity unknown		

The total flora distribution pattern closely resembles that of Inari Lapland (Mäkinen & Kallio 1979: 10). However, the average values per square indicate that basoclines and basocoles are rare in the reserve; vegetation is mostly characterized by acidoclines and amphiclines.

Mäkinen & Kallio (1979: 7) also divided vascular plants into different categories based on their origin in Inari Lapland and to their relation to culture. This information was not used in the present study, because both the number and abundance of introduced species is insignificant, as is the influence of human activities in this protected area (Heikkinen & Kalliola 1989: 7).

4. Plants and the environment
4.1. Species richness

The total number of species or subspecies found in the reserve was 313 (15 couplets of two subspecies). Most of the squares contained 50 to 70 or 70 to 90 species (Fig. 5), and the mean number of species per square was 70.1 (s.d. = 29.9). However, there were some squares surprisingly rich in species. Six of them yielded over 150. These were located in the River Kevojoki valley (Fig. 6), often featuring high site variation including cliffs and luxurious meadow forests (compare Figs. 2-3).

Two separate correlation calculations were made for variables with zero values in some squares (e.g. length of cliffs): one using all 362 observations and the other excluding the squares with zero values. The species count per square correlates with many environmental variables (Table 1), and the significant negative correlation ($r = -0.459$, $P < 0.001$) between the number of species and the mean elevation is particularly pronounced. However, the points in the regression scatter plot (Fig. 7A) are not very heavily concentrated along the regression line.

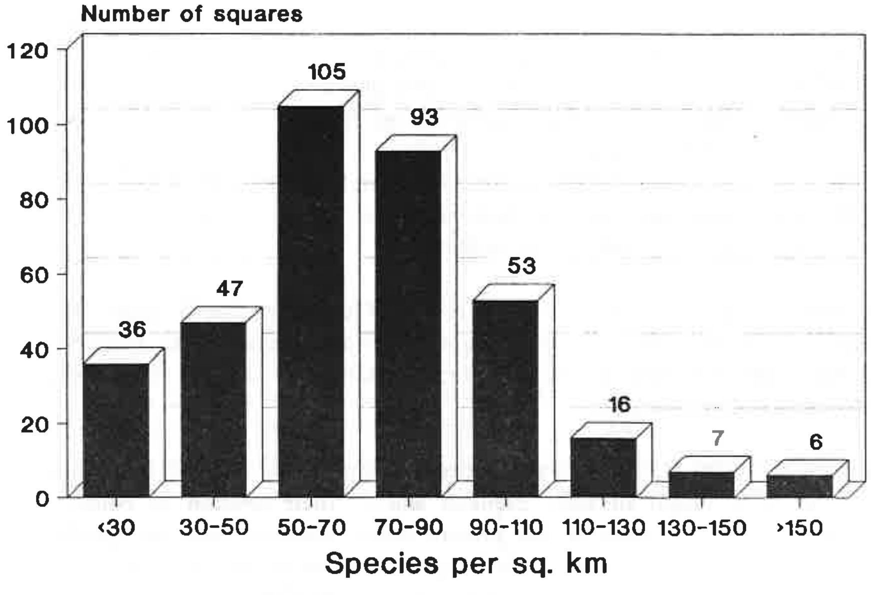


Fig. 5. Distribution of squares into different classes according to their species amount.

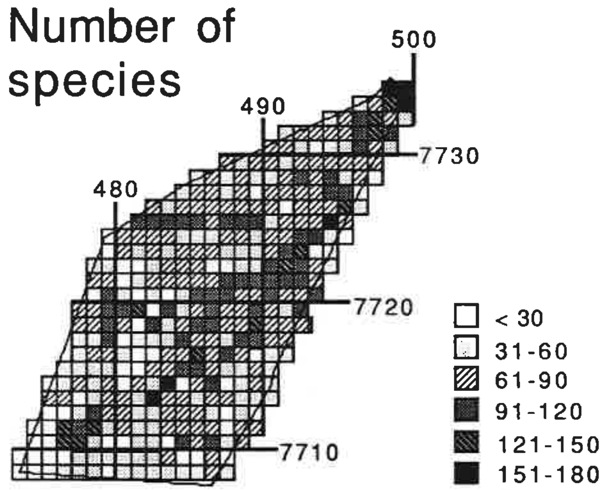


Fig. 6. Variation in the number of species per square in the study area.

Table 1. Correlation between number of species and some environmental and vegetational factors. See text for further information on alternative correlations.

	Coefficient of correlation	
Elevation range (n=362)	0.309***	
Mean elevation (n=362)	-0.459***	
Lenght of cliffs (n=362)	0.303***	S
(n=46)	0.342*	S
Lenght of rivers (n=362)	0.386***	S
(n=54)	0.247	S
Lenght of brooks (n=362)	0.409***	S
(n=273)	0.379***	S
Lenght of rivers and brooks (n=362)	0.543***	S
(n=287)	0.454***	S
Area of watercourse (n=362)	0.375***	S
(n=178)	0.273***	S
Area of lakes (n=362)	0.199***	S
(n=125)	0.228*	S
Area of moist forests (n=362)	0.593***	S
(n=160)	0.259**	S
Diversity of vegetation types (n=362)	0.293***	

S = Spearman rank correlation

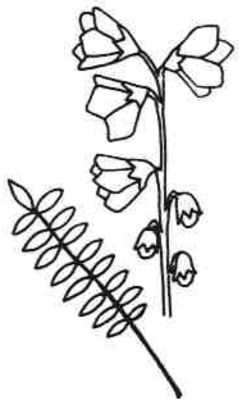
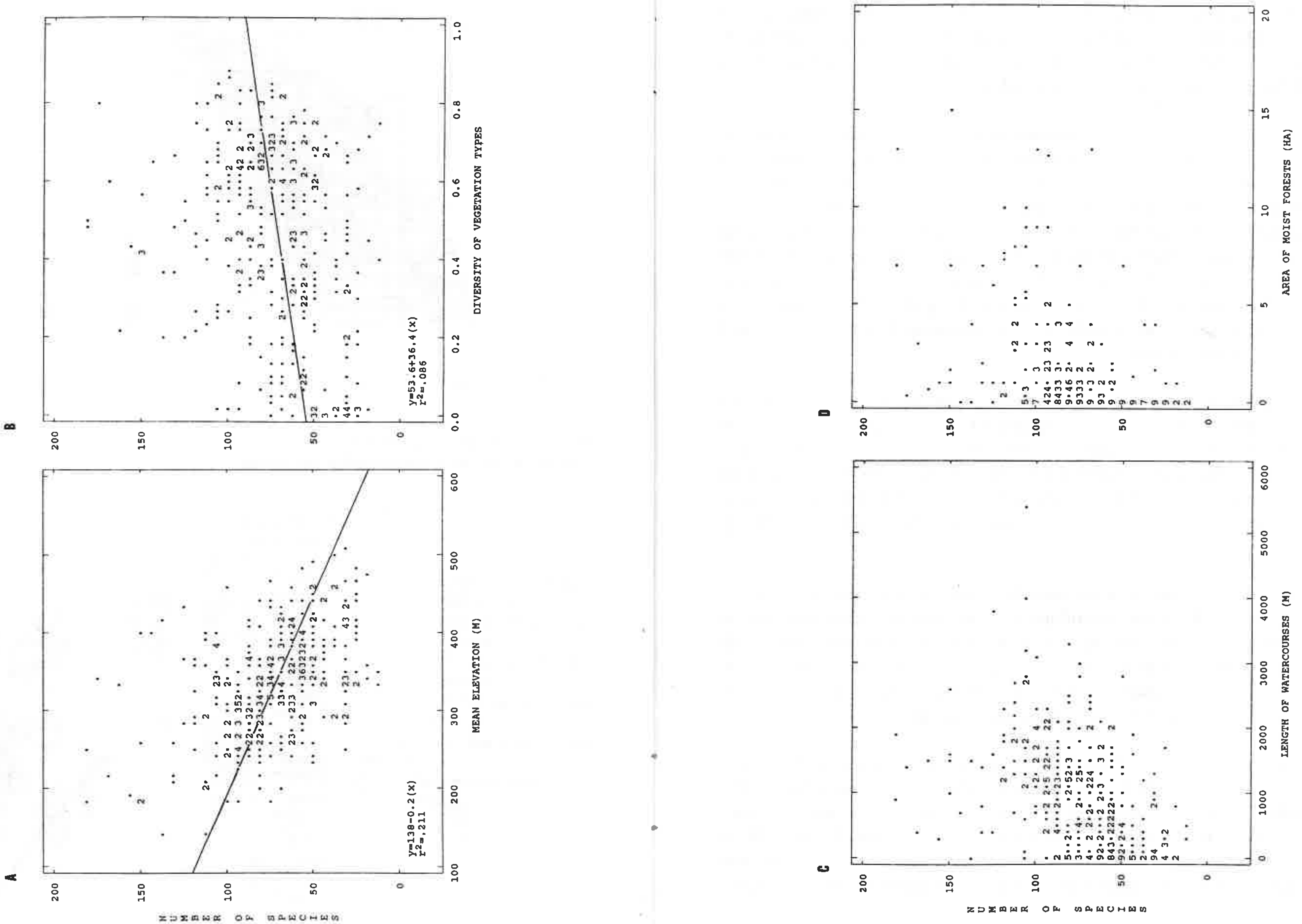


Fig. 7. Bivariate scatter plots between number of species and different environmental-vegetational factors.



The number of species has strong, positive correlations with elevation range, diversity of vegetation type, length of brooks, total length of brooks and rivers, area of watercourse and area of moist forests (Table 1, Figs. 7 B-D). However, it should be noted that these factors are not independent of each other. For example, squares with a wide elevation range usually feature rivers and brooks, and also harbour all the cliff habitats (see Fig. 2). Similarly, the index of diversity of vegetation types coincides with the presence of mires, brooks and some rivers.

The total length of brooks and rivers, combined and separate, affects the number of species, because there is usually at least a narrow belt of luxurious vegetation along them in contrast to the surroundings. Mountain birch forests, alpine heaths and many other areally large types are often poor in species, and even short brooks or river stretches add notably to the number. However, increased watercourse lenght in the squares does not produce a relative increase in the number of species, and the points in the scatter diagram (Fig. 7C) are therefore somewhat widely dispersed. This phenomenon is clear especially for rivers; there is a strong positive correlation with all the squares, but no significant correlation with increasing length of river stretch (squares with zero values excluded).

In spite of the significant positive correlation between the species count and several environmental variables (e.g. diversity of vegetation type, see Fig. 7B), it is obvious that the bivariate distribution of variables in the diagrams is too scattered to give reliable regressions. This may be partly due to the fact that most of the vegetation types in the study area are poor in species and only a few "better" ones (e.g. "moist" forests) have a more marked effect on the total species number (see Table 1 and Fig. 7D).

When squares with zero values were excluded, cliff length showed only just significant correlation with the number of species. This may be understood in terms of the characteristics of cliff habitats. They are for the most part rather dry, consisting of rocks poor in nutrients (mainly granites, gneisses and diorites; Laine 1956, 1970). Obviously, the chemical make-up of the rocks has a bigger effect on species richness than the abundance of cliff habitats in itself.

However, it must be stressed that there is scope for misinterpretation in the results. The differences in degree of significance can partly reflect differences in the number of cases included, and also many of the variables occur very closely together, especially in the River Kevojoki valley (see above and Figs. 2 and 3). In addition, also the size of the observation unit (one square kilometer) make conclusions about the variables that actually cause the changes in the species number somewhat vague.

4.2. Ecological characteristics of plants and the environment

In order to get some idea about changes in the relative proportions of the ecological characteristics of species in the reserve, a further set of correlation matrices was calculated; the first was concerned with some environmental factors (Table 2) and the second with the coverage of certain vegetation type groups in a square (Table 3). The ecological characteristics of the plants used in the analysis were the same as those mentioned in chapter 3, although some of the categories were combined. The analysis produced the correlation between environmental variables and the relative proportion of plants representing certain ecological characteristics (e.g. wind-pollinated species) per square.

In leaf phenology the two categories (evergreens and seasonal) produce so-called 'mirror images' of correlations. The strongest significant correlations occur between watercourse lenght and area of moist forests; on this basis, it is obvious that evergreen species are quite clearly in the minority along brooks and rivers in more moist forests rich in species. Their abundance at high elevations substantiates statements about the adaptive value of evergreen leaves in arctic and alpine habitats (Billings & Mooney 1968: 491).

Some obvious correlations occur between life forms and environmental factors or life forms and vegetation type groups. The percentage of phanerophytes correlates negatively with mean elevation, and that of alpine heaths and helophytes positively with mires and negatively with alpine heaths. The percentage of chamaephytes correlates significantly with mean elevation and this is easily understood in terms of the advantageousness of this life form in severe habitats (Bliss 1971: 421). However, the slight negative correlation between mean elevation and the proportion of hemicryptophytes was unpredicted. Geophytes do not have any clear correlation with any of the environmental or vegetational variables studied, but a scarcity of therophytes in upper alpine areas is apparent.

Of the pollination syndromes, insect pollination seems to become less abundant at high elevations. This syndrome has the strongest positive correlation with the area of xeric mountain birch forests damaged by *Epirrita autumnata* for reasons hard to imagine. Wind pollination has the only meaningful significant correlation with mire area; this is largely because of the abundance of the family Cyperaceae in these sites. Self pollination has somewhat obscure correlations; it seems to be frequent along watercourses, especially rivers, as well as in xeric mountain birch forests.

Apomixis correlates positively with length of watercourses and area of moist forests - habitats rich in herbaceous species - but not significantly with mean elevation. This may be partly explained by the fact that brook and river margins are

Table 2. Correlation between relative proportion of different ecological-distributional plant categories and some environmental factors. n indicates the number of species representing each category (see also appendix 1).

	Mean height	Lenght of cliffs	Lenght of rivers	Lenght of brooks	Lenght of water-courses
LEAF PHENOLOGY					
Evergreen (n=31)	.327***	-.325***	-.375***	-.367***	-.492***
Seasonal (n=265)	-.327***	.325***	.375***	.367***	.492***
LIFE FORM					
Phanerophyte (n=21)	-.449***	.099	.109	-.025	.010
Chamaephyte (n=48)	.415***	-.143*	-.284***	-.167**	-.271***
Hemicryptophyte (n=167)	-.171**	.067	.186**	.185**	.253***
Geophyte (n=46)	-.169**	.095	.139*	.070	.118***
Helophyte (n=6)	-.371***	.127*	.116*	.132*	.168**
Therophyte (n=9)	-.300***	.073	.237***	.055	.145*
POLLINATION					
Insect pollination (n=115)	-.394***	.244***	.117*	-.118*	-.071
Wind pollination (n=96)	.006	-.183**	-.093	.093	.056
Self pollination (n=10)	-.161**	.282***	.408***	.109	.268***
Various (n=12)	.627***	-.340***	-.311***	-.174**	-.287***
Apomixis (n=25)	.006	.131*	.093	.294***	.328***
DIASPORE TYPE					
Pterochore (n=15)	.041	.052	.034	-.051	-.037
Pogonochore (n=46)	.209***	-.221***	-.103	.121*	.065
Desmochore (n=35)	.119*	.003	.016	.006	.028
Sacrochore (n=18)	.063	-.223***	-.308***	-.453***	-.559***
Sporochore (n=41)	-.291***	.232***	.120*	-.032	.011
Sclerochore (n=137)	-.089	.149**	.186**	.330***	.398***
Ballochore (n=4)	-.260***	.136*	.281***	.284***	.372***
VEGETATIVE EXPANSION					
None (n=90)	-.113*	.361***	.259***	.190**	.284***
Some (n=140)	.016	-.040	.113*	.161**	.203***
Strong (n=67)	.091	-.333***	-.335***	-.314***	-.437***
STRATEGY					
Competitor (n=18)	-.622***	.255***	.230***	.148**	.222***
Stress-tol. competitor (n=78)	.307***	-.438***	-.440***	-.348***	-.501***
Stress-tolerator (n=43)	-.111	.222***	.066	-.085	-.055
Stress-tol. ruderal (n=72)	.129*	.203***	.306***	.322***	.437***
Ruderal (n=6)	-.292***	.059	.139*	.006	.055
Competative ruderal (n=14)	-.357***	.192**	.342***	.202***	.320***
CSR-strategist (n=59)	-.231***	.345***	.263***	.276***	.363***
DISTRIBUTION GROUP					
Atlantic southern (n=4)	-.036	.206***	.056	.030	.061
Disjunctive (n=4)	-.228***	.271***	.285***	-.022	.106
Eastern (n=3)	-.259***	.377***	.321***	-.017	.098
Hemerochores (n=11)	-.014	.237***	.200***	.137*	.230***
Lowland (n=94)	-.654***	.390***	.383***	.276***	.404***
Montane (n=29)	.636***	.013	.011	-.034	-.006
Northern (n=50)	.563***	.051	.023	.027	.050
Southern (n=15)	-.348***	.259***	.229***	.013	.088
Whole area (n=91)	.050	-.402***	-.341***	-.195***	-.318***
VERTICAL DISTRIBUTION					
Alpike/alpine (n=28)	.818***	-.312***	-.296***	-.099	-.199***
Silvike/silvine (n=239)	-.677***	.403***	.422***	.301***	.443***
Ubiquitous (n=43)	.491***	-.413***	-.418***	-.363***	-.507***
CORR. TO SOIL ACIDITY					
Acidocline/Acidocole (n=25)	.198***	-.397***	-.417***	-.339***	-.484***
Amphicline (n=187)	.094	-.172**	-.046	.166**	.119*
Basocline/Basocole (n=97)	-.217***	.424***	.390***	.293***	.436***

Hemerochores = southern and northern hemerochores and hemerochores with unclear origin

Table 3. Correlation between relative proportion of different ecological-distributional plant categories and the cover of some vegetation type groups (for further information about vegetation types see Heikkinen & Kalliola 1989).

	FORESTS			ALPINE VEGETATION		MIRES		
	Xeric	Dam.Xeric	Moist	Heahts	Sec.alp.	Fens	Bogs	Total
LEAF PHENOLOGY								
Evergreen	-.192***	-.206***	-.465***	.259***	.182**	-.172**	-.105	-.137*
Seasonal	.192***	.206***	.465***	-.259***	-.182**	.172**	.105	.137*
LIFE FORM								
Phanerophyte	.060	.377***	.218***	-.358***	.083	.151**	.198***	.195***
Chamaephyte	-.163**	-.311***	-.378***	.303***	.095	-.156**	-.149**	-.165**
Hemicryptophyte	.109	.127*	.240***	-.093	-.109	.033	.026	.037
Geophyte	.144***	.120*	.163**	-.166**	-.050	.089	.069	.076
Helophyte	.054	.257***	.315***	-.331***	.046	.333***	.330***	.349***
Therophyte	.277***	.199***	.215***	-.245***	-.018	.025	.030	.038
POLLINATION								
Insect pollination	.139*	.322***	.222***	-.274***	-.043	-.052	-.016	-.033
Wind pollination	-.149**	-.013	-.078	-.077	.148**	.302***	.299***	.331***
Self pollination	.265***	.068	.262***	-.080	-.183**	-.085	-.120*	-.109
Various	-.209***	-.470***	-.485***	.543***	.064	-.269***	-.263***	-.290***
Apomixis	.133*	.006	.231***	.012	-.106	.012	-.038	-.026
DIASPORE TYPE								
Pterochore	.157**	.028	-.078	.021	.193***	-.273***	-.194***	-.222***
Pogonochore	-.226***	-.117*	-.062	.202***	-.050	.110	.037	.049
Desmochore	.100	-.119*	-.001	.097	-.017	-.022	-.080	-.059
Sacrochore	-.178**	.037	-.355***	.000	.218***	-.076	.035	.004
Sporochore	.134*	.208***	.191**	-.211***	-.015	.006	-.009	-.011
Sclerochore	.086	-.045	.190**	-.064	-.178**	.145*	.096	.116*
Ballochore	.227***	.195***	.409***	-.265***	-.059	.109	.078	.094
VEGETATIVE EXPANSION								
None	.258***	.066	.226***	.017	-.300***	-.265***	-.300***	-.303***
Some	-.029	-.046	.122*	-.002	-.020	.221***	.118*	.150**
Strong	-.241***	-.029	-.321***	-.007	.308***	.103	.198***	.180**
STRATEGY								
Competitor	.203***	.481***	.434***	-.580***	.099	.320***	.314***	.334***
Stress-tol. comp.	-.332***	-.174**	-.487***	.181**	.284***	.027	.121*	.096
Stress-tolerator	.184**	.003	.036	-.032	-.081	-.063	-.093	-.101
Stress-tol. ruderal	.158**	-.178**	.240***	.212***	-.342***	-.141*	-.249***	-.225***
Ruderal	.005	.159**	.220***	-.266***	-.060	.313***	.244***	.262***
Competative ruderal	.121*	.266***	.373***	-.265***	-.122*	.159**	.081	.107
CSR strategist	.231***	.188**	.329***	-.132*	-.204***	-.114*	-.169**	-.152**
DISTRIBUTION GROUP								
Atlantic southern	.094	.046	.057	.004	-.088	-.077	-.155**	-.138*
Disjunctive	.016	.155**	.217***	-.117*	-.100	.015	-.027	-.019
Eastern	.144*	.121*	.259***	-.128*	-.116*	-.050	-.038	-.032
Hemerochores	.222***	.028	.189**	.025	-.101	-.055	-.212***	-.176**
Lowland	.290***	.402***	.591***	-.532***	-.116*	.304***	.229***	.263***
Montane	.055	-.492***	-.228***	.663***	-.236***	-.534***	-.605***	-.629***
Northern	-.009	-.444***	-.230***	.610***	-.288***	-.482***	-.510***	-.533***
Southern	.170**	.204***	.241***	-.180**	-.217***	-.001	-.022	-.016
Whole area	-.237***	.080	-.310***	-.162**	.431***	.240***	.385***	.374***
VERTICAL DISTRIBUTION								
Alpike/Alpine	-.184***	-.573***	-.496***	.736***	-.043	-.426***	-.429***	-.458***
Silvike/Silvine	.281***	.418***	.612***	-.541***	-.158**	.318***	.248***	.283***
Ubiquitous	-.284***	-.257***	-.570***	.333***	.266***	-.189***	-.081	-.116*
CORR. TO SOIL ACIDITY								
Acidocline/-cole	-.284***	-.091	-.437***	.044	.360***	.129*	.251***	.231***
Amphicline	-.131*	-.011	.049	.070	-.037	.065	-.006	.006
Basocline/-cole	.335***	.045	.406***	-.067	-.328***	-.106	-.198***	-.180**

Xeric forests = sELiT, sELiPIT & sEMT; Dam. Xeric forest= sELiT, sELiPIT & sEMT damaged by *Epirrita autumnata*; Moist forests = Meadow forest, Mountain birch forest of low herb type, Birch mire with rich fen features & Herb and grass birch mire; Sec.alp. = Secondary alpine heaths quite disturbed habitats where, according to Crawford (1989: 72-73), apomixis might be an advantage. However, species clearly benefit from having more than one pollination syndrome in upper areas (Crawford 1989: 72), where bad seasons with few insect pollinators can be offset by self pollination and apomixis.

The diaspore types pogonochores, and desmochores in particular, do not show clear correlation with any environmental or vegetational variable. Pterochores seem to be less abundant in squares with larger mires. Sacrochores have a strong negative correlation with watercourse lenght and moist forest area. However, this may also be some sort of artefact, since most of the sacrochores are very common (e.g. *Vaccinium* spp., *Empetrum nigrum* subsp. *hermaphroditum, Rubus chamaemorus)* and are therefore present in most of the squares. Their absolute number does not change in squares rich in species, but the relative proportion decreases. The positive correlation between proportion of sporochores and cliff length reflects the abundance of fern species. Sclerochores seem to be most common along watercourses, which suggests that many of these species (e.g. *Montia fontana, Cerastium* spp., *Sagina* spp., some *Saxifraga* spp.) may be dispersed partly by water (see Pijl 1969: 63). The small number of ballochores makes it difficult to give an ecological interpretation, although *Cardamine* spp. and *Geranium sylvaticum* occupy very similar habitats along brooks and river sides.

Plants which tend towards strong vegetative expansion are distinctive in squares with larger areas of relatively stable habitats (and a low number of species), such as bogs and secondary alpine heaths. On the other hand, disturbed river or brook boundaries and cliffs, sites where frost-heaving occurs and other highly disturbed environments are occupied by ruderals and other short-lived species producing little or no vegetative expansion.

The primary and secondary strategies defined by Grime (1979) also reflect environmental variation. Competitors are a clear minority in the upper areas, whereas stress-tolerant competitors prevail. However, there is obviously a danger of circular reasoning: species occurring in alpine areas must all survive under stress factors caused by the short growing season, and therefore all somewhat competitive species occurring in these areas are stress-tolerant competitors.

The proportion of ruderal species in the squares correlates negatively with mean elevation and positively with area of mires (but note the small number of ruderal species). Competitive ruderals and 'CSR' strategists show similar kinds of distribution pattern; they both populate low areas, moist forests and water margins.

By distribution group, atlantic southern, disjunctive, eastern and southern species quite clearly prefer habitats in the Kevojoki valley, although they are all represented by very few species. The proportion of hemerochores in the squares correlates positively e.g. with xeric forest cover and length of cliffs and watercourses; this species group is absent in mires. Lowland species occur in various sites at low elevations, especially in moist forest habitats. Montane and northern species occur in the highest proportions in alpine areas. Species occurring in all Inari Lapland are obviously mostly mire plants; the positive correlation with secondary alpine heaths can be partly explained in terms of paludification processes (Heikkinen & Kalliola 1989: 28).

Correlations between different vertical distribution groups of species are somewhat self-evident; silvine and silvike species characterize low elevation sites, sunny cliff habitats, water margins and all but alpine vegetation. Alpine and ubiquitous plants show somewhat similar distribution patterns.

Soil acidity requirements of the species show some obvious and some contradictory correlations. Basoclines and basocoles quite clearly prefer cliffs, brook and river sides and moist forests in the River Kevojoki valley. However, there is also positive correlation with area of xeric forests, which is rather difficult to explain. Acidoclines and acidocoles seem to occur more in alpine areas and in mires.

It must again be stressed that there are many obvious pitfalls in interpreting the results. Because the tests were based on relative proportions of species (with different ecological characteristics) in the squares, the total number of species contributes to the results. This may give correlations with little ecological advantage, and at the same time obscure otherwise clear changes in absolute values. The 20-25 species which are present in most of the squares contribute to the floristic structure of the whole area, but this influence is most pronounced when the number of species is low. Excluding these might give more reliable correlations for further analysis.

Another real danger in using correlation tests is the uneven, and in some cases extremely low number of species in certain categories. Therefore the relevant correlations (e.g. for ruderals and the atlantic southern, disjunctive and eastern distribution groups) are somewhat vague. The statements made in chapter 4.1. concerning species richness and environmental variables also hold true here.

5. Index of families and genera

In the following indices, the first number refers to the plant list (appendix 1) and the second to the distribution maps (appendix 2).

5.1. Index of families

5.2. Index of genera

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Appendix 1. List of vascular plants observed in the Kevo Nature Reserve (see chapter 3. for information of columns).

		BELT =======						POL	DIA			
	FR	A	B	A-B	HEIG	LEAF	LIFEFORM	LINA TION	SPO RE	VEG. EXP.	STRA TEGY	HABITAT
LYCOPODIACEAE												
Diphasiastrum alpinum	85.7	96.3	80.8	***	5	E	CHAM	-	SPORO	2	CS	SNOWBEDS
Diphasiastrum complanatum	37.5	15.6	44.0	***	15	E	CHAM	-	SPORO	2	CS	XER/MES FOR.
Huperzia selago	73.0	85.3	65.3	***	10	E	CHAM	-	SPORO	0	S	SNOWBEDS, SHORES
Lycopodium annotinum annotinum	23.1	7.3	27.9	***	20	E	CHAM	-	SPORO	2	CS	MOIST FOR.
Lycopodium annotinum alpestre	72.2	56.0	76.6	***	10	E	CHAM	-	SPORO	2	CS	XER/MES FOR.
Lycopodium clavatum monostachyon	45.7	28.4	51.3	***	15	E	CHAM	-	SPORO	2	CS	XER/MES FOR.
SELAGINELLACEAE												
Selaginella selaginoides	43.5	19.3	50.9	***	5	E	CHAM	-	SPORO	1	S/SR	SHORES, CLIFFS
ISOËTACEAE												
Isoëtes echinospora	0.3	0.0	0.4				(SUBMERGED WATERPLANT)					LAKES
EQUISETACEAE												
Equisetum arvense	28.9	24.8	29.4		30	S	GEOP	-	SPORO	2	CSR	WIDE AMPL.
Equisetum fluviatile	20.1	2.8	26.0	***	50	S	HELO	-	SPORO	2	CS	LAKES
Equisetum palustre	37.5	17.4	43.0	***	30	S	GEOP	-	SPORO	2	CS	MIRES
Equisetum pratense	52.3	36.7	58.1	***	30	S	HEMI	-	SPORO	2	CSR	SHORES, SNOWBEDS
Equisetum scirpoides	4.1	0.0	5.7	*	10	E	HEMI	-	SPORO	1	SR	SHORES, SLOPES
Equisetum sylvaticum	61.2	30.3	67.9	***	35	S	HEMI	-	SPORO	2	CS	MOIST FOR., SHORES, MIRES
Equisetum variegatum	20.4	10.1	22.6	**	20	E	HEMI	-	SPORO	1	SR	GRAVEL
OPHIOGLOSSACEAE												
Botrychium boreale	3.9	2.8	3.4		10	S	GEOP	-	SPORO	0	SR	MEADOWS
Botrychium lunaria	3.3	1.8	3.4		10	S	GEOP	-	SPORO	0	SR	MEADOWS
Botrychium multifidum	0.3	0.0	0.4		10	S	GEOP	-	SPORO	0	SR	MEADOWS
THELYPTERIDACEAE												
Thelypteris phegopteris	18.2	5.5	22.3	***	20	S	GEOP	-	SPORO	2	CS	MOIST FOR., CLIFFS
ATHYRIACEAE												
Athyrium alpestre	2.2	4.6	1.1	*	40	S	HEMI	-	SPORO	1	CS	SNOWBEDS
Athyrium filix-femina	0.6	0.0	0.8		60	S	HEMI	-	SPORO	1	CS	MOIST FOR.
Cystopteris fragilis fragilis	7.4	3.7	8.3		15	S	HEMI	-	SPORO	1	S	CLIFFS
Cystopteris fragilis dickieana	1.1	0.0	1.5		15	S	HEMI	-	SPORO	1	S	CLIFFS
Cystopteris montana	1.1	0.0	1.5		15	S	HEMI	-	SPORO	1	CS	MOIST FOR., CLIFFS
Diplazium sibiricum	0.3	0.0	0.4		25	S	GEOP	-	SPORO	1	CS	MOIST FOR.
Matteuccia struthiopteris	0.3	0.0	0.4		100	S	HEMI	-	SPORO	2	C	MOIST FOR.
Woodsia alpina	6.9	0.0	8.7	**	10	S	HEMI	-	SPORO	0	S	CLIFFS
Woodsia glabella	3.3	0.0	4.5	*	8	S	HEMI	-	SPORO	0	S	CLIFFS
Woodsia ilvensis	3.0	0.0	3.8	*	15	S	HEMI	-	SPORO	0	S	CLIFFS
ASPIDIACEAE												
Dryopteris expansa	5.8	5.5	5.7		40	S	HEMI	-	SPORO	1	CS	SHORES, MOIST FOR.
Dryopteris fragrans	2.2	0.0	3.0		20	S	HEMI	-	SPORO	0	S	BOULDERS
Gymnocarpium dryopteris	24.5	9.2	29.8	***	20	S	GEOP	-	SPORO	2	CS	MOIST FOR., SHORES
Gymnocarpium dryopteris x jessoënse	3.3	0.0	4.2	*	20	S	GEOP	-	SPORO	1	S	SLOPES
Gymnocarpium jessoënse parvulum	0.6	0.0	0.4		20	S	GEOP	-	SPORO	1	S	RARE, BOULDERS
Polystichum lonchitis	0.8	0.0	1.1		25	E	HEMI	-	SPORO	1	S	SLOPES
POLYPODIACEAE												
Polypodium vulgare	5.5	1.8	6.8		15	E	HEMI	-	SPORO	2	CS	CLIFFS, SLOPES

	BELT FR	A	B	A-B	HEIG	LEAF	LIFE FORM	POLLINATION	DIASPORE	VEG. EXP.	STRATEGY	HABITAT
PINACEAE												
Pinus sylvestris	25.3	11.9	28.7	***	1400	E	PHAN	WI	PTERO	0	CS	VALLEY
CUPRESSACEAE												
Juniperus communis coll.	93.4	81.7	96.2	***	130	E	PHAN	WI	SACRO	1	CS	WIDE AMPL.
SALICACEAE												
Populus tremula	12.1	1.8	14.7	***	700	S	PHAN	WI	POGON	2	C	SLOPES
Salix borealis	27.6	4.6	34.7	***	500	S	PHAN	IN	POGON	1	CS	MOIST FOR.
Salix caprea coaetanea	8.3	0.0	11.4	***	600	S	PHAN	IN	POGON	1	CS	MOIST FOR., SLOPES
Salix glauca	84.6	65.1	90.6	***	130	S	PHAN	IN	POGON	2	C	WIDE AMPL.
Salix hastata	32.5	11.0	40.0	***	100	S	PHAN	IN	POGON	2	C	SHORES
Salix herbacea	56.2	88.1	43.4	***	3	S	CHAM	IN	POGON	2	CS	SNOWBEDS
Salix lanata lanata	8.0	4.6	9.1		100	S	PHAN	IN	POGON	2	C	SHORES
Salix lanata glandulifera	0.3	0.0	0.4		100	S	PHAN	IN	POGON	2	C	SHORES
Salix lapponum	66.7	36.7	75.1	***	120	S	PHAN	IN	POGON	2	C	SHORES
Salix myrsinifolia	4.7	0.0	6.4	**	300	S	PHAN	IN	POGON	1	CS	MOIST FOR.
Salix myrsinites	33.6	30.3	32.8		60	S	PHAN	IN	POGON	1	CS	FENS, GRAVEL
Salix myrtilloides	4.7	0.0	6.0	**	50	S	PHAN	IN	POGON	1	CS	FENS
Salix phylicifolia	69.4	33.9	81.1	***	180	S	PHAN	IN	POGON	2	C	SHORES
Salix reticulata	0.3	0.9	0.0		5	S	CHAM	IN	POGON	2	CS	RARE
Salix xerophila	1.7	0.0	1.9		80	S	PHAN	IN	POGON	1	CS	XER/MES FOR.
BETULACEAE												
Alnus incana kolaënsis	1.4	0.0	1.9		500	S	PHAN	WI	PTERO	1	CS	VALLEY
Betula nana	98.9	97.2	98.1		100	S	CHAM	WI	PTERO	2	CS	WIDE AMPL.
Betula pubescens tortuosa	84.3	47.7	97.7	***	1200	S	PHAN	WI	PTERO	1	C	FORESTS
URTICACEAE												
Urtica dioica sondenii	0.6	0.0	0.8		60	S	HEMI	WI	SCLER	2	C	SLOPES
POLYGONACEAE												
Oxyria digyna	10.5	6.4	11.7		10	S	HEMI	AP	PTERO	1	SR	GRAVEL
Polygonum viviparum	73.8	60.6	77.7	***	15	S	GEOP	AP	SCLER	0	CSR	SHORES, MEADOWS
Rumex acetosa acetosa	7.4	7.3	7.2		30	S	HEMI	WI	PTERO	1	CSR	MEADOWS, SNOWBEDS
Rumex acetosa lapponicus	0.9	0.9	0.8		30	S	HEMI	WI	PTERO	1	CS	SHORES, GRAVEL
Rumex acetosella acetosella	0.6	0.0	0.8		25	S	HEMI	WI	PTERO	2	CSR	CASUAL
Rumex acetosella tenuifolius	2.8	0.0	3.8	*	25	S	HEMI	WI	PTERO	2	CSR	GRAVEL
PORTULACACEAE												
Montia fontana	0.3	0.9	0.0		10	S	THER	SE	SCLER	0	R	SNOWBEDS
CARYOPHYLLACEAE												
Cerastium alpinum alpinum	10.7	3.7	12.8	**	13	S	CHAM	IN	SCLER	1	CSR	GRAVEL, CLIFFS
Cerastium alpinum glabratum	1.1	2.8	0.4	*	10	S	CHAM	IN	SCLER	1	CSR	GRAVEL
Cerastium alpinum lanatum	0.3	0.0	0.4		13	S	CHAM	IN	SCLER	1	CSR	CLIFFS, BOULDERS
Cerastium cerastoides	14.3	26.6	9.4	***	7	S	CHAM	SE	SCLER	1	SR	GRAVEL, SPRINGS
Cerastium fontanum scandicum	12.7	1.8	15.8	***	25	S	CHAM	SE	SCLER	1	SR	SHORES, MEADOWS
Cerastium fontanum triviale	0.6	0.0	0.8		25	S	CHAM	IN	SCLER	1	SR	CASUAL
Lychnis alpina	5.8	6.4	5.3		15	S	HEMI	IN	SCLER	0	SR	GRAVEL
Minuartia biflora	0.9	0.9	0.8		6	S	CHAM	IN	SCLER	0	SR	GRAVEL
Sagina nivalis	0.6	1.8	0.0	*	3	S	HEMI	SE	SCLER	0	SR	SPRINGS, GRAVEL
Sagina saginoides	3.3	6.4	1.9	*	8	S	HEMI	IN	SCLER	0	SR	GRAVEL, SNOWBEDS
Silene acaulis	2.8	5.5	1.5	*	5	S	CHAM	IN	SCLER	1	SR	ALPINE, GRAVEL
Stellaria calycantha	36.9	13.8	44.5	***	10	S	HEMI	?	SCLER	1	SR	SHRUBBERIES, SPRINGS
Stellaria graminea	0.6	0.0	0.8		20	S	HEMI	IN	SCLER	2	CSR	SLOPES, CLIFFS
Stellaria longifolia	2.8	0.0	3.8	*	15	S	HEMI	IN	SCLER	2	CSR	SLOPES, VALLEY
Stellaria media	0.3	0.0	0.4		13	S	THER	SE	SCLER	1	R	CASUAL

	BELT FR	A	B	A-B	HEIG	LEAF	LIFE FORM	POLLINATION	DIASPORE	VEG. EXP.	STRATEGY	HABITAT
RANUNCULACEAE												
Caltha palustris coll.	48.2	20.2	56.6	***	30	S	HEMI	IN	SCLER	1	C	WATERCOURSES
Ranunculus acris coll.	6.1	4.6	6.8		25	S	HEMI	IN	DESMO	0	CSR	MEADOWS
Ranunculus auricomus coll.	2.5	0.9	2.6		25	S	HEMI	AP	DESMO	0	CSR	MOIST FOR., MEADOWS
Ranunculus hyperboreus	13.2	0.9	17.0	***	8	S	HELO	IN	DESMO	1	R	FENS
Ranunculus lapponicus	3.6	0.0	4.2	*	15	S	HEMI	IN	DESMO	1	SR	MOIST FOR., SHRUBBERIES
Ranunculus nivalis	2.2	5.5	1.1	*	10	S	HEMI	IN	DESMO	0	SR	SNOWBEDS, GRAVEL
Ranunculus peltatus	3.9	0.0	4.2	*			(SUBMERGED WATERPLANT)					WATERCOURSES
Ranunculus pygmaeus	2.5	6.4	0.8	**	4	S	HEMI	IN	DESMO	0	SR	SNOWBEDS
Ranunculus repens	1.4	1.8	1.1		15	S	HEMI	IN	DESMO	2	CR	SHORES
Ranunculus reptans	8.3	3.7	8.7		5	S	HEMI	SE	DESMO	1	SR	WATERCOURSES
Ranunculus trichophyllus eradicatus	1.1	0.0	1.1				(SUBMERGED WATERPLANT)					WATERCOURSES
Thalictrum alpinum	28.4	15.6	31.3	**	12	S	HEMI	WI	SCLER	0	SR	SHORES, MEADOWS
Trollius europaeus	62.5	33.0	73.2	***	40	S	HEMI	IN	SCLER	0	CSR	MOIST FOR., MEADOWS
BRASSICACEAE												
Arabis alpina	9.9	9.2	9.8		20	S	CHAM	IN	PTERO	0	SR	SHORES, SPRINGS
Barbarea stricta	2.8	0.0	3.4		50	S	HEMI	IN	SCLER	0	R	SHORES
Cardamine bellidifolia	6.1	10.1	4.2	*	5	S	CHAM	IN	BALLO	1	SR	SNOWBEDS, GRAVEL
Cardamine pratensis dentata	0.3	0.0	0.4		30	S	HEMI	IN	BALLO	0	SR	SHORES
Cardamine pratensis polemonioides	17.6	11.9	18.9		10	S	HEMI	IN	BALLO	0	SR	SHORES, SPRINGS
Draba daurica	2.5	0.0	3.4		20	S	CHAM	?	SCLER	0	SR	CLIFFS
Draba norvegica	1.1	0.0	1.5		15	S	CHAM	?	SCLER	0	SR	CLIFFS
Erysimum hieraciifolium	0.6	0.0	0.8		50	S	HEMI	IN	SCLER	0	CR	SLOPES
Subularia aquatica	1.4	0.0	1.9				(SUBMERGED WATERPLANT)					LAKES
DROSERACEAE												
Drosera anglica	0.3	0.0	0.4		12	S	HEMI	VA	SCLER	0	SR	MIRES
Drosera rotundifolia	1.1	0.0	1.5		12	S	HEMI	VA	SCLER	0	SR	MIRES
SAXIFRAGACEAE												
Chrysosplenium tetrandrum	4.4	0.0	5.3	*	5	S	HEMI	VA	SCLER	0	SR/CSR	SPRINGS
Saxifraga aizoides	0.8	0.0	1.1		10	S	CHAM	IN	SCLER	1	SR	GRAVEL, CLIFFS
Saxifraga cernua	2.5	0.0	3.4		15	S	HEMI	AP	SCLER	0	SR	CLIFFS
Saxifraga cespitosa	2.8	0.0	3.4		10	S	CHAM	IN	SCLER	1	CSR	CLIFFS
Saxifraga nivalis	8.5	1.8	10.2	**	15	S	HEMI	IN	SCLER	1	SR	CLIFFS
Saxifraga oppositifolia	3.0	0.0	4.2	*	5	S	CHAM	IN	SCLER	2	CSR	CLIFFS
Saxifraga rivularis	4.1	6.4	3.0		5	S	HEMI	AP	SCLER	1	SR	SPRINGS
Saxifraga stellaris	19.3	26.6	15.8	*	10	S	HEMI	IN	SCLER	0	SR	SNOWBEDS, SPRINGS, GRAVEL
Saxifraga tenuis	0.3	0.0	0.4		8	S	HEMI	IN	SCLER	0	SR	RARE
PARNASSIACEAE												
Parnassia palustris	23.7	1.8	30.9	***	15	S	HEMI	IN	SCLER	0	SR	SHORES
GROSSULARIACEAE												
Ribes spicatum lapponicum	7.2	0.9	8.7	**	120	S	PHAN	IN	SACRO	0	C	MOIST FOR.
ROSACEAE												
Alchemilla alpina	0.6	1.8	0.0	*	5	S	HEMI	AP	SCLER	2	CS	SNOWBEDS
Alchemilla glomerulans	37.2	18.3	43.8	***	30	S	HEMI	AP	SCLER	2	CS	SHORES, MOIST FOR.
Alchemilla murbeckiana	16.5	13.8	16.6		15	S	HEMI	AP	SCLER	2	CSR	SHORES, MOIST FOR.
Alchemilla wichurae	0.3	0.0	0.4		10	S	HEMI	AP	SCLER	2	CS	RARE
Dryas octopetala	8.3	22.0	2.3	***	12	E	CHAM	IN	POGON	2	CS	ALPINE
Filipendula ulmaria	17.9	0.9	23.8	***	70	S	HEMI	IN	SCLER	1	CS	MOIST FOR.
Geum rivale	0.8	0.0	0.8		35	S	HEMI	IN	DESMO	0	CS	MOIST FOR.
Potentilla crantzii	18.2	10.1	20.4	*	20	S	CHAM	AP	SCLER	1	CSR	SHORES, MEADOWS
Potentilla nivea coll.	2.5	0.0	3.0		25	S	CHAM	AP	SCLER	0	SR	CLIFFS

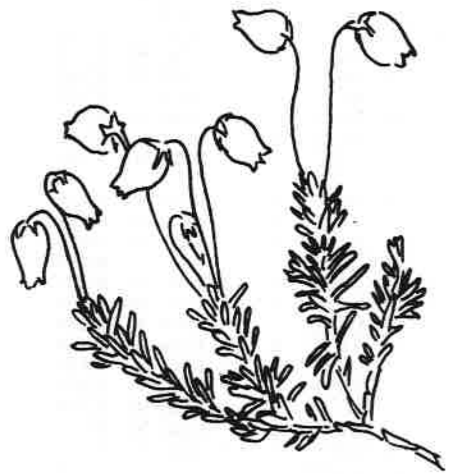
	FR	BELT A	BELT B	A-B	HEIG	LEAF	LIFE FORM	POL LINA TION	DIA SPO RE	VEG. EXP.	STRA TEGY	HABITAT
Potentilla norvegica	0.6	0.0	0.4		35	S	THER	AP	SCLER	0	R	CLIFFS
Potentilla palustris	66.4	41.3	73.2	***	35	S	HEMI	IN	SCLER	2	CS	FENS, SHORES
Prunus padus borealis	0.6	0.0	0.8		250	S	PHAN	IN	SACRO	1	C	MOIST FOR.
Rubus arcticus	41.3	6.4	53.6	***	20	S	HEMI	IN	SACRO	2	CSR	MOIST FOR.
Rubus chamaemorus	68.3	38.5	76.6	***	20	S	HEMI	IN	SACRO	2	CS	BOGS
Rubus saxatilis	16.3	2.8	20.0	***	20	S	HEMI	IN	SACRO	2	CSR	MOIST FOR., BOULDERS, SLOPES
Sibbaldia procumbens	22.9	51.4	11.7	***	10	S	CHAM	IN	SCLER	2	CS	SNOWBEDS
Sorbus aucuparia aucuparia	16.3	3.7	20.0	***	600	S	PHAN	IN	SACRO	0	C	SLOPES
Sorbus aucuparia glabrata	2.8	2.8	2.6		600	S	PHAN	IN	SACRO	0	C	SLOPES
FABACEAE												
Astragalus alpinus	6.1	0.9	7.5	*	15	S	HEMI	IN	PTERO	1	CSR	GRAVEL
Astragalus frigidus	5.8	0.9	6.8	*	30	S	HEMI	IN	PTERO	1	CSR	MOIST FOR., SLOPES
GERANIACEAE												
Geranium sylvaticum	53.7	11.9	68.7	***	50	S	HEMI	IN	BALLO	0	C	MOIST FOR., MEADOWS
VIOLACEAE												
Viola biflora	39.7	24.8	44.5	***	10	S	HEMI	IN	SCLER	0	S	SHORES, MOIST FOR.
Viola epipsila	66.7	39.4	75.1	***	15	S	HEMI	IN	SCLER	1	S	SHORES
Viola palustris	2.8	1.8	3.0		7	S	HEMI	IN	SCLER	1	S	SHORES
ONAGRACEAE												
Epilobium alsinifolium	2.8	1.8	3.0		20	S	HEMI	AP	POGON	1	CSR	SPRINGS
Epilobium anagallidifolium	15.7	22.9	12.1	**	10	S	HEMI	AP	POGON	1	SR	SNOWBEDS, GRAVEL
Epilobium angustifolium	37.2	17.4	44.2	***	70	S	HEMI	IN	POGON	2	CR	SLOPES, CLIFFS, BOULDERS
Epilobium collinum	0.3	0.0	0.4		25	S	HEMI	AP	POGON	1	SR	CLIFFS
Epilobium davuricum	2.8	0.0	3.0		20	S	HEMI	AP	POGON	1	SR	GRAVEL
Epilobium hornemannii	33.3	24.8	36.2	*	20	S	HEMI	AP	POGON	1	SR	SPRINGS
Epilobium lactiflorum	0.3	0.9	0.0		25	S	HEMI	AP	POGON	1	SR	RARE
Epilobium palustre	49.3	21.1	58.5	***	30	S	HEMI	AP	POGON	1	CSR	FENS, SPRINGS, SHORES
MYRIOPHYLLACEAE												
Myriophyllum alterniflorum	3.3	0.9	3.4				(SUBMERGED WATERPLANT)					LAKES
HIPPURIDACEAE												
Hippuris vulgaris	4.4	0.9	4.9				(SUBMERGED WATERPLANT)					LAKES
CORNACEAE												
Cornus suecica	67.5	21.1	82.6	***	15	S	HEMI	IN	SACRO	2	CS	MOIST FOR., SHORES
APIACEAE												
Angelica archangelica archangelica	23.7	9.2	28.3	***	175	S	HEMI	IN	PTERO	1	C	MOIST FOR., SHORES
DIAPENSIACEAE												
Diapensia lapponica	13.5	30.3	6.8	***	5	E	CHAM	IN	SCLER	1	S	ALPINE
PYROLACEAE												
Moneses uniflora	0.6	0.0	0.8		10	E	CHAM	IN	SCLER	1	S	CONIFER
Orthilia secunda	9.7	5.5	10.2		15	E	CHAM	SE	SCLER	1	S	SHORES
Pyrola minor	51.5	29.4	59.2	***	15	E	HEMI	IN	SCLER	1	S	FORESTS, GRAVEL
Pyrola rotundifolia norvegica	4.7	2.8	5.3		15	E	HEMI	IN	SCLER	1	S	FORESTS
ERICACEAE												
Andromeda polifolia	74.4	56.0	78.1	***	15	E	CHAM	VA	SCLER	1	S	MIRES
Arctostaphylos alpinus	79.9	83.5	76.6		5	S	CHAM	VA	SACRO	2	CS	ALPINE
Arctostaphylos uva-ursi	10.7	3.7	12.5	**	10	E	CHAM	VA	SACRO	2	CS	SLOPES

	FR	BELT A	BELT B	A-B	HEIG	LEAF	LIFE FORM	POL LINA TION	DIA SPO RE	VEG. EXP.	STRA TEGY	HABITAT
Calluna vulgaris	69.1	63.3	68.7		25	E	CHAM	VA	DESMO	1	S	XER/MES FOR.
Cassiope hypnoides	22.6	51.4	10.2	***	8	E	CHAM	VA	SCLER	1	S	SNOWBEDS
Ledum palustre	72.2	28.4	87.2	***	40	E	CHAM	IN	SCLER	0	S	BOGS
Loiseleuria procumbens	78.8	89.9	72.8	***	5	E	CHAM	VA	SCLER	1	CS	ALPINE
Phyllodoce caerulea	95.3	95.4	93.2		20	E	CHAM	IN	SCLER	2	CS	ALPINE, XER/MES FOR.
Vaccinium microcarpum	36.4	5.5	46.8	***	10	E	CHAM	IN	SACRO	1	S	BOGS
Vaccinium myrtillus	98.3	93.6	98.5	*	25	S	CHAM	IN	SACRO	2	CS	WIDE AMPL.
Vaccinium oxycoccos	0.6	1.8	0.0	*	10	E	CHAM	IN	SACRO	1	S	FENS
Vaccinium uliginosum	98.1	93.6	98.1	*	35	S	CHAM	IN	SACRO	1	CS	WIDE AMPL.
Vaccinium vitis-idaea	99.2	96.3	98.9		10	E	CHAM	IN	SACRO	2	CS	WIDE AMPL.
EMPETRACEAE												
Empetrum nigrum hermaphroditum	98.1	95.4	97.7		15	E	CHAM	IN	SACRO	2	CS	WIDE AMPL.
PRIMULACEAE												
Primula stricta	0.6	0.0	0.8		15	S	HEMI	IN	SCLER	0	SR	CLIFFS
Trientalis europaea	78.2	50.5	87.5	***	10	S	GEOP	IN	SCLER	1	S	WIDE AMPL.
GENTIANACEAE												
Gentiana nivalis	0.3	0.0	0.4		15	S	THER	?	SCLER	0	R	GRAVEL
MENYANTHACEAE												
Menyanthes trifoliata	15.4	0.0	20.8	***	30	S	HELO	IN	SCLER	2	CS	FENS, WATERCOURSES
POLEMONIACEAE												
Polemonium acutiflorum	1.9	0.0	2.6		40	S	HEMI	IN	SCLER	0	CSR	MOIST FOR.
BORAGINACEAE												
Lappula deflexa	1.9	0.0	2.3		40	S	THER	IN	DESMO	0	SR	CLIFFS
Myosotis decumbens	5.8	0.9	7.5	*	25	S	HEMI	IN	SCLER	0	CSR	MOIST FOR.
CALLITRICHACEAE												
Callitriche palustris	0.8	0.0	1.1				(SUBMERGED WATERPLANT)					WATERCOURSES
SCROPHULARIACEAE												
Bartsia alpina	67.8	58.7	69.1		25	S	HEMI	IN	PTERO	0	S	MEADOWS, MOIST FOR., SHORES
Euphrasia frigida	29.2	14.7	33.2	***	10	S	THER	SE	SCLER	0	SR	GRAVEL, MEADOWS
Melampyrum pratense	29.2	4.6	37.7	***	25	S	THER	IN	SCLER	0	S	FORESTS
Pedicularis lapponica	84.8	68.8	89.4	***	20	S	HEMI	IN	SCLER	0	S	XER/MES FOR., ALPINE
Pedicularis sceptrum-carolinum	1.4	0.0	1.5		50	S	HEMI	IN	SCLER	0	CSR	GRAVEL
Rhinanthus groenlandicus	2.8	2.8	2.6		30	S	THER	IN	PTERO	0	CSR	MEADOWS
Veronica alpina	13.8	15.6	12.1		15	S	HEMI	VA	SCLER	0	SR	GRAVEL
Veronica longifolia	1.9	0.0	1.9		50	S	HEMI	IN	SCLER	1	CS	MOIST FOR., MEADOWS
LENTIBULARIACEAE												
Pinguicula alpina	14.0	8.3	14.7		12	S	HEMI	IN	SCLER	0	S	GRAVEL, CLIFFS
Pinguicula villosa	5.2	0.0	7.2	**	7	S	HEMI	IN	SCLER	0	S	BOGS
Pinguicula vulgaris	64.7	56.9	65.3		15	S	HEMI	IN	SCLER	0	S	GRAVEL, CLIFFS, MIRES
Utricularia minor	1.1	0.0	1.5				(SUBMERGED WATERPLANT)					POOLS
Utricularia vulgaris	0.6	0.0	0.8				(SUBMERGED WATERPLANT)					POOLS
PLANTAGINACEAE												
Plantago major major	0.3	0.0	0.4		20	S	HEMI	WI	DESMO	0	SR	CASUAL
RUBIACEAE												
Galium boreale	1.8	0.0	1.5		35	S	HEMI	IN	DESMO	1	CS	MEADOWS
Galium trifidum	1.1	0.0	1.1		20	S	HEMI	IN	DESMO	0	CSR	SHORES
Galium uliginosum	30.3	2.8	39.2	***	20	S	HEMI	IN	DESMO	0	CSR	MOIST FOR., SHORES

	FR	A	B	A-B	HEIG	LEAF	LIFE FORM	POLLINATION	DIASPORE	VEG. EXP.	STRATEGY	HABITAT
		BELT										
CAPRIFOLIACEAE												
Linnaea borealis	72.2	42.2	81.9	***	10	E	CHAM	IN	DESMO	1	S	WIDE AMPL.
CAMPANULACEAE												
Campanula rotundifolia coll.	42.4	33.9	43.0		30	S	HEMI	IN	SCLER	0	SR	XER/MES FOR., BOULDERS, GRAVEL
ASTERACEAE												
Achillea millefolium coll.	6.9	3.7	7.5		30	S	HEMI	IN	POGON	1	CR	MEADOWS
Antennaria alpina coll.	1.4	0.0	1.9		10	S	CHAM	AP	POGON	1	SR	GRAVEL, CLIFFS
Antennaria dioica	71.3	73.4	68.3		10	S	HEMI	IN	POGON	1	SR	XER/MES FOR., ALPINE, GRAVEL
Arnica alpina	0.3	0.0	0.4		30	S	HEMI	IN	POGON	0	CSR/SR	CLIFFS
Cirsium helenioides	39.7	6.4	50.9	***	100	S	HEMI	IN	POGON	1	CR	MOIST FOR.
Erigeron acer politus	0.3	0.0	0.4		25	S	HEMI	IN	POGON	0	SR	CLIFFS
Gnaphalium norvegicum	11.3	8.3	12.5		25	S	HEMI	VA?	POGON	0	CSR	MOIST FOR.
Gnaphalium supinum	33.9	62.4	21.5	***	10	S	HEMI	VA?	POGON	1	SR	SNOWBEDS, GRAVEL
Petasites frigidus	4.4	1.8	4.9		30	S	HEMI	IN	POGON	2	C	MOIST FOR.
Saussurea alpina	59.8	33.9	67.9	***	40	S	HEMI	IN	POGON	0	CSR	MOIST FOR., MEADOWS
Solidago virgaurea	95.3	88.1	96.6	**	35	S	HEMI	IN	POGON	0	S	WIDE AMPL.
Tussilago farfara	0.3	0.9	0.0		15	S	HEMI	IN	POGON	2	CR	RARE
CICHORIACEAE												
Crepis tectorum nigrescens	0.3	0.0	0.4		30	S	HEMI	IN	POGON	0	CSR	CLIFFS, SLOPES
Hieracium alpinum coll.	57.3	67.0	52.1	**	20	S	HEMI	AP	POGON	0	CSR	ALPINE
Taraxacum croceum coll.	61.7	55.0	64.5		12	S	HEMI	AP	POGON	0	SR	SHORES
SPARGANIACEAE												
Sparganium angustifolium	4.4	0.0	6.0	**			(SUBMERGED WATERPLANT)					LAKES
Sparganium emersum	0.3	0.0	0.4				(SUBMERGED WATERPLANT)					LAKES
Sparganium hyperboreum	9.9	0.9	12.5	***			(SUBMERGED WATERPLANT)					POOLS
Sparganium minimum	0.6	0.0	0.8				(SUBMERGED WATERPLANT)					RARE
JUNCAGINACEAE												
Triglochin palustre	6.9	5.5	6.0		30	S	HEMI	WI	DESMO	1	SR	SHORES, MIRES
POTAMOGETONACEAE												
Potamogeton alpinus	1.1	0.0	1.5				(SUBMERGED WATERPLANT)					LAKES
Potamogeton gramineus	2.8	0.0	3.0				(SUBMERGED WATERPLANT)					LAKES
Potamogeton perfoliatus	0.3	0.0	0.4				(SUBMERGED WATERPLANT)					LAKES
LILIACEAE												
Paris quadrifolia	2.8	0.0	3.8	*	25	S	GEOP	IN	SACRO	1	CS	MOIST FOR.
Tofieldia pusilla	51.8	52.3	49.1		15	S	HEMI	IN?	SCLER	0	SR	SHORES, BOGS
JUNCACEAE												
Juncus alpinoarticulatus alpestris	5.8	3.7	5.7		30	S	HEMI	WI	DESMO	2	CR	GRAVEL, SHORES
Juncus biglumis	40.8	41.3	37.7		15	S	GEOP	WI	DESMO	1	SR	SNOWBEDS, SPRINGS
Juncus filiformis	48.8	34.9	51.7	*	40	S	GEOP	WI	DESMO	2	CS	SHORES, FENS
Juncus stygius	0.6	0.0	0.8		20	S	HEMI	WI	DESMO	1	SR/CSR	GRAVEL
Juncus trifidus	89.5	94.5	84.9	*	25	S	HEMI	WI	DESMO	1	CS	ALPINE, XER/MES FOR.
Juncus triglumis	3.6	0.9	4.2		15	S	GEOP	WI	DESMO	1	SR	SPRINGS, SHORES
Luzula arcuata arcuata	4.7	11.0	1.9	***	25	S	HEMI	WI	SCLER	1	S	ALPINE
Luzula multiflora frigida	25.6	15.6	28.7	**	25	S	HEMI	WI	DESMO	1	SR	MEADOWS, SHORES
Luzula pallescens	2.2	0.9	2.3		25	S	HEMI	WI	DESMO	0	SR	MOIST FOR., SHORES
Luzula parviflora	21.5	6.4	26.0	***	35	S	HEMI	WI	DESMO	0	SR	SHORES, MOIST FOR.
Luzula pilosa	16.5	4.6	21.5	***	20	S	HEMI	WI	DESMO	0	CSR	MOIST FOR.
Luzula spicata	63.4	68.8	59.2		20	S	HEMI	WI	DESMO	1	SR	ALPINE, XER/MES FOR.
Luzula sudetica	51.2	22.0	60.0	***	25	S	HEMI	WI	DESMO	0	SR	MOIST FOR., SHORES
Luzula wahlenbergii	4.7	11.9	1.5	***	20	S	HEMI	WI	DESMO	0	SR	GRAVEL, SNOWBEDS

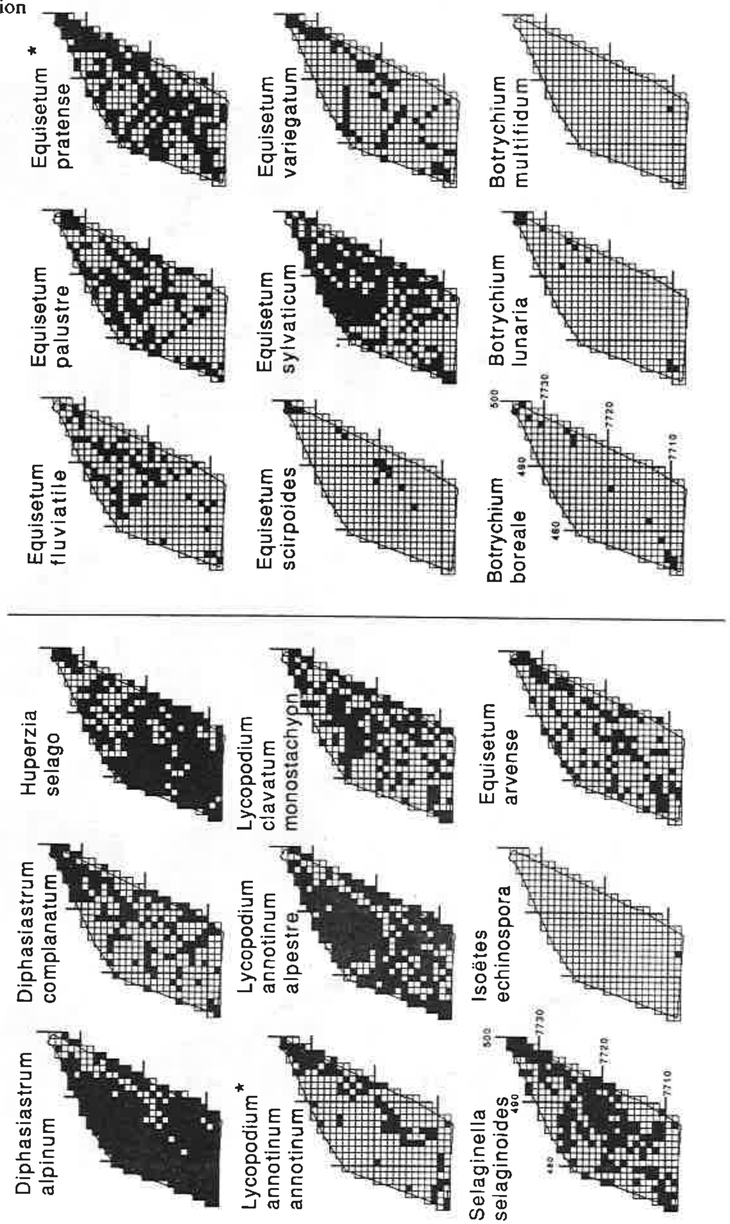
	FR	A	B	A-B	HEIG	LEAF	LIFE FORM	POLLINATION	DIASPORE	VEG. EXP.	STRATEGY	HABITAT
		BELT										
POACEAE												
Agrostis mertensii	71.9	58.7	74.7	**	25	S	HEMI	WI	SCLER	1	CSR	SHORES, MEADOWS
Agrostis stolonifera	0.3	0.0	0.4		35	S	HEMI	WI	SCLER	2	CR	RARE
Agrostis vinealis	2.8	1.8	2.3		35	S	HEMI	WI	SCLER	1	CSR	SHORES
Alopecurus aequalis	7.2	0.9	8.7	**	20	S	HEMI	WI	DESMO	1	CSR	POOLS
Anthoxanthum odoratum alpinum	56.5	42.2	61.1	***	25	S	HEMI	WI	SCLER	1	CSR	SHORES, MEADOWS
Calamagrostis lapponica	76.6	46.8	86.0	***	50	S	HEMI	AP	SCLER	1	CSR	XER/MES FOR.
Calamagrostis purpurea	61.6	24.8	73.6	***	100	S	HEMI	AP	SCLER	1	CS	MOIST FOR.
Calamagrostis stricta	51.8	38.5	54.7	**	50	S	HEMI	WI	SCLER	1	CS	SHORES
Deschampsia cespitosa	24.0	19.3	24.2		50	S	HEMI	WI	SCLER	1	CR	GRAVEL, MEADOWS
Deschampsia flexuosa	95.6	90.8	94.7		25	S	HEMI	WI	SCLER	1	CS	WIDE AMPL.
Elymus alaskanus scandicus	0.6	0.0	0.8		50	S	HEMI	WI	SCLER	1	SR	CLIFFS, SLOPES
Elymus caninus	6.3	0.0	8.7	**	70	S	HEMI	WI	SCLER	1	C/CR	MOIST FOR.
Elymus mutabilis	3.9	1.8	4.5		100	S	HEMI	WI	SCLER	1	CR	MOIST FOR., SHORES
Festuca ovina	97.0	94.5	96.2		25	S	HEMI	WI	SCLER	0	CSR	XER/MES FOR., ALPINE
Festuca rubra rubra	5.8	0.9	7.2	*	50	S	HEMI	WI	SCLER	1	CS	SHORES, MEADOWS
Hierochloë hirta arctica	10.2	5.5	9.8		50	S	GEOP	WI	SCLER	1	CSR	SHORES, MEADOWS
Melica nutans	14.9	1.8	19.6	***	35	S	GEOP	WI	SCLER	1	CSR	MOIST FOR.
Milium effusum	4.7	3.7	5.3		70	S	HEMI	WI	SCLER	1	CS	MOIST FOR.
Molinia caerulea	0.8	0.9	0.8		40	S	HEMI	WI	SCLER	1	CS	SHORES
Nardus stricta	66.7	77.1	60.4	**	25	S	HEMI	WI	SCLER	1	CS	SNOWBEDS
Phleum alpinum	33.9	34.9	32.1		30	S	HEMI	WI	DESMO	1	SR	SHORES, MEADOWS
Phleum pratense pratense	0.3	0.0	0.4		60	S	HEMI	WI	DESMO	1	CR	CASUAL
Poa alpina	9.1	15.6	6.0	**	25	S	HEMI	AP	SCLER	1	CSR	GRAVEL
Poa annua	0.3	0.0	0.4		20	S	THER	SE	SCLER	1	CR	CASUAL
Poa arctica	1.1	0.0	1.5		25	S	GEOP	WI	SCLER	1	SR	BOULDERS, MEADOWS
Poa glauca	3.0	0.0	3.8	*	30	S	HEMI	WI	SCLER	1	SR	CLIFFS
Poa nemoralis	16.8	2.8	20.8	***	40	S	HEMI	WI	SCLER	1	CSR	MOIST FOR.
Poa alpigena	51.2	30.3	57.0	***	70	S	GEOP	WI	SCLER	1	CR	MEADOWS, SHORES, SPRINGS
Vahlodea atropurpurea	39.4	28.4	42.6	*	25	S	HEMI	WI	SCLER	1	SR	SHORES
CYPERACEAE												
Carex aquatilis	55.9	31.2	63.0	***	70	S	GEOP	WI	SCLER	2	CS	WATERCOURSES
Carex bigelowii	92.6	92.7	91.3		30	S	GEOP	WI	SCLER	2	CS	ALPINE
Carex brunnescens brunnescens	60.3	39.4	67.2	***	40	S	HEMI	WI	SCLER	1	CR	XER/MES FOR.
Carex brunnescens laetior	1.9	0.0	2.6		30	S	HEMI	WI	SCLER	1	CSR	MOIST FOR.
Carex buxbaumii buxbaumii	3.3	1.8	3.8		50	S	GEOP	WI	SCLER	1	CS	FENS, SHORES
Carex buxbaumii mutica	25.6	21.1	25.3		40	S	GEOP	WI	SCLER	1	CSR/CS	FENS, SHORES
Carex canescens	65.8	39.4	73.2	***	40	S	HEMI	WI	SCLER	1	CS	FENS, SHORES
Carex capillaris	14.6	2.8	18.1	***	20	S	HEMI	WI	SCLER	0	CSR	MEADOWS, FENS, CLIFFS
Carex cespitosa	11.6	2.8	14.3	**	50	S	HEMI	WI	SCLER	1	CS	MOIST FOR., SHORES, SPRINGS
Carex chordorrhiza	9.9	0.9	13.2	***	25	S	GEOP	WI	SCLER	2	CS	FENS
Carex dioica	32.5	9.2	39.6	***	20	S	GEOP	WI	SCLER	1	S	FENS
Carex flava	0.3	0.0	0.4		35	S	HEMI	WI	DESMO	1	CS	FENS
Carex glacialis	7.2	19.3	2.3	***	12	S	HEMI	WI	SCLER	0	SR	ALPINE
Carex lachenalii	21.8	49.5	10.2	***	30	S	HEMI	WI	SCLER	0	CSR	SNOWBEDS
Carex lasiocarpa	12.9	0.9	17.4	***	60	S	HELO	WI	SCLER	2	CS	FENS, SHORES
Carex limosa	10.5	0.9	13.6	***	30	S	GEOP	WI	SCLER	1	SR	FENS
Carex livida	1.1	0.0	1.5		25	S	GEOP	WI	SCLER	1	CSR	FENS
Carex loliacea	12.7	1.8	15.5	***	30	S	HEMI	WI	SCLER	0	SR	MOIST FOR., SHORES
Carex magellanica irrigua	61.4	32.1	70.2	***	30	S	HEMI	WI	SCLER	1	CSR	FENS
Carex nigra juncella	57.0	22.0	68.7	***	60	S	HEMI	WI	SCLER	1	CS	SHORES
Carex nigra nigra	0.3	0.0	0.4		35	S	HEMI	WI	SCLER	2	CSR	RARE
Carex norvegica norvegica	2.2	0.9	2.6		30	S	HEMI	WI	SCLER	1	CSR	SHORES
Carex norvegica inferalpina	23.1	8.3	27.2	***	35	S	HEMI	WI	SCLER	1	CSR	MOIST FOR., SHORES
Carex panicea	0.3	0.0	0.4		35	S	GEOP	WI	SCLER	1	CSR	MEADOWS
Carex parallela	0.3	0.9	0.0		20	S	GEOP	WI	SCLER	1	S	RARE

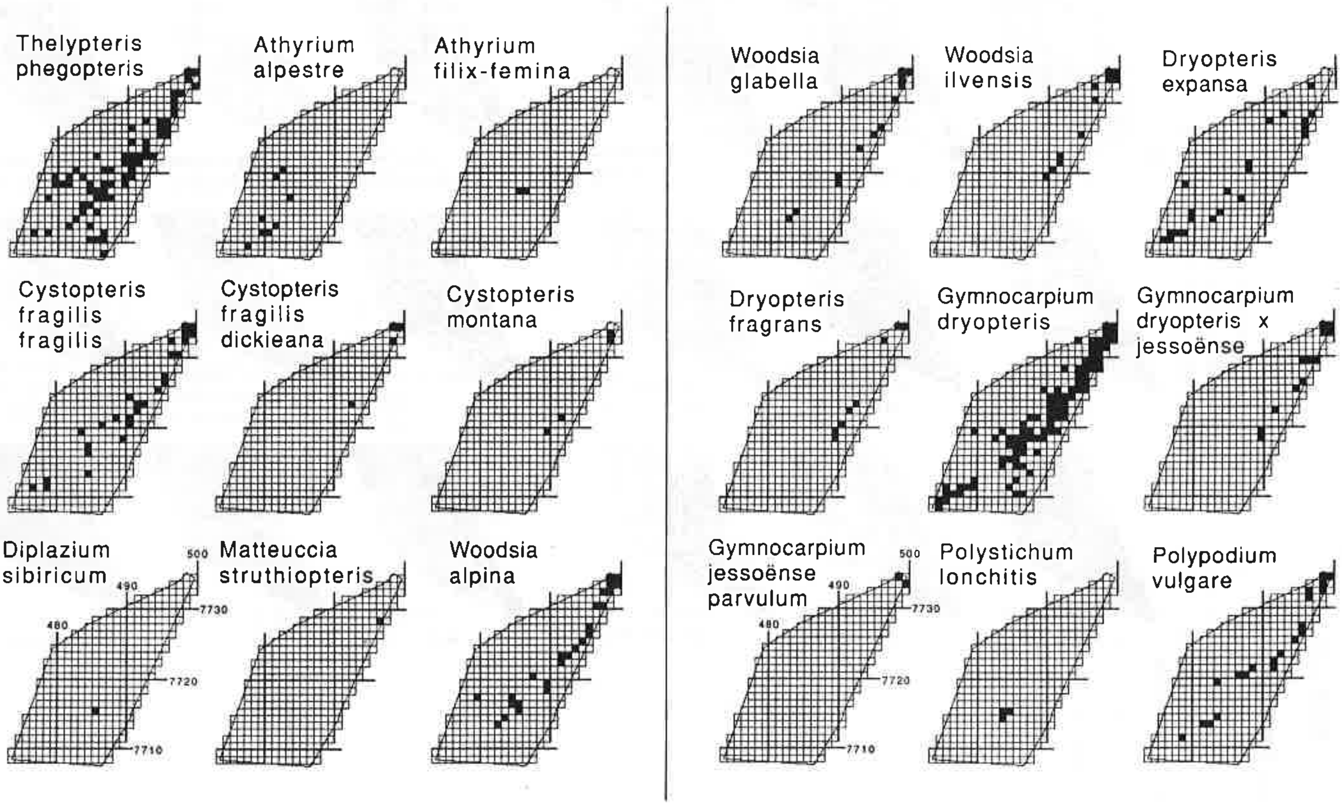
	FR	BELT A	BELT B	A-B	HEIG	LEAF	LIFEFORM	POLLINATION	DIASPORE	VEG. EXP.	STRATEGY	HABITAT
Carex pauciflora	1.7	0.0	2.3		20	S	GEOP	WI	DESMO	1	S	BOGS
Carex rariflora	8.5	3.7	9.8	•	20	S	GEOP	WI	SCLER	1	CS	FENS
Carex rostrata	39.1	13.8	47.5	•••	60	S	HELO	WI	SCLER	2	CS	FENS, SHORES
Carex rotundata	60.6	35.8	68.3	•••	30	S	HEMI	WI	SCLER	2	CS	FENS
Carex rupestris	0.8	0.0	1.1		15	S	GEOP	WI	SCLER	1	CSR	CLIFFS
Carex stenolepis	0.3	0.0	0.4		40	S	HEMI	WI	SCLER	2	CS	RARE
Carex tenuiflora	4.4	0.0	5.7	•	30	S	HEMI	WI	SCLER	0	SR	FENS, SHORES
Carex vaginata	89.5	72.5	95.1	•••	30	S	GEOP	WI	SCLER	1	CSR	WIDE AMPL.
Carex vesicaria	1.7	1.8	1.2		50	S	HELO	WI	SCLER	2	CS	FENS
Eleocharis quinqueflora	0.3	0.0	0.4		20	S	HEMI	WI	SCLER	1	SR	FENS, SHORES
Eriophorum angustifolium	70.0	45.9	76.2	•••	50	S	GEOP	WI	POGON	2	CS	MIRES
Eriophorum brachyantherum	0.3	0.0	0.4		40	S	GEOP	WI	POGON	0	CSR/SR	RARE
Eriophorum russeolum rufescens	0.3	0.9	0.0		40	S	GEOP	WI	POGON	1	CS	FENS
Eriophorum russeolum russeolum	4.4	0.9	5.7	•	40	S	GEOP	WI	POGON	2	CS	FENS
Eriophorum scheuchzeri	12.9	22.0	9.1	•••	40	S	GEOP	WI	POGON	2	CSR	SHORES, GRAVEL
Eriophorum vaginatum	59.8	31.2	67.9	•••	40	S	HEMI	WI	POGON	1	CS	BOGS
Trichophorum alpinum	9.4	7.3	8.7		25	S	GEOP	WI	POGON	1	CSR	FENS, SHORES
Trichophorum cespitosum	76.9	61.5	80.4	•••	25	S	HEMI	WI	POGON	1	CSR	FENS, SHORES, GRAVEL
ORCHIDACEAE												
Coeloglossum viride	12.9	11.0	14.0		25	S	GEOP	IN	SPORO	0	S	MOIST FOR., SHORES
Corallorhiza trifida	1.7	0.0	1.9		20	S	GEOP	IN	SPORO	0	S	MOIST FOR., SHORES
Dactylorhiza maculata	3.3	1.8	3.0		35	S	GEOP	SE	SPORO	0	S	MEADOWS, FENS
Epipogium aphyllum	0.6	0.0	0.8		25	S	GEOP	IN	SPORO	0	S	MOIST FOR.
Gymnadenia conopsea	1.4	0.9	1.5		25	S	GEOP	IN	SPORO	0	S	SHORES
Listera cordata	9.6	8.3	10.6		15	S	GEOP	IN	SPORO	0	S	MOIST FOR.

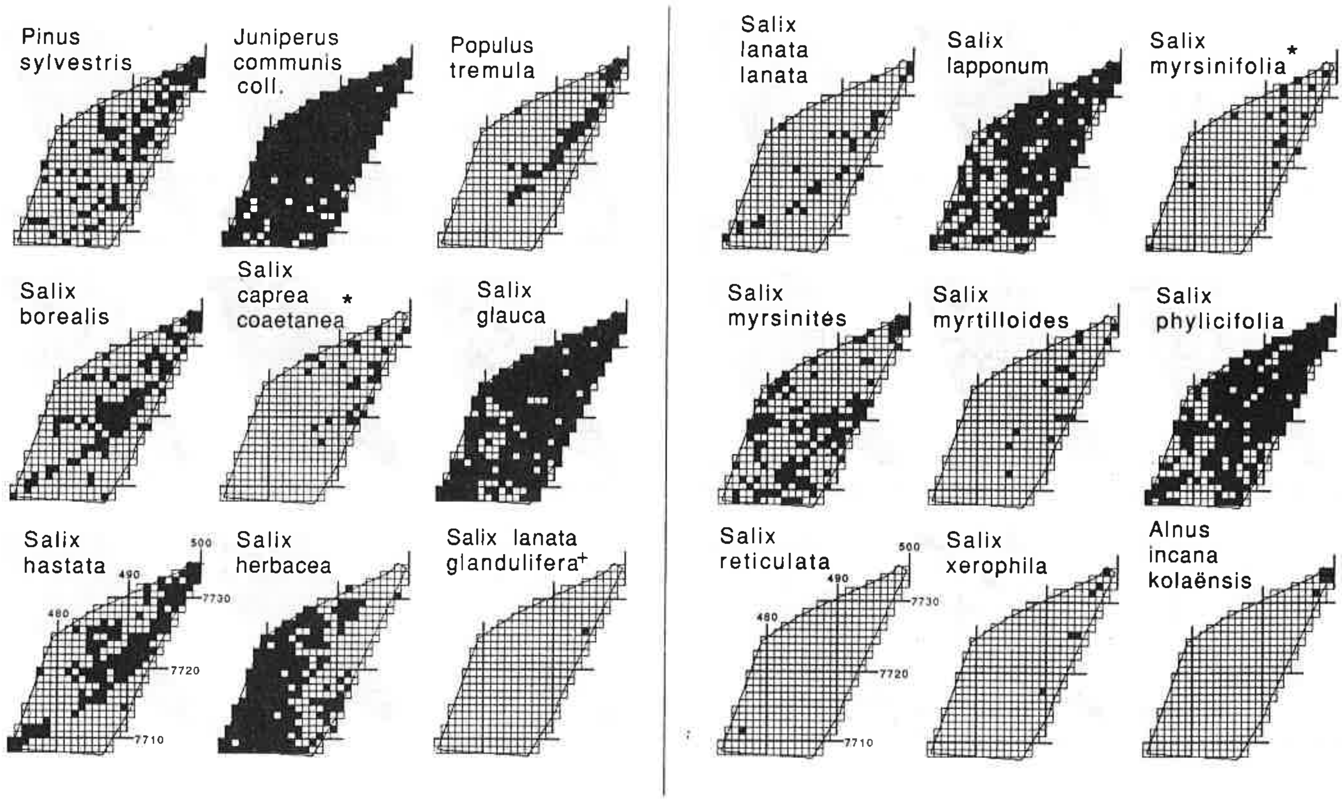


Appendix 2. Distribution maps.

Additional information:
* because of misidentifications species is probably not as common as presented
+ because of misidentifications species is probably more common than presented
# due to possible mapping errors species is probably more common than presented
▒ uncertain observation




Thelypteris phegopteris
Athyrium alpestre
Athyrium filix-femina
Woodsia glabella
Woodsia ilvensis
Dryopteris expansa
Cystopteris fragilis fragilis
Cystopteris fragilis dickieana
Cystopteris montana
Dryopteris fragrans
Gymnocarpium dryopteris
Gymnocarpium dryopteris x jessoënse
Diplazium sibiricum
Matteuccia struthiopteris
Woodsia alpina
Gymnocarpium jessoënse parvulum
Polystichum lonchitis
Polypodium vulgare
500
490
480
7730
7720
7710


Pinus sylvestris
Juniperus communis coll.
Populus tremula
Salix lanata lanata
Salix lapponum
Salix myrsinifolia *
Salix borealis
Salix caprea coaetanea *
Salix glauca
Salix myrsinites
Salix myrtilloides
Salix phylicifolia
Salix hastata
Salix herbacea
Salix lanata glandulifera+
Salix reticulata
Salix xerophila
Alnus incana kolaënsis
500
490
480
7730
7720
7710