

Supplementary material

Detailed evaluation of flood meadow types

1. *Equisetum fluviatile* meadows



Figure A1. In the middle: *Equisetum fluviatile* –dominated flood meadow along the river Oulankajoki. *Equisetum* meadows border typically with tall *Carex* –stands (in the front). Wet grass growth –dominated by *Phalaris arundinacea* stand out clearly in the middle left.

Low water *Equisetum fluviatile* stands are common along riversides all around Finland. *Equisetum fluviatile* meadows are described in areas along rivers Kemi- and Tornionjoki by Cajander (1909), rivers Siika- and Temmesjoki (Huumonon 1913), in Petsamo Lapland (Kalela 1939), in Kemijärvi (referring to river Kemijoki river near Kemijärvi parish village, Tomanterä 1943) along river Iijoki (Aaltonen 1955 & Tauriainen 1969), Kemi- Tornio- and Tenojoki -rivers (Lähdeoja 1965), along river Kalajoki (Kaakinen 1972), along river Ounasjoki (Heikkinen 1978) and along river Koitajoki in North Karelia (Ruokolainen 1981).

Equisetum fluviatile meadows are situated lowest by the river shore and are almost continuously prone to physical forces: scouring by ice, flooding water and sedimentation. In addition to *Equisetum fluviatile* true water plants such as *Hippuris vulgaris*, *Myriophyllum alternifolium*, *Nuphar lutea* and *Sparganium emersum* occur abundantly (cf. Appendix 3). Thus, distinguishing of *Equisetum* flood meadows from habitual aquatic vegetation is sometimes difficult: most parts

belong, in fact, into shore- and water plant associations and according to Hanhela (1985) at least some parts are below waterline during the whole summer. The uppermost parts are associated with tall *Carex* –stands (Tomanterä 1943). The species compilation of *Equisetum fluviatile* flood meadows are equivalent to inherent, unmanaged *Equisetum fluviatile* stands in common. Thus, besides natural physical forces, anthropogenic management seems to have very little effect in determining species compilation in this zone.

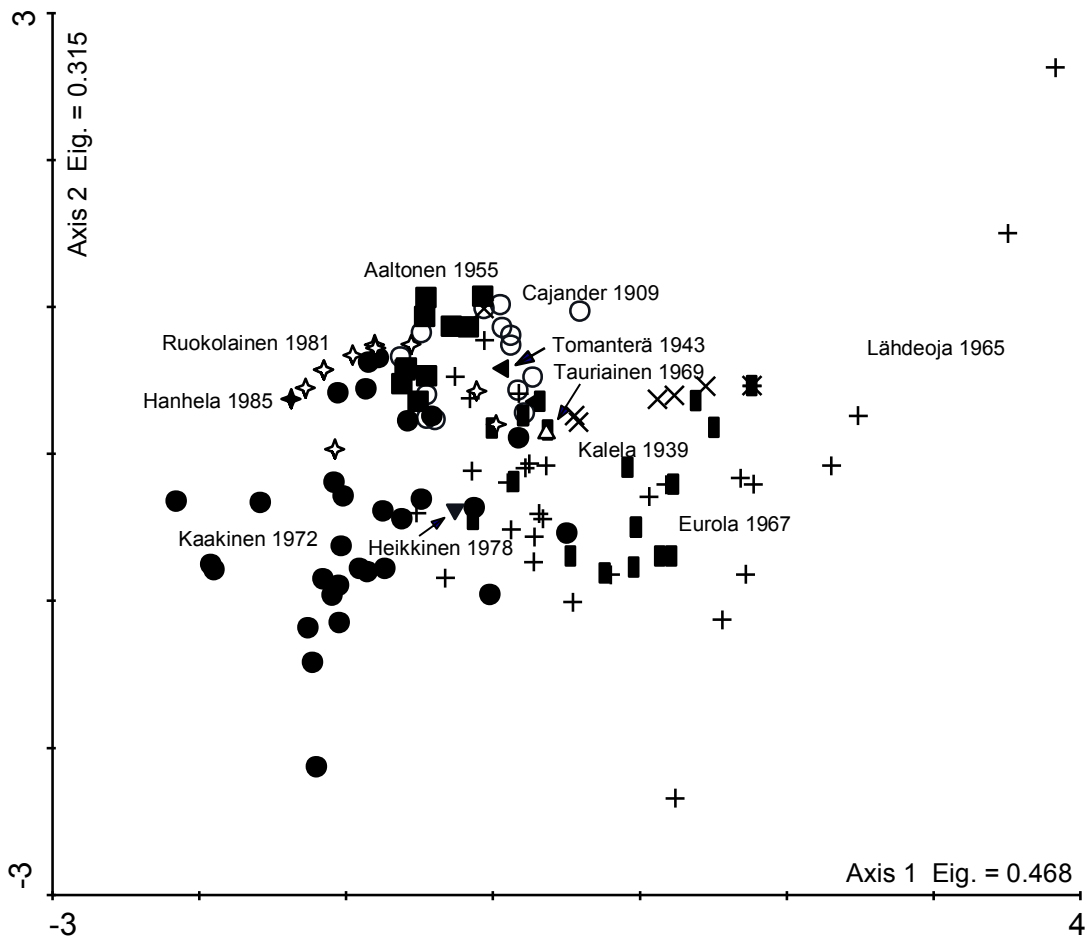


Figure A2. DCA ordination of the *Equisetum* meadow sites. Symbols for different investigators: Cajander 1909 = ○, Kalela 1939 = ×, Tomanterä 1943 = ◄, Aaltonen 1955 = ■, Lähdeoja 1965 = +, Eurola 1967 = ▨, Tauriainen = △, Kaakinen 1972 = ●, Heikkinen 1978 = ▼, Ruokolainen 1981 = ◆, Hanhela 1985 = ✦

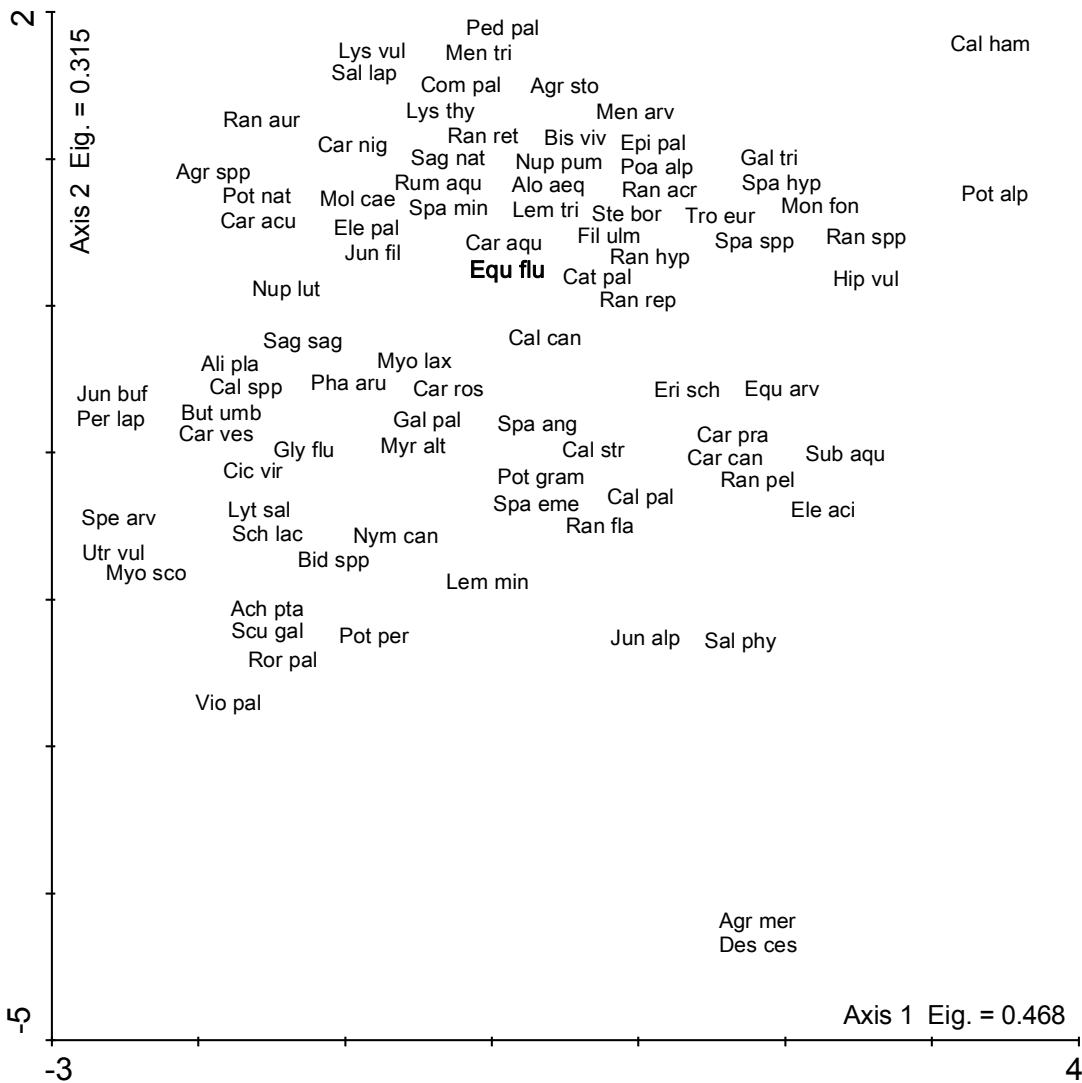


Figure A3. DCA ordination of the *Equisetum* meadows species arrangement. Species (see complete list in Appendix 3) are presented as three letter abbreviations (exceptions: Cat pal = *Caltha palustris*, cf. Cal pal = *Callitriche palustris*), Ran ret = *Ranunculus reptans*, cf. Ran rep = *Ranunculus repens*).

Most of the *Equisetum fluviatile* communities described in different parts of Finland are seemingly homogenous. The most deviating types are from Lähdeoja's (1965) material, Kalela's (1939) from Petsamo Lapland and part of the from Kaakinen's data (1972), river Kalajoki (Fig. A2).

When comparing the different researchers' classifications, it is notable that the only common species (> 30 occurrences in total 127 sample units), in addition to *Equisetum fluviatile* are *Carex aquatilis*, *Caltha palustris* and *Sparganium emersum* (Appendix 3). Ruderal species are scarce, and those few e.g. *Achillea ptarmica*, *Juncus bufonius*, *Persicaria lapathifolia*, *Rorippa palustris* and *Spergula arvensis*, come from southernmost material (Kalajoki area, Kaakinen 1972). The vicinity

of shoreline, thus regular flooding, seems to have prevented paludification reflected by invasion of true mire species. Further, it is hard to perceive any clear moisture gradient within the type: true hydrophytes occur evenly in every classifier's material. Finally, species indicating overgrowing by scrubs are also rare (only two *Salix* species).

2. Tall *Carex* flood meadows

Tall *Carex* flood meadows are regularly under influence of spring- and autumn flood meadows bounding from their lower limit into *Equisetum fluviatile* meadows and from the upper into wet grass flood meadows (Hanhela 1985). The dominating species are 0.5-1 m tall *Carex* species, mainly *Carex acuta* and *C. aquatilis* (Appendix 3). In the data collected along Kitinen and Luro rivers Euroala (1967) separates *Carex rostrata* –dominated types, which comprise mixed stands with *Equisetum fluviatile*. According to Hanhela (1985) fourth, small and slightly paludified subtype is –dominated by *Carex vesicaria* alone. Only few supplementary species occur over 30 abundance alongside with tall *Carex* species and *Equisetum fluviatile*: *Galium palustre*, *Juncus filiformis*, *Comarum palustre*, *Caltha palustris* and *Ranunculus repens*. Aaltonen (1955), Kaakinen 1972) and Hanhela (1985) include *Carex nigra* subsp. *juncella* and *Callitriche palustris* into the top ten list in their classifications. Finally, mosses are scarce due to heavy sedimentation (Hanhela 1985). Of the two above-named dominants, *Carex acuta* has more southern distribution, and *C. aquatilis* –dominated flood meadows prevail along northernmost rivers. According to Lähdeoja (1965), *C. acuta* meadows can be found scarcely up to Kolari-Kittilä level, and become common south from Rovaniemi area whereas they are dominating types along the southernmost rivers Iijoki (Tauriainen 1969), river Kalajoki (Kaakinen 1972) and river Koitajoki (Ruokolainen 1981). *C. vesicaria* –dominated meadows have been described by Cajander (1909) along river Torniojoki, Aaltonen (1955) along river Iijoki and Hanhela (1985) along river Oulankajoki. Throughout the descriptions, wet meadows in the vicinity of mean water level are arranged distinctively, and because sedimentation is regular, paludification is rare (Hanhela 1985). In contrast, *C. vesicaria* –dominated wet meadows tend to converge towards open swamps (cf. Euroala & Kaakinen 1978), and if sedimentation is lacking, the corresponding types are, in fact, peat-based swamps (Hanhela 1985). The fifth commonest species in *Juncus filiformis* forms sometimes small and narrow zones above tall *Carex* meadows. Cajander (1909) separates *Juncus* meadows into its own, but quite insignificant association, whereas Euroala (1967) includes *Juncus* to be main association former along with *Carex aquatilis* and *C. canescens*. Pure *Juncus filiformis* associations are described also by Huuonen (1913) and Teräsvuori (1926).

Along with *Equisetum fluviatile* -type, tall *Carex* meadows are occasionally mown to produce fodder within areas of reindeer husbandry, although the nutrient content of the forage is poor, and thus it is used only in the absence of better options. The origin and maintenance of tall *Carex* flood meadows is largely similar to *Equisetum* meadows. Due to physical forces the type remains physiognomically unchanged for decades without human interference. Corresponding intrinsic vegetation types occur by river- and lakeshores. As with *Equisetum* meadows, there are no qualitative data available from the differences between tall *Carex* flood meadows and corresponding virgin types along lakes and southern rivers. On grounds of reciprocal comparison tall *Carex* associations represents the commonest flood meadow type in Finland (Raunio et al. 2008b, Table 1.).

In DCA the southern samples (Kaakinen 1972, Ruokolainen 1969) are characterized by *Carex acuta*, and lie in the right side of the Fig. A4 (cf. species arrangement in Fig A5). In contrast, the northernmost sites (Kalela 1939, Lähdeoja 1965 & Eurola 1967) characterized by *Carex aquatilis* lie on the upper left corner. Further, *Carex vesicaria* meadows described by Tomanterä (1943), Aaltonen's (1955) and Tauriainen's (1969) sites are situated in the upper right corner of the Fig. A4. As with *Equisetum* meadows, it seems that during the decades there have been very little changes in species compilation also in tall *Carex* meadows. On the contrary, the bulk of the sites coincide with one another quite coherently. On grounds of the species list there were very little indications of overgrowing, paludification nor increase of weedy species in time (Appendix 3).

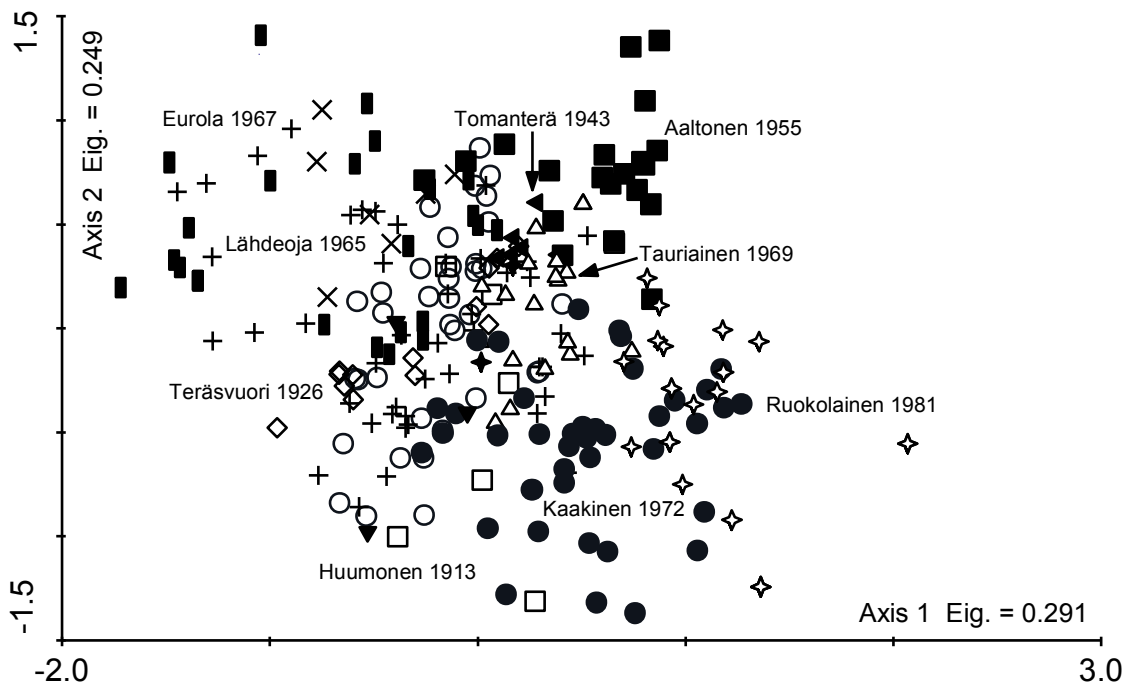


Figure A4. DCA ordination of the tall *Carex* meadows. Symbols for different investigators: Cajander 1909 = ○ Huumonen 1913 = □, Teräsvuori 1926 = ◇, Kalela 1939 = ×, Tomanterä 1943 = ◄, Aaltonen 1955 = ■, Lähdeoja 1965 = +, Eurola 1967 = ▣, Tauriainen = Δ, Kaakinen 1972 = ●, Heikkinen 1978 = ▼, Ruokolainen 1981 = ✧, Hanhela 1985 = ✦.

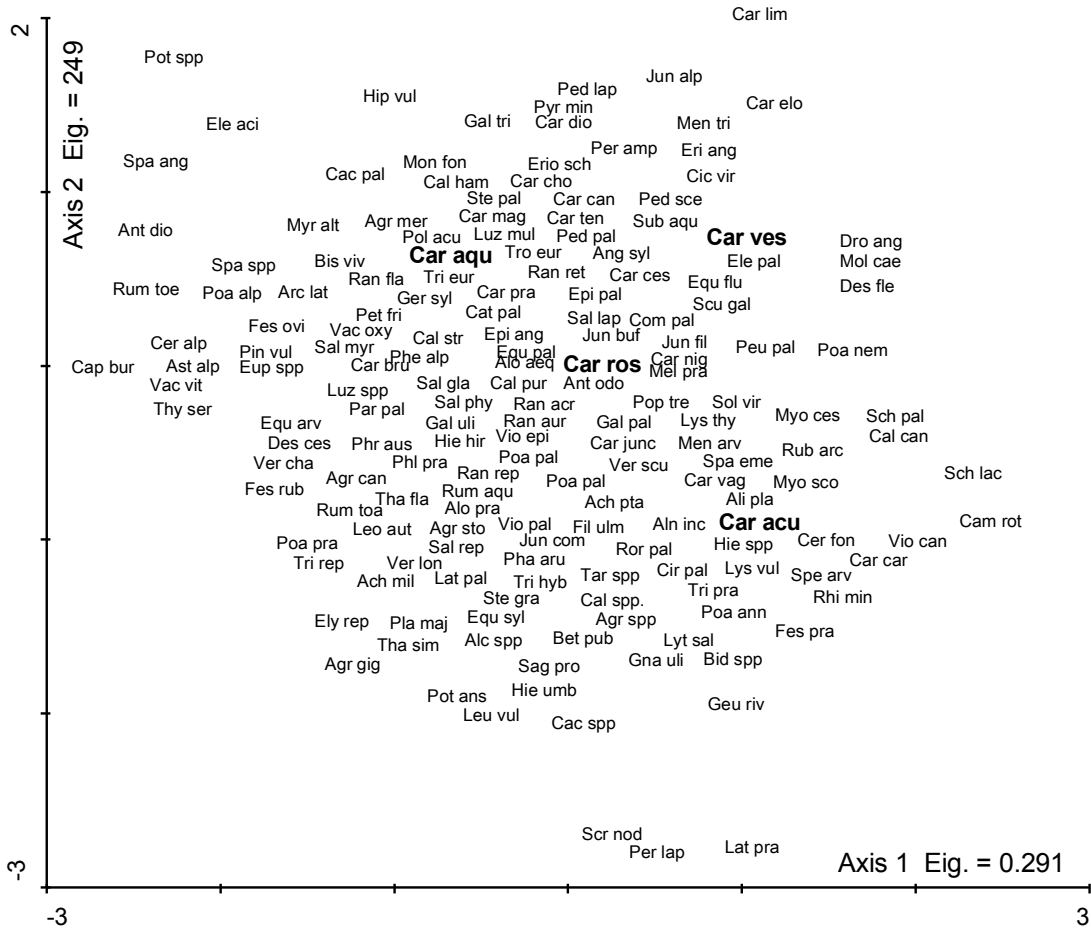


Figure A5. DCA ordination of the tall *Carex*-meadows. Species arrangement. Dominant tall *Carex* species are in bold. Species abbreviations as in Fig. A3. Addition: Cac pal = *Callitriche palustris*.

3. Wet grass flood meadows



Figure A6. Wet grass meadow by a steep bank of the river Oulankajoki. *Salix*–species occur in places where scouring ice cannot reach.

Climbing upwards along the flood meadow profile the last type under continuous impact of spring and autumn floods are wet grass flood meadows (Hanhela 1985). The character species are *Phalaris arundinacea* and *Calamagrostis purpurea*, from which Aaltonen (1955) separates also a rarer *C. canescens* association (cf. Appendix 3). Eurola (1967) does not separate *Calamagrostis canescens* stands, but joins them into *C. purpurea* collective in his grouping. Further, the type includes *Calamagrostis stricta* association which are described e.g. from Kemijärvi (Tomanterä 1943), Kitinen and Luro (Eurola 1967) and from river Koitajoki (Ruokolainen 1981). *Phalaris arundinacea*–dominated wet grass meadows are lush, thick and tall-growing and compose almost entirely of the name species. Looking from the waterline, they are always situated above the tall *Carex* meadows, usually below *Calamagrostis* associations (Hanhela 1985) and occur commonly under areas of quite heavy sedimentation (Heikkinen 1978). Typical stands are small and occur on

sandy or gravely islands by rapidly flooding water (Hanhela 1985). *Comarum palustre*, *Galium palustre*, *Juncus filiformis*, *Ranunculus repens* and *Viola palustris* are the commonest, but scarcely occurring accompanying species, which due to their low growth habit, cannot gain dominant status and form long-standing associations when competing with tall grasses (cf. Elveland 1988). Depending on microtopographical factors, tall *Carex* species, semi-tall grasses, especially *Deschampsia cespitosa* and tall herbs such as *Filipendula ulmaria* from adjacent zones mix fluently with tall grasses, making the outlining of the type sometimes difficult.

Table 3. Total number of species, number of sites studied and average number of species per site (\pm SE) in different wet grass subtypes in earlier inventories.

Wet Grass subtype	Species no	Site no	Species / site	\pm S.E.
<i>Calamagrostis stricta</i>	116	74	8.74	0.49
<i>Calamagrostis</i> spp.	153	127	8.68	0.35
<i>Calamagrostis purpurea</i> / <i>canescens</i>	88	42	7.93	0.48
<i>Phalaris arundinacea</i>	20	20	6.15	0.66
Mixed (<i>Phalaris</i> & <i>Calamagrostis</i>)	74	49	9.71	0.52

Associations dominated by *Calamagrostis purpurea/canescens* and *C. stricta* are more species-rich compared to associations dominated solely by *Phalaris* (Table 3, pairwise comparison of estimated marginal means: $p = 0.030$ and $p = 0.001$, respectively). Further, there is no statistical difference in species number between wet grass associations dominated by *Calamagrostis purpurea/canescens* and *C. stricta* ($p = 0.228$). Finally, the average species number / site of mixed stands of *Phalaris* and *Calamagrostis* are significantly higher than *Calamagrostis purpurea/canescens* and *Phalaris arundinacea* stands ($p = 0.021$ and $p < 0.001$, respectively), but not when compared to pure *C. stricta* stands ($p = 0.170$).

Wet grass meadows dominated by *C. purpurea* are among the most important flood meadow types e.g. along Oulankajoki river (Hanhela 1985) and because of their high productivity, they have been utilized for fodder production alongside the use of *Equisetum* and tall *Carex* meadows (cf. also Nilsson 1977). Along river Iijoki *Calamagrostis* –dominated wet grass meadows are the most widespread flood meadow types (Aaltonen 1955). Wet grass flood meadows have also been described along the river Tornionjoki (Cajander 1909), from rivers Siika- and Temmesjoki (Huomonen 1913) and from rivers Kitinen and Luiro (Eurola 1967). As with other wet types, the species compilation of wet grass flood meadows is very similar to natural, unmanaged vegetation

along lakeshores. Eurola (1967) thus assimilates northern, species poor *Phalaris* –dominated wet grass meadows to lakeshore meadows in southern- and central Finland.

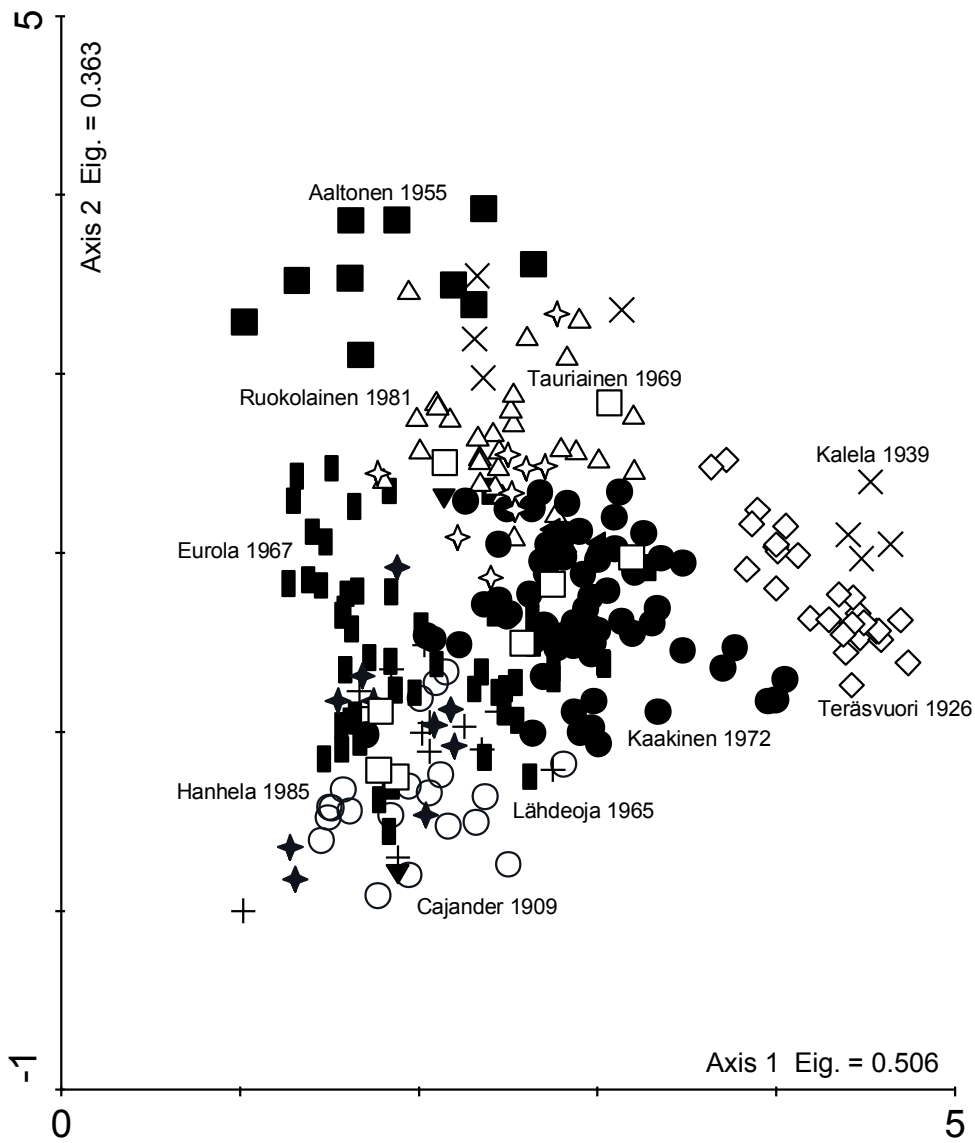


Figure A7. DCA ordination of the wet grass meadows. Symbols for different investigators as in Fig. A4.

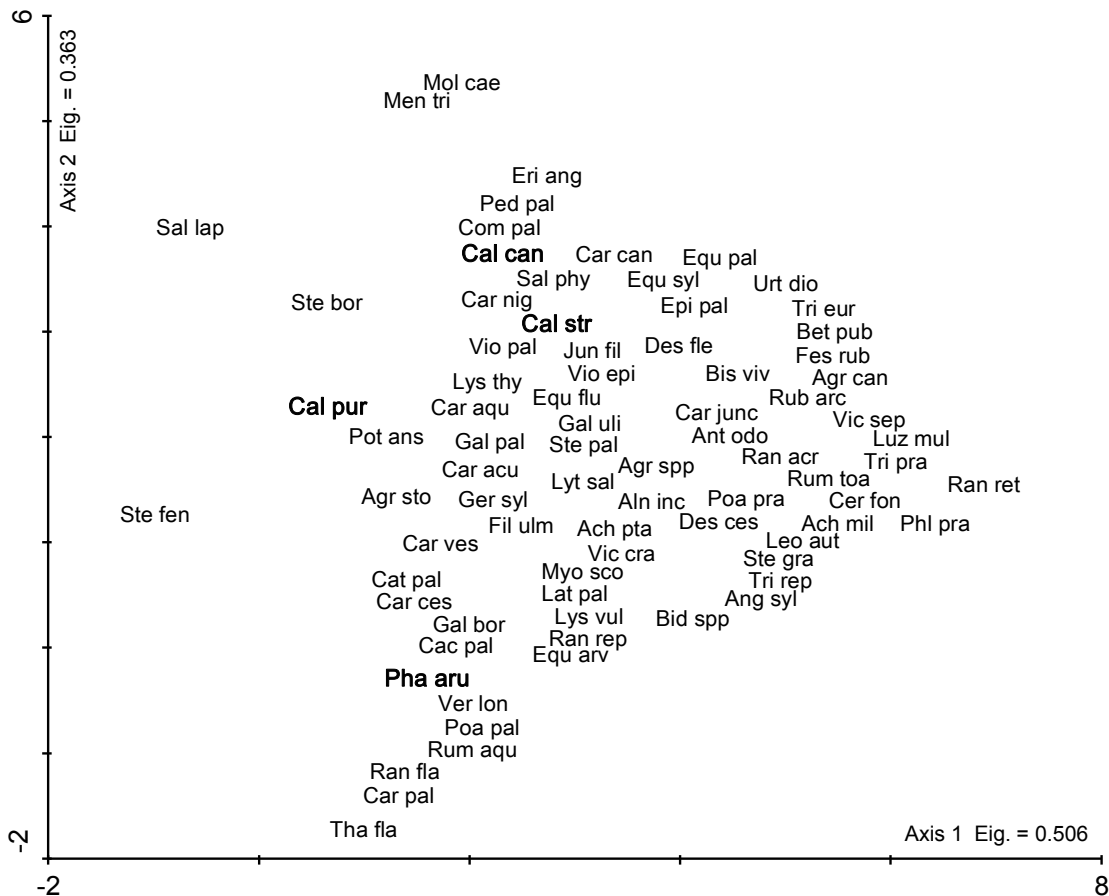


Figure A8. DCA ordination of the wet grass -meadows. Arrangement for 79 most common species. Dominant association formers are in bold. Species abbreviations as in Fig. A3.

Compared to previous types, there are clearer differences between different researcher's wet grass meadows (Fig. A7). The core in Cajander (1909), Lähdeoja (1967), Eurola (1967) and Hanhela (1985) is formed by associations characterized by *Phalaris arundinacea* and *Calamagrostis purpurea*. Even though the *Salix* species are promoted as indicators along with the two grasses in Eurolas' (1967) classification, it does not show particularly well in DCA runs. Instead, in Aaltonen's (1955) and also partly in Tauriainen's (1969) wet grass meadows, the occurrence of *Salix phylicifolia* and *S. lapponum* shrubs is more like a rule than an exception (cf. Figs 7 & 8). The character species along river Kalajoki (Kaakinen 1972) is *Calamagrostis canescens*, a species that is practically lacking from every other researcher's data. Further, in Kaakinen's (1972) data there are several species indicating cultural influence, such as *Achillea ptarmica*, *Festuca rubra*, *Leontodon autumnalis* and *Trifolium repens* (cf. Suominen & Hämet-Ahti 1993). However, there are few clear indicators for paludification in the data as a whole.

4. Moist grass -meadows



Figure A9. Moist grass meadows cover large areas on flatland islets, and are able to resist overgrowing for decades even without human prevention. Islet by Kiutavaara along the Oulankajoki River.

The core of the spring-flood, grass –dominated moist flood meadows is formed by *Deschampsia cespitosa* (Lähdeoja 1965, Hanhela 1985). Cajander (1909) mentions this species to be the most important association former in Kemi-Tornio area separating as much as six subtypes. Aaltonen (1955) adds the grasses *Agrostis capillaris* and *A. stolonifera* as dominant character species. Moist grass meadows lie over one and half meter high in relation to mean water level, thus the annual sedimentation is rather weak (Hanhela 1985). Accompanying species are e.g.: *Achillea millefolium*, *Festuca rubra*, *F. ovina*, *Poa pratensis*, *Ranunculus acris*, *R. repens*, *Rubus arcticus*, *Solidago virgaurea* and *Veronica longifolia* (Appendix 3). Scrubs are insignificant but mosses begin to have quite important status (Hanhela 1985). According to Cajander (1909) and Lähdeoja (1965) the abundance of herbs ceases towards north. Respectively this comes clear when examining southern

classifications, where pure *Deschampsia cespitosa* types are hard to find; they form transitional zones and mix unlimitedly with moist tall herb flood meadows (cf. Kaakinen 1972). According to Hanhela (1985) *Deschampsia cespitosa* types occur in all places along waterways. Besides Cajander (1909) (Kemi-Tornio-Rovaniemi) similar types have been described e.g. along river Utsjoki-Tenojoki (Hult 1898), from Kittilä (Auer 1921), from Luiro-Kitinen (Eurola 1967) and from Ounasjoki (Heikkinen 1978). Southern variants have been described from Pori, south-western Finland (Häyren 1909), Tervola (Huumonen 1913), Kemijärvi and Rantsila, Savonia borealis and Northern Ostrobothnia (Teräsvuori 1920), Kemijärvi (Tomanterä 1943), Åland (Jaatinen 1950) and from Pudasjärvi (Aaltonen 1955).

Besides that species compilation in moist grass flood meadows corresponds closely to lakeside meadows, similar variants can be found in places which are totally out of reach of floods. Species poor flood meadow variants barely differ from abandoned, *Deschampsia cespitosa* –dominated old-fields (cf. Huhta 1997), though their species richness was evidently greater in 1950-60's compared to the situation today (Kujala 1967, Huhta & Rautio 2005).

Moist grass flood meadows were used for fodder production alongside with *Equisetum*- and tall *Carex* flood meadows. Before field cultivation era, *Deschampsia cespitosa* was the most important winter forage grass, composing the most important part of the forage crop (Aaltonen 1955).

Management of moist grass flood meadows died away alongside with the cessation of mowing and grazing in traditional rural biotopes, although in areas of reindeer herding this practice still have some local importance.

According to Raunio et al. (2008b) moist grass meadows are nowadays the fourth most common flood meadow type. In NWI the recorded moist grass meadows by rule comprise mixtures with lower- and higher occurring zones, thus emphasizing the difficulty of defining their moisture status. In NWI the sward height and density were reported to be high due to low management intensity. In moist grass flood meadows the dense tussocks of clonally spreading grasses prevent effectively the overgrowth by shrubs and tree saplings, thus their physiognomy can remain unchanged for decades after the management has ceased.

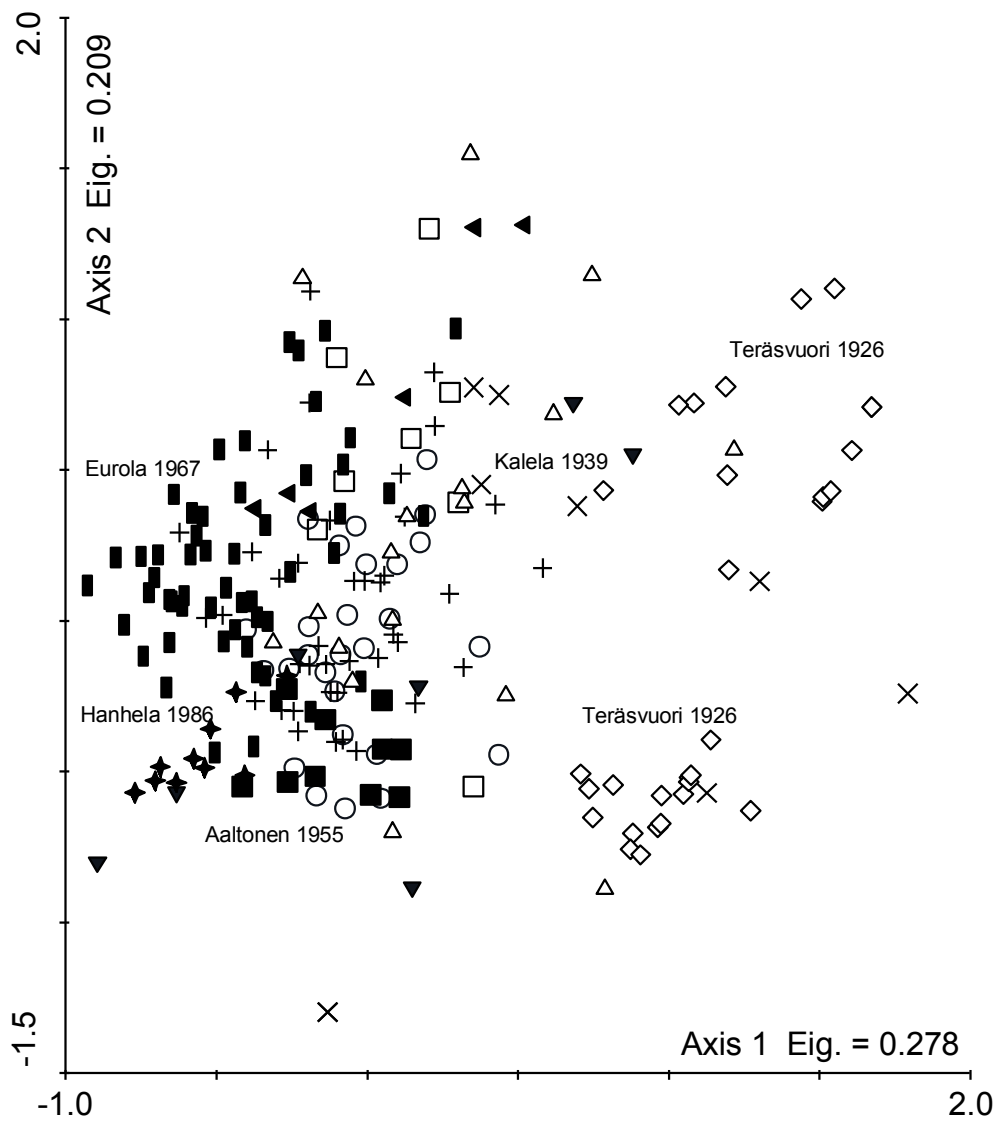


Figure A10. DCA ordination of the moist grass meadows. Symbols for different investigators as in Fig. A2.

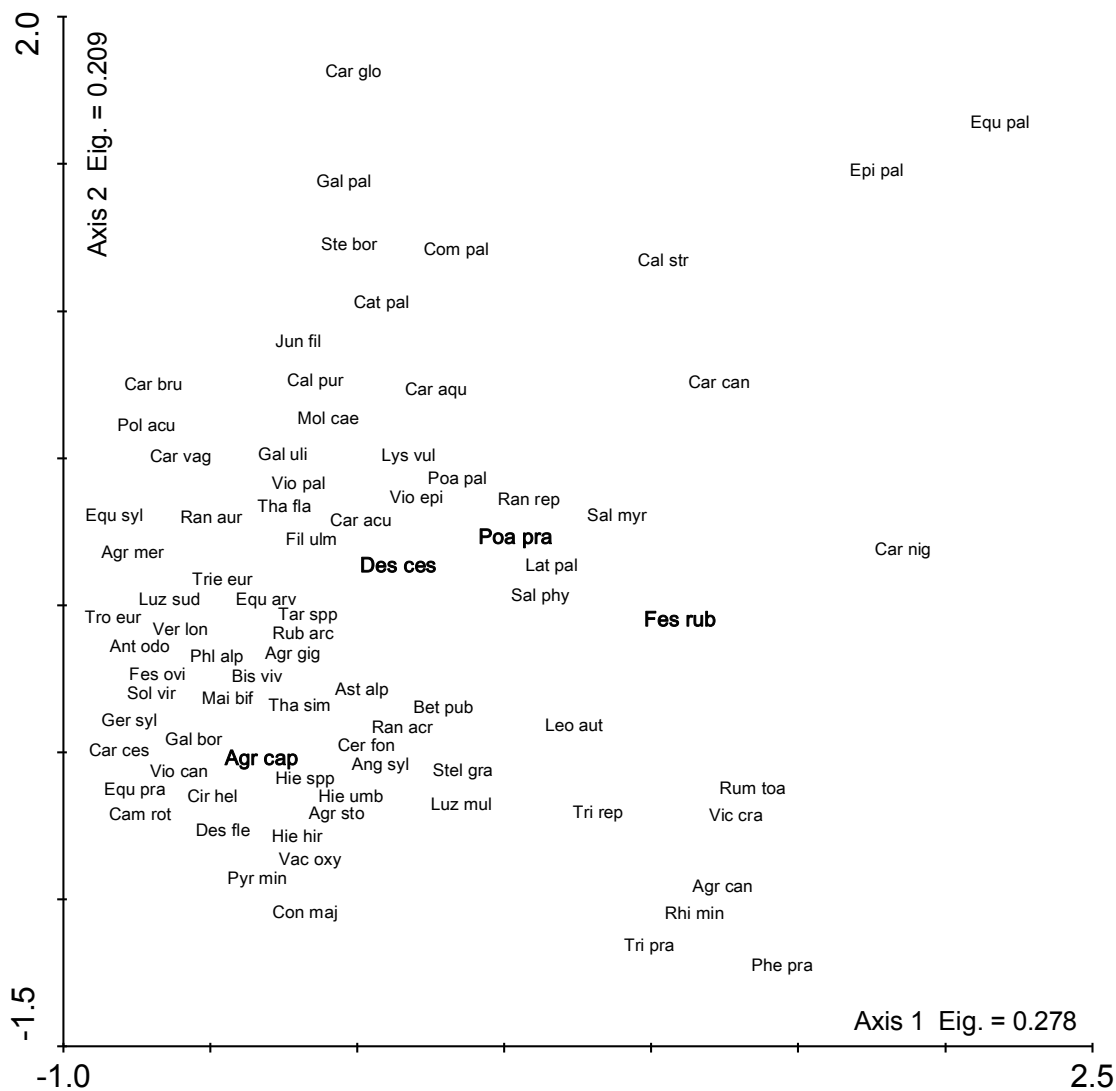


Figure A11. DCA ordination of the moist grass -meadows. Species arrangement. Dominant association formers are in bold. Species abbreviations as in Fig. A3.

After first preliminary DCA runs (not shown) Ruokolainen's (1981) data were omitted since their completely deviating species compilation which lead to over 6 S.D. units long gradient along the first axis suggesting that the bulk of the Ruokolainen's (1981) samples do not correspond with other researcher's samples. Ruokolainen's (1981) species compilation strongly suggests towards paludified swamps and altered mire complexes, which are typical outcomes for meadows where flooding and sedimentation has ceased long time ago. The indicators for this are e.g.: *C. globularis*, *Carex serotina*, *C. vesicaria*, *Drosera anglica*, *Eleocharis palustris*, *Peucedanum palustris*, *Rhamnus frangula* and *Scheuchzeria palustris*.

In final DCA ordination the moistest sites are placed on the upper part in the ordination diagram (Fig. 10). Hanhela's (1985) samples approach dry tall- and small herb meadows characterized with

Festuca ovina, *Galium boreale*, *Geranium sylvaticum*, *Solidago virgaurea*, *Trollius europaeus* and *Veronica longifolia* forming a quite clear cluster of their own (down & far left, Figs. 10 & 11). Also Teräsvoori's (1926) sites stand out characterized with anthropochorous species e.g. *Phleum pratense*, *Rhinanthus minor*, *Trifolium pratense* and *Vicia cracca*. Management cessation is outlined by scrubs *Salix myrsinifolia* and *S. phylicifolia* near dominating grasses whereas forest species *Equisetum pratensis* and *Mainthemum bifolium* (lower left corner on the Fig. A11) belong into character species in Cajander's (1909) classification.

5. Tall herb flood meadows



Figure A12. Tall herb meadow along Oulankajoki River. Typically, tall herb meadows include abundantly tall to intermediate tall grasses, e.g. *Agrostis* spp., *Alopecurus pratensis*, *Deschampsia cespitosa* and *Poa pratensis*.

According to Hanhela (1985) tall herb flood meadows belong to spring flood meadows standing out in the river scenery as narrow, ribbon-like vegetation zones outlining drier and low-growing upper

riverbanks, thus constituting a certain transitional zone with adjacent moist grass meadows. According to Hanhela (1985) representatives here are *Filipendula ulmaria* –dominated vegetation stands situated typically just above *Phalaris arundinacea*– and *Calamagrostis purpurea* –dominated wet grass stands. Tall herb associations characterized by *Cirsium helenioides* (Cajander 1909) and *Trollius europaeus* (Hanhela 1985) represent intermediate transitional zones between moist and dry flood meadows. As a rule they are found upper in the meadow series compared to moist grass association. In addition Cajander (1909) defines tall herb associations dominated by *Lysimachia thyrsiflora*, *Thalictrum flavum*, *T. simplex*, and *Veronica longifolia*. According to Hanhela (1985) *Filipendula ulmaria* meadows are commonly found throughout river Oulankajoki area, but they are never wide-ranging. In Kaakinen’s data (1972) *Filipendula* commonly composes mixed stands with *Deschampsia cespitosa*. *Filipendula* –dominated types have been described by Eurola (1967) from Kitinen and Luiro, by Teräsvoori (1926) from Rantsila, Liminka and Kiuruvesi, by Aaltonen (1955) from Pudasjärvi, by Jaatinen (1950) from Åland and by Eurola (1965) from Southern Saimaa. The two latter descriptions are dealing more with flooding lakeshore vegetation. After first DCA runs Ruokolainen’s (1981) deviating data were omitted. His type represents *Lysimachia thyrsiflora* –dominated tall herb variant spiced with *Comarum palustre*, *Peucedanum palustre* and *Carex acuta* and where *Filipendula ulmaria* is totally lacking.

DCA ordination is similar to moist grass type. There are plenty of similar semi-dominant species in both types which complicates defining the associations. This is reflected in subtype abundance e.g.: Eurola’s (1967) *Geranium sylvaticum* - *Cirsium helenioides*-, Kaakinen’s (1972) *Filipendula* - *Deschampsia cespitosa* and Hanhela’s (1985) *Geranium sylvaticum* - *Galium boreale* -type. As the species number within this type increases, also the differences between researchers’ and – naturally – between inventory areas become evident. With this type Cajander’s (1909) various associations stand out clearly from other researcher’s samples including such character species as *Tanacetum vulgare*, *Thalictrum flavum* and *T. simplex*, *Cirsium helenioides* and *Trollius europaeus* (Figs. 13 & 14). At the first time clear gradients coming up from moisture- and degree of cultural influence are evident: Cajander’s (1909) wettest samples characterized by *Rumex aquaticus*, *Lysimachia vulgaris*, *Agrostis stolonifera* and *Caltha palustris* are situated high up. In far right are Eurola’s (1967) and Hanhelas’s (1985) drier samples vicariating small herb flood meadows including: *Anthoxanthum odoratum*, *Astragalus alpinus*, *Campanula rotundifolia*, *Carex vaginata* *Dianthus superbus*, *Euphasia* spp, *Festuca ovina*, *Luzula multiflora* and *Vaccinium vitis-idaea*. Kaakinen’s (1972) southerly samples deviate clearly from the others with strong cultural anthropogenic engagement (archaeophytes and apophytes sensu Jalas 1953) such as *Achillea ptarmica*, *Alopecurus pratensis*, *Geum rivale*, *Leontodon autumnalis*, *Phleum pratense*, *Poa trivialis*, *Trifolium repens* and *Vicia*

cracca. In all, the absolute dominant is still *Filipendula ulmaria*, which is absent only from Heikkinen's (1978) scarce data. Clear overgrowing indicator *Salix phylicifolia* is commonly present in Eurola's (1967) and Kaakinen's (1972) data.

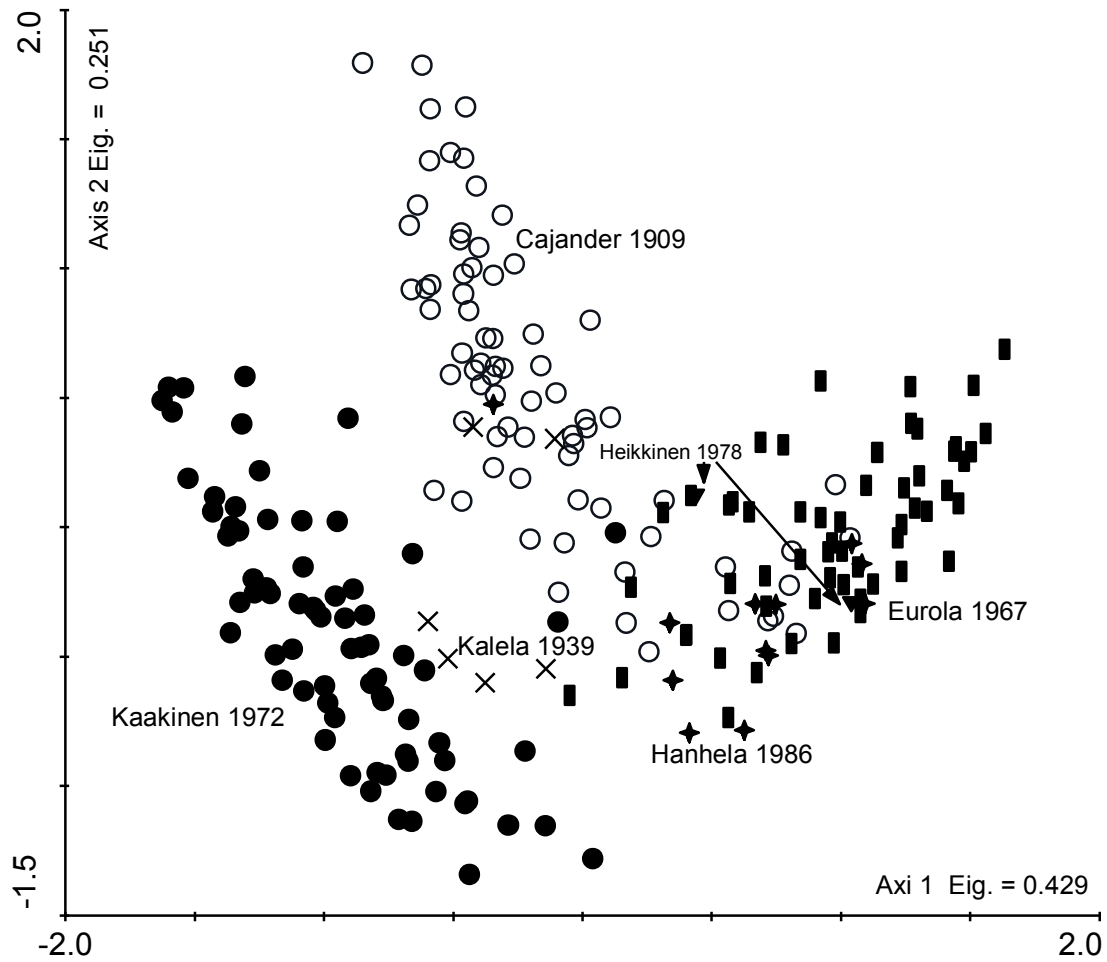


Figure A13. DCA ordination of the tall herb meadows. Symbols for different investigators as in Fig. A2.



Figure A15. Dry small herb flood meadow along the river Oulankajoki. Saplings of Norwegian spruce (*Picea abies*) and Scotch pine (*Pinus sylvestris*) are strongly prevented in their growth mainly because of elk browsing and dryness.

Small herb flood meadows are located highest measured from the mean water level covering typically topmost parts of the river banks and small islands (Tomanterä 1943). Not even the spring floods reach these highest parts annually (Hanhela 1985). According to Hanhela (1985) dry flood meadows comprise types dominated particularly by *Festuca ovina* and *Galium boreale*. Cajander (1909) adds here the subtypes dominated partly by *Deschampsia cespitosa* along with *Anthoxanthum odoratum*, *Tanacetum vulgare*, *Festuca rubra* and *Achillea millefolium*. Cajander's (1909) profuse classification identifies also types characterized by *Calamagrostis epigejos*, *Solidago virgaurea*, *Equisetum pratense* and *Maianthemum bifolium* (cf. also Nilsson 1977). Tomanterä (1943), Aaltonen (1955) and Eurola (1967) regard various *Festuca ovina* variants to be one coherent type accompanied e.g. by *Carex vaginata*, *Vaccinium vitis-idaea* and the moss *Pleurozium schreberi*, the latter indicating particularly low annual sedimentation. Profusely named variants and subtypes indicate high species richness (cf. Tomanterä 1943 & Aaltonen 1955).

Hanhela (1985) as well as Eurola (1967) include *Cirsium helenioides*-, *Molinia caerulea*- and *Geranium sylvaticum* –dominated variants into their small herb meadow series. *Geranium sylvaticum* is typical for dry to half-dry meadow patches near the forest edges, and thus they depart from the bulk of the actual small herbs flood meadows. According to Hanhela (1985) the vegetation in *Geranium* –dominated stands points clearly towards dry heath forests and groves, which they – in fact – truly are: only regularly occurring trees are lacking.

Molinia caerulea –dominated meadows are exceptional. As with *Geranium sylvaticum* stands, the soil consists mainly of moraine indicating unsubstantial sedimentation (Hanhela 1985). However, the ground of *Molinia caerulea* meadows may often be moist because of the proximity of soil water table (Eurola 1967). As a whole, *Molinia caerulea* stands described by Eurola (1967) and Hanhela (1985) cover only small areas. The last of a sort among small herb types is Cajander's (1909) and Eurola's (1967) *Nardus stricta* meadows. Tomanterä (1943) states that *Nardus* stands occur on poor soils by sharply sloped river banks in confluence over moraine and alluvial soils.

Galium boreale- and *Festuca ovina*- and several other small herb meadows have been described mainly along larger rivers Tornio, Teno and Kemi (Hult 1898, Cajander 1909, Tomanterä 1943), along Kitinen and LUIRO (Eurola 1967) and along Ounasjoki (Heikkinen 1978). Hanhela (1985) and Heikkilä-Huhta (2008) have described vicariant types along river Oulankajoki, which deviates from the larger ones on grounds of its topography and scarcity of flood-balancing lakes. Their species compilation of small herb flood meadows is very similar to traditionally managed dry and semi-dry hay meadows (Raunio et al. 2008b).

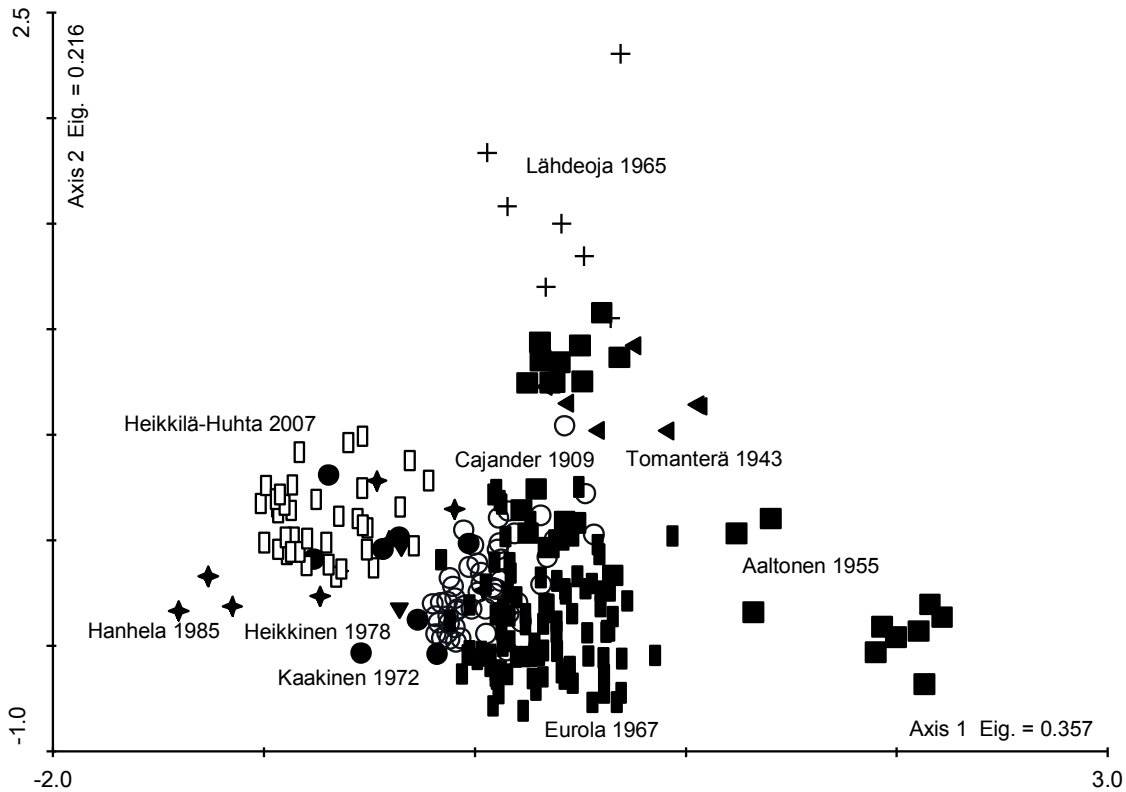


Figure A16. DCA ordination of the small herb meadows. Symbols for different investigators as in Fig. A2.

Regional differences are clearly visible in DCA ordination (Fig. A16). Samples along river Oulankajoki (Hanhela 1985 & Heikkilä-Huhta 2008) and driest *Galium boreale* –dominated samples by the river Iijoki (Kaakinen 1972) stand out in the left side of the figure. Species, e.g. *Carex ericetorum*, *Elymus caninus*, *E. fibrosus*, *Hieracium rigida* and *Oxytropis campestris* occur solely by the river Oulankajoki (Fig. A17). Further, the figure shows that the overgrowing by tree saplings *Pinus sylvestris* and *Picea abies* and shrub *Rosa majalis* is typical for Oulanka’s small herb meadows, in contrast to Lähdeoja’s (1965) more moist samples, where management cessation has led to overgrowth by *Salix phylicifolia*. Tomanterä’s (1943) and part of the Aaltonen’s (1955) samples represent rather moist short grass or moist herb meadows characterized by *Agrostis canina*, *Galium palustre*, *Ranunculus repens*, *Rhinanthus serotinus* and *Viola epipsila* as shown in the right side of the figure. Cajander’s (1909) and Euroola’s (1967) samples compose the core of the small herb meadows in the middle of the Fig. A16 characterized by the most common type species *Festuca ovina* (Fig. A17).

Small herb data include over 200 species, thus greatly complicating interpretations, not to mention disentangling vicariant types. The dominant is *Festuca ovina* (Appendix 3.) accompanied by slightly less abundant *Achillea millefolium* and *Solidago virgaurea*. Thereafter finding clear

character species is difficult. *Festuca ovina* and *Galium boreale* are clear dominants especially in Hanhela's (1985) and Heikkilä-Huhta's (2008) data, but in Aaltonen (1955) and Lähdeoja's (1965) data the latter is totally missing. Aaltonen's (1955) vicariant small herb type is characterized by *Achillea millefolium*, *Agrostis capillaris*, *Convallaria majalis* and *Rubus arcticus*, the latter occurring twice as abundant as *Festuca ovina*. In Euroola's (1967) data *Campanula rotundifolia* and *Carex vaginata* strongly come on to the above mentioned species compilation. Typical character species for moister hollows inside the type are e.g. *Deschampsia cespitosa*, *Filipendula ulmaria*, *Poa pratensis*, *Ranunculus acris*, *Solidago virgaurea*, *Thalictrum simplex*, *Trollius europaeus* and *Veronica longifolia* which comprise – in fact – the core species compilation in lower situated tall herb and moist grass flood meadows. However, increasing moisture and paludification is not a threat for small herb type, but overgrowing with forest species is, as pointed out by the Fig. A17 where bushes and tree saplings, e.g. *Betula pubescens*, *Pinus sylvestris*, *Picea abies* and *Rosa majalis* lie close to dominant association formers.

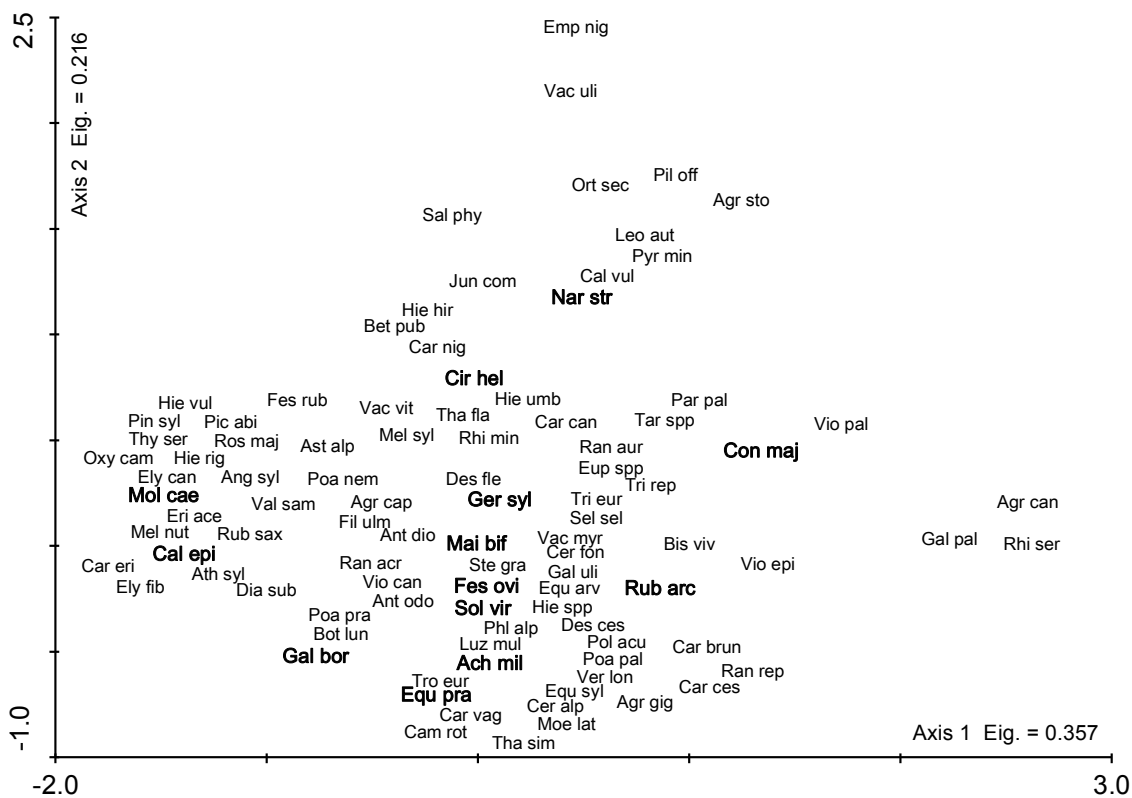


Figure A17. DCA ordination of the small herb -meadows. Species arrangement. Dominant association formers are in bold. Species abbreviations as in Fig. A3.

Appendix 2. Compilation of flood meadow types in earlier inventories data.

Investigator	Year	Measure type	Number of samples	Sample unit size m ²	Size x units	Total species no	Average species No	±S.E.
Equisetum -types								
Cajander	1909	1-9 scale	15	-	-	22	5.2	0.44
Kalela	1939	3-7 scale	6	1	6	25	7.7	1.48
Tomanterä	1943	No of indiv.	2	1	2	5	3.5	1.5
Aaltonen	1955	%-cover	8	1	8	13	6.1	0.64
Lähdeoja	1965	%-cover	31	1,2,4,25	351	31	6.0	0.59
Eurola	1967	%-cover	17	1	17	16	3.6	0.43
Tauriainen	1969	%-cover	1	1	1	3	-	-
Kaakinen	1972	%-cover	29	1	29	49	6.3	0.38
Heikkinen	1978	%-cover	1	25	25	7	-	-
Ruokolainen	1981	%-cover	10	1	10	14	4.2	0.55
Hanhela	1985	%-cover	7	1	7	14	-	-
Tall Carex -types								
Cajander	1909	1-9 scale	40	-	-	78	11.0	0.73
Huomonen	1913	1-9 scale	7	-	-	30	8.7	1.34
Teräsvuori	1926	%-cover	13	4	52	38	12.8	1.47
Kalela	1939	3-7 scale	7	1	7	27	8.1	1.67
Tomanterä	1943	No of indiv.	6	1	6	23	14.7	1.17
Aaltonen	1955	%-cover	20	1	20	24	8.4	0.68
Lähdeoja	1965	%-cover	59	1,5,6,25	405	94	10.7	0.71
Eurola	1967	%-cover	25	1	25	39	5.4	0.83
Tauriainen	1969	%-cover	19	1	19	32	8.3	0.56
Kaakinen	1972	%-cover	51	1	51	93	8.1	0.39
Heikkinen	1978	%-cover	3	25	75	37	13.3	2.32
Ruokolainen	1981	%-cover	22	1	22	18	3.4	0.39
Hanhela*	1985	%-cover	25	1	25	32	-	-
Wet grass -types								
Cajander	1909	1-9 scale	20	-	-	39	10.4	0.65
Kalela	1939	3-7 scale	8	1	8	31	8.4	0.56
Aaltonen	1955	%-cover	10	1	10	16	6.6	0.65
Lähdeoja	1965	%-cover	16	1, 25	566	46	11.8	1.36
Eurola	1967	%-cover	83	1	83	55	6.6	0.28
Tauriainen	1969	%-cover	32	1	32	56	8.8	0.38
Kaakinen	1972	%-cover	73	1	73	94	11.2	0.46
Heikkinen	1981	%-cover	2	25	50	18	9.0	7.00
Hanhela**	1985	%-cover	10 / 27	5 / 1	50 / 27	42 / 59	9.6 / -	1.28 / -
Moist grass -types								
Cajander	1909	1-9 scale	27	-	-	81	16.6	0.73
Kalela	1939	3-7 scale	9	1	9	48	10.4	1.72
Tomanterä	1943	No of indiv.	6	1	6	53	26.2	5.69
Aaltonen	1955	%-cover	10	1	10	55	27.8	0.87
Lähdeoja	1965	%-cover	40	1,5	378	89	23.0	1.06
Eurola	1967	%-cover	54	1	54	83	14.9	0.76
Tauriainen	1969	%-cover	18	1	18	82	11.8	0.86
Heikkinen	1978	%-cover	7	25	175	67	13.3	2.79
Ruokolainen	1981	%-cover	33	1	33	31	5.6	0.40
Hanhela**	1985	%-cover	10 / 18	5 / 1	50 / 18	41 / 77	16.4 / -	0.90 / -
Tall herb -types								
Cajander	1909	1-9 scale	73	-	-	85	13.9	0.53
Kalela	1939	3-7 scale	6	1	6	39	17.2	1.85
Eurola	1967	%-cover	57	1	57	102	17.1	0.73
Kaakinen	1972	%-cover	72	1	72	72	13.4	0.41
Heikkinen	1978	%-cover	2	25	50	30	18.0	8.00
Ruokolainen	1981	%-cover	11	1	11	15	6.1	0.41
Hanhela**	1985	%-cover	13 / 38	5 / 1	65 / 38	53 / 89	17.1 / -	1.12 / -
Small Herb -types								
Cajander	1909	1-9 scale	52	-	-	82	18.8	0.56
Tomanterä	1943	No of indiv.	7	1	7	79	37.0	2.27
Aaltonen	1955	%-cover	30	1	30	75	18.1	1.63
Lähdeoja	1965	%-cover	7	-	-	58	22.3	2.51
Eurola	1967	%-cover	92	1	92	97	13.5	0.56
Kaakinen	1972	%-cover	8	1	8	25	8.4	0.82
Heikkinen	1978	%-cover	2	25	50	34	20.0	6.00
Hanhela**	1985	%-cover	9 / 111	5 / 1	45 / 111	45 / 81	13.7 / -	1.43 / -
Heikkilä-Huhta	2008	1-7 scale	37	30	1110	130	35.8	1.15

* includes 2 types: *Carex acuta* & *C. vesicaria*

** includes two values from two independent data sets

Appendix 4. Species frequencies discovered during the nationwide inventory of valuable rural landscapes in Finland along with their combined occurrence in earlier classifications (see material and methods). Highest record in classifications and zone character species are in bold. Indication characteristics for species was given if it was unambiguously possible.

Species name	Frequency in NWI		Occurrence in classifications						Indication				
	Used	Abandoned	<i>Equisetum</i>	Tall <i>Carex</i>	Wet grass	Tall herb	Moist grass	Small herb	Overgrowing indicator	Ruderal /cultural influence	Forest species	Mire / swamp species	Grazing / mowing
1 <i>Deschampsia cespitosa</i>	97	91	4	44	102	161	202	153					
2 <i>Achillea millefolium</i>	91	70	-	3	32	115	104	174		1			
3 <i>Filipendula ulmaria</i>	89	89	2	25	63	155	70	43					
4 <i>Ranunculus acris</i>	83	65	1	8	41	98	97	97					
5 <i>Geranium sylvaticum</i>	80	69	-	1	8	73	43	79					1
6 <i>Juncus filiformis</i>	77	57	13	116	67	18	60	8					
7 <i>Betula pubescens</i>	69	70	-	4	8	12	26	28	1				
8 <i>Agrostis capillaris</i>	69	61	-	-	1	16	48	79					
9 <i>Solidago virgaurea</i>	69	59	-	6	15	63	84	173					
10 <i>Carex aquatilis</i>	69	57	33	186	60	4	18	6					
11 <i>Carex acuta</i>	66	85	22	144	71	14	29	4					
12 <i>Veronica longifolia</i>	66	67	-	23	48	137	124	113					1
13 <i>Caltha palustris</i>	63	61	28	103	47	15	-	3					
14 <i>Rubus arcticus</i>	60	67	-	5	24	29	96	115					1
15 <i>Ranunculus repens</i>	60	50	4	98	124	71	94	35					
16 <i>Achillea ptarmica</i>	60	35	1	6	16	34	8	3					
17 <i>Leontodon autumnalis</i>	60	35	-	8	30	40	44	15					
18 <i>Poa pratensis</i>	60	33	-	11	51	54	108	70		1			1
19 <i>Trifolium repens</i>	60	24	-	9	35	36	24	17					
20 <i>Galium palustre</i>	57	63	14	128	139	19	42	19					
21 <i>Stellaria graminea</i>	57	50	-	4	23	9	63	84					
22 <i>Salix phylicifolia</i>	54	70	3	40	88	27	44	23	1				
23 <i>Comarum palustre</i>	54	67	10	111	59	13	74	11					
24 <i>Cirsium helenioides</i>	54	54	-	-	4	81	26	30			1		1
25 <i>Festuca ovina</i>	54	46	-	6	4	58	89	199					1
26 <i>Trollius europaeus</i>	54	39	1	3	4	83	73	106					1
27 <i>Angelica sylvestris</i>	51	54	-	1	-	35	19	21					
28 <i>Rumex acetosa</i>	51	33	-	7	41	50	45	9					
29 <i>Viola palustris</i>	51	30	1	21	28	20	31	22					
30 <i>Equisetum arvense</i>	49	54	5	50	65	92	70	60					
31 <i>Campanula rotundifolia</i>	49	44	-	1	-	28	22	113					
32 <i>Carex nigra</i>	49	20	1	20	52	6	23	13					
33 <i>Juniperus communis</i>	46	46	-	1	1	-	9	18	1				
34 <i>Maianthemum bifolium</i>	46	35	-	-	1	37	20	64					
35 <i>Valeriana sambucifolia</i>	46	33	-	-	5	8	2	38					
36 <i>Trifolium pratense</i>	46	19	-	3	7	5	9	1					
37 <i>Viola epipsila</i>	43	52	-	26	77	46	67	46			1		
38 <i>Festuca rubra</i>	43	43	-	6	47	50	89	49					1
39 <i>Phleum pratense</i>	43	20	-	10	24	38	24	-		1			1
40 <i>Calamagrostis purpurea</i>	40	46	-	35	82	32	15	9					
41 <i>Vaccinium vitis-idaea</i>	40	44	-	2	2	14	1	38			1		
42 <i>Phalaris arundinacea</i>	40	37	3	36	91	18	8	3					
43 <i>Bistorta vivipara</i>	40	33	-	5	9	65	80	60					1
44 <i>Vicia cracca</i>	40	26	-	1	29	54	10	8					1
45 <i>Poa annua</i>	40	4	-	2	2	-	-	-		1			
46 <i>Anthoxanthum odoratum</i>	37	54	-	3	4	44	75	95					1
47 <i>Equisetum fluviatile</i>	37	41	91	112	28	4	3	-					
48 <i>Galium uliginosum</i>	37	33	-	19	31	51	68	29					1
49 <i>Populus tremula</i>	37	26	-	1	-	3	1	9	1				
50 <i>Rumex acetosella</i>	37	20	-	2	-	1	4	11					1
51 <i>Lysimachia thyrsoiflora</i>	34	46	16	77	27	5	7	2					
52 <i>Ranunculus reptans</i>	34	26	6	32	1	2	1	-					
53 <i>Anthriscus sylvestris</i>	34	20	-	-	2	9	5	14					
54 <i>Cerastium fontanum</i>	34	20	-	3	20	30	57	62					
55 <i>Plantago major</i>	34	13	-	1	1	-	1	-		1			
56 <i>Deschampsia flexuosa</i>	31	50	-	1	4	38	51	90					
57 <i>Vaccinium uliginosum</i>	31	41	-	-	1	3	8	20			1	1	
58 <i>Carex canescens</i>	31	37	15	44	55	8	52	17					
59 <i>Rhinanthus minor</i>	31	33	-	2	16	19	30	37		1			
60 <i>Calamagrostis stricta</i>	31	28	6	69	113	11	32	7					
61 <i>Ranunculus auricomus</i>	31	28	1	7	2	22	20	26					
62 <i>Thalictrum flavum</i>	31	26	-	4	17	24	27	16					
63 <i>Rumex longifolius</i>	31	17	-	-	-	-	3	5					
64 <i>Sorbus aucuparia</i>	29	39	-	-	-	1	2	6	1				

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Species name	Frequency in NWI		Occurrence in classifications						Indication				
	Used	Abandoned	<i>Equisetum</i>	Tall <i>Carex</i>	Wet grass	Tall herb	Moist grass	Small herb	Overgrowing indicator	Ruderal /cultural influence	Forest species	Mire / swamp species	Grazing / mowing
65 <i>Rumex aquaticus</i>	29	20	3	15	21	21	-	-					
66 <i>Luzula multiflora</i>	29	19	-	3	18	13	51	67					1
67 <i>Phelum alpinum</i>	26	39	-	3	1	5	29	14					
68 <i>Pinus sylvestris</i>	26	37	-	-	-	-	-	13	1				
69 <i>Alnus incana</i>	26	35	-	2	9	4	2	-	1				
70 <i>Equisetum sylvaticum</i>	26	26	-	1	7	17	15	17					
71 <i>Hieracium umbellata</i> coll.	26	24	-	3	1	36	17	49					
72 <i>Taraxacum</i> spp.	26	24	-	5	2	2	20	13		1			
73 <i>Lathyrus palustris</i>	26	22	-	11	15	31	12	5					
74 <i>Nardus stricta</i>	26	15	-	-	-	4	10	14					1
75 <i>Tanacetum vulgare</i>	26	11	-	1	1	44	7	11					
76 <i>Elymus repens</i>	26	9	-	2	2	4	5	2		1			
77 <i>Picea abies</i>	23	41	-	-	-	-	1	13	1				
78 <i>Calluna vulgaris</i>	23	35	-	-	1	9	-	21			1		1
79 <i>Viola canina</i>	23	35	-	2	5	32	12	87					
80 <i>Lysimachia vulgaris</i>	23	33	10	13	29	48	23	2					
81 <i>Antennaria dioica</i>	23	26	-	3	-	8	2	65					
82 <i>Rubus saxatilis</i>	23	24	-	-	1	13	2	38					
83 <i>Prunus padus</i>	23	22	-	-	-	-	4	5	1				
84 <i>Salix</i> spp.	23	11	-	-	-	-	1	-	1				
85 <i>Urtica dioica</i>	23	6	-	-	6	2	12	-		1			
86 <i>Carex vesicaria</i>	20	37	6	56	7	8	7	-					
87 <i>Eriophorum angustifolium</i>	20	22	-	19	18	1	11	-			1		
88 <i>Salix repens</i>	20	19	-	2	2	-	1	-	1				
89 <i>Rorippa palustris</i>	20	17	2	14	9	1	2	-					
90 <i>Euphrasia stricta</i>	20	7	-	-	-	-	-	-		1			
91 <i>Stellaria media</i>	20	4	-	-	1	-	-	-		1			
92 <i>Rosa majalis</i>	17	26	-	-	2	10	5	40	1				
93 <i>Carex brunnescens</i>	17	24	-	3	2	3	48	29					
94 <i>Cornus suecica</i>	17	20	-	-	1	4	5	9					
95 <i>Silene dioica</i>	17	17	-	-	1	1	1	-					
96 <i>Agrostis canina</i>	17	15	-	5	21	3	29	12					
97 <i>Euphrasia frigida</i>	17	6	-	-	-	1	-	-					
98 <i>Polygonum aviculare</i> agg.	17	6	-	-	-	-	-	-					
99 <i>Juncus bufonius</i>	17	2	1	10	-	-	-	-		1			
100 <i>Matricaria matricarioides</i>	17	2	-	-	-	-	-	-					
101 <i>Phragmites australis</i>	17	2	-	2	-	3	-	-	1				
102 <i>Epilobium angustifolium</i>	14	37	-	10	-	12	11	9					
103 <i>Trientalis europaea</i>	14	33	-	7	17	25	52	52					
104 <i>Carex nigra</i> ssp. <i>juncella</i>	14	30	-	2	12	-	1	2					
105 <i>Molinia caerulea</i>	14	30	10	1	7	11	37	21					
106 <i>Vaccinium myrtillus</i>	14	30	-	-	-	2	1	14			1		
107 <i>Galium boreale</i>	14	28	-	1	6	62	32	100					1
108 <i>Calamagrostis epigejos</i>	14	15	-	-	-	-	1	24					
109 <i>Melampyrum pratense</i>	14	15	-	1	1	1	2	4					
110 <i>Prunella vulgaris</i>	14	15	-	1	3	2	-	-					1
111 <i>Gnaphalium uliginosum</i>	14	4	-	8	3	1	2	5		1			
112 <i>Salix lapponum</i>	11	44	1	6	30	1	11	3	1				
113 <i>Melampyrum sylvaticum</i>	11	35	-	-	-	9	4	27					
114 <i>Equisetum pratense</i>	11	30	-	-	5	46	31	100					
115 <i>Carex rostrata</i>	11	28	6	12	-	-	-	-					
116 <i>Dianthus suberbus</i>	11	22	-	-	1	12	10	47					1
117 <i>Carex cespitosa</i>	11	20	-	11	9	6	12	12					
118 <i>Hieracium</i> spp.	11	11	-	4	1	16	25	17					
119 <i>Geum rivale</i>	11	9	-	3	2	23	3	4			1		1
120 <i>Mentha arvensis</i>	11	7	-	1	1	-	2	-					
121 <i>Menyanthes trifoliata</i>	11	7	1	31	14	-	2	-					
122 <i>Vicia sepium</i>	11	7	-	-	1	-	-	-		1			
123 <i>Nuphar lutea</i>	11	6	14	-	-	-	-	-					
124 <i>Lythrum salicaria</i>	11	4	7	16	12	-	-	1					
125 <i>Pinquicula vulgaris</i>	11	4	-	1	-	1	7	11					
126 <i>Veronica serpyllifolia</i>	11	2	-	-	-	-	-	-		1			
127 <i>Galeopsis speciosa</i>	11	-	-	-	-	-	-	-		1			
128 <i>Persicaria lapathifolia</i>	11	-	4	1	-	-	5	-					
129 <i>Carex vaginata</i>	9	31	-	3	1	19	23	106					
130 <i>Luzula sudetica</i>	9	20	-	-	-	1	20	5					

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	Used	Abandoned	Equisetum	Tall Carex	Wet grass	Tall herb	Moist grass	Small herb	Overgrowing indicator	Ruderal /cultural influence	Forest species	Mire / swamp species	Grazing / mowing
131 Thalictrum simplex	9	20	-	8	5	62	37	74					
132 <i>Salix caprea</i>	9	19	-	-	-	-	-	2	1				
133 <i>Astragalus alpinus</i>	9	17	-	2	1	12	12	60					1
134 <i>Epilobium palustre</i>	9	15	3	16	22	-	20	6					
135 <i>Rubus chamaemorus</i>	9	15	-	-	3	-	-	-			1		
136 <i>Luzula pilosa</i>	9	13	-	-	1	2	1	6					
137 <i>Alisma plantago-aquatica</i>	9	11	24	7	3	-	-	-					
138 Convallaria majalis	9	11	-	-	1	6	10	45					
139 <i>Pedicularis sceptrum-carolinum</i>	9	11	-	4	1	1	5	3					
140 <i>Polemonium acutiflorum</i>	9	9	-	4	1	4	33	15					
141 <i>Alopecurus aequalis</i>	9	7	13	7	4	1	-	-					
142 <i>Hippuris vulgaris</i>	9	7	27	15	1	-	-	-					
143 <i>Solidago</i> spp.	9	7	-	-	-	-	-	-					
144 <i>Callitriche palustris</i>	9	6	16	27	12	-	-	-					
145 <i>Carum carvi</i>	9	6	-	3	1	-	-	-	1				
146 <i>Leucanthemum vulgare</i>	9	6	-	6	5	3	11	7	1				
147 <i>Poa subcaerulea</i>	9	6	-	-	-	-	-	-					
148 <i>Tussilago farfara</i>	9	6	-	-	-	-	1	-					
149 <i>Alchemilla</i> spp.	9	2	-	1	-	-	1	6					
150 <i>Galeopsis bifida</i>	9	2	-	-	-	-	-	5	1				
151 <i>Trifolium</i> spp.	9	-	-	-	-	-	-	-					
152 Calamagrostis canescens	6	24	2	23	21	7	6	2					
153 <i>Veronica officinalis</i>	6	17	-	-	-	-	-	2					
154 <i>Gymnocarpium dryopteris</i>	6	15	-	-	1	1	4	-					
155 <i>Eleocharis palustris</i>	6	13	23	20	1	-	2	-					
156 <i>Empetrum nigrum</i>	6	13	-	1	2	-	4	12					
157 <i>Ribes spicatum</i>	6	13	-	-	-	-	-	5	1				
158 <i>Elymus caninus</i>	6	11	-	-	2	2	6	25					
159 <i>Galium trifidum</i>	6	11	2	1	-	-	-	-					
160 <i>Poa nemoralis</i>	6	11	-	2	1	12	8	16					
161 <i>Sparganium</i> spp.	6	11	5	-	1	-	-	-					
162 <i>Poa palustris</i>	6	9	-	24	37	55	31	27					
163 <i>Scirpus sylvaticus</i>	6	9	-	-	-	-	-	-					
164 <i>Veronica chamaedrys</i>	6	7	-	1	-	-	-	-	1				1
165 <i>Angelica archangelica</i>	6	6	-	-	7	-	-	-					
166 <i>Ranunculus peltatus</i>	6	6	3	-	-	-	-	-					
167 <i>Rhinanthus serotinus</i>	6	6	-	-	-	-	-	16					
168 <i>Salix cinerea</i>	6	6	-	-	-	-	-	-	1				
169 <i>Sparganium emersum</i>	6	6	35	6	-	-	-	-					
170 <i>Trifolium hybridum</i>	6	4	-	2	-	-	-	-	1				
171 <i>Agrostis stolonifera</i>	6	2	-	20	8	17	20	19					
172 <i>Capsella bursa-pastoris</i>	6	2	-	1	-	-	-	-	1				
173 <i>Chenopodium suecicum</i>	6	2	-	-	-	-	4	-	1				
174 <i>Rumex</i> spp.	6	2	-	-	-	-	-	-					
175 <i>Glyceria fluitans</i>	6	-	1	-	5	1	-	-					
176 <i>Myosotis arvensis</i>	6	-	-	-	-	-	-	-	1				
177 <i>Pimpinella saxifraga</i>	6	-	-	-	-	-	-	1	1				1
178 <i>Spergula arvensis</i>	6	-	1	1	-	-	-	-	1				
179 <i>Stellaria nemorum</i>	6	-	-	-	2	2	-	-		1	1		
180 <i>Tripleurospermum inodorum</i> agg.	6	-	-	-	-	-	-	-	1				
181 <i>Veronica scutellata</i>	6	-	-	4	1	1	-	3					
182 <i>Hierochloë hirta</i>	3	19	-	2	2	2	16	32					
183 <i>Salix myrsinifolia</i>	3	19	-	1	4	-	15	3	1				
184 <i>Calamagrostis</i> spp.	3	17	-	2	1	-	1	1					
185 <i>Scutellaria galericulata</i>	3	17	1	9	4	1	4	3					
186 <i>Salix hastata</i>	3	15	-	1	1	15	5	10	1				
187 <i>Parnassia palustris</i>	3	11	-	8	3	9	11	13					1
188 <i>Poa alpigena</i>	3	11	1	1	5	6	9	1					
189 <i>Betula pendula</i>	3	9	-	-	1	-	1	-	1				
190 <i>Barbarea stricta</i>	3	7	-	1	1	2	1	-					
191 <i>Euphrasia</i> spp.	3	7	-	-	-	23	-	46					
192 <i>Rubus idaeus</i>	3	7	-	-	-	-	1	2	1				
193 <i>Calamagrostis lapponica</i>	3	6	-	-	-	-	-	1					
194 <i>Carex ovalis</i>	3	6	-	-	1	-	-	-	1				
195 <i>Paris quadrifolia</i>	3	6	-	-	2	5	4	8		1			
196 <i>Pilosella officinarum</i>	3	6	-	-	-	-	-	17					1
197 <i>Stellaria longifolia</i>	3	6	-	-	-	-	-	5					

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Species name	Frequency in NWI		Occurrence in classifications						Indication				
	Used	Abandoned	Equisetum	Tall Carex	Wet grass	Tall herb	Moist grass	Small herb	Overgrowing indicator	Ruderal /cultural influence	Forest species	Mire / swamp species	Grazing / mowing
198 <i>Thalictrum</i> spp.	3	6	-	-	-	-	-	-					
199 <i>Carex chordorrhiza</i>	3	4	-	9	2	-	-	-				1	
200 <i>Equisetum palustre</i>	3	4	-	4	18	2	15	-					
201 <i>Erysimum</i> spp.	3	4	-	7	1	-	8	-					
202 <i>Hieracium vulgata</i> coll.	3	4	-	-	-	-	2	20					
203 <i>Lemna minor</i>	3	4	1	-	-	-	-	-					
204 <i>Myosotis scorpioides</i>	3	4	10	10	6	6	2	3					
205 <i>Poa trivialis</i>	3	4	-	-	4	13	7	1					
206 <i>Potamogeton natans</i>	3	4	2	-	-	-	-	-					
207 <i>Potentilla anserina</i>	3	4	-	2	50	4	-	2					
208 <i>Sagittaria natans</i>	3	4	11	-	-	-	-	-					
209 <i>Bartsia alpina</i>	3	2	-	-	-	5	-	4					
210 <i>Carex dioica</i>	3	2	-	1	-	-	-	-				1	
211 <i>Cerastium alpinum</i>	3	2	-	1	1	6	3	18					
212 <i>Dactylorhiza maculata</i>	3	2	-	-	-	3	-	-					
213 <i>Dryopteris carthusiana</i>	3	2	-	-	-	-	5	-					
214 <i>Lathyrus pratensis</i>	3	2	-	1	6	9	-	-	1				
215 <i>Luzula</i> spp.	3	2	-	1	-	-	-	-					
216 <i>Myosotis laxa</i>	3	2	1	-	-	-	-	-					
217 <i>Persicaria amphibia</i>	3	2	-	12	3	1	1	-					
218 <i>Petasites frigidus</i>	3	2	-	4	1	-	-	-					
219 <i>Poa</i> spp.	3	2	-	-	-	2	-	-					
220 <i>Polemonium caeruleum</i>	3	2	-	-	-	-	-	-	1				
221 <i>Salix pentandra</i>	3	2	-	-	-	-	-	5	1				
222 <i>Schoenoplectus lacustris</i>	3	2	12	2	-	-	-	-					
223 <i>Stellaria palustris</i>	3	2	-	1	11	5	2	-					
224 <i>Bidens radiata</i>	3	-	-	-	-	-	-	-					
225 <i>Carex echinata</i>	3	-	-	-	1	-	1	-					
226 <i>Carex flava</i>	3	-	-	-	-	-	1	-			1		1
227 <i>Carex pallidula</i>	3	-	-	-	-	-	-	-	1				
228 <i>Carex panicea</i>	3	-	-	-	-	-	-	-			1		1
229 <i>Carex</i> spp.	3	-	-	-	-	-	-	-					
230 <i>Drosera anglica</i>	3	-	-	1	-	-	1	-			1		
231 <i>Eleocharis</i> spp.	3	-	-	-	-	-	-	-					
232 <i>Festuca pratensis</i>	3	-	-	4	-	-	-	-	1				
233 <i>Herachleum sphondylium</i>	3	-	-	-	-	-	-	-	1				
234 <i>Juncus alpinoarticulatus</i>	3	-	5	11	-	-	-	1					
235 <i>Ledum palustre</i>	3	-	-	-	-	-	-	-			1		
236 <i>Oxalis acetosella</i>	3	-	-	-	-	-	-	-		1			
237 <i>Polygonum</i> spp.	3	-	-	-	-	-	-	-					
238 <i>Sagina procumbens</i>	3	-	-	2	1	-	-	-					
239 <i>Viola riviniana</i>	3	-	-	-	-	-	-	-		1			
240 <i>Agrostis</i> spp.	-	13	4	10	45	54	-	2					
241 <i>Linna borealis</i>	-	13	-	-	-	-	-	6		1			
242 <i>Melica nutans</i>	-	13	-	-	1	-	4	15					
243 <i>Phegopteris connectilis</i>	-	9	-	-	-	-	-	-		1	1		
244 <i>Thymus serpyllum</i>	-	9	-	1	-	-	-	26					1
245 <i>Betula nana</i>	-	7	-	-	5	-	1	1			1		
246 <i>Hieracium prenanthoidea</i> coll.	-	7	-	1	-	1	1	8					
247 <i>Lychnis alpina</i>	-	7	-	-	-	4	2	8					
248 <i>Pyrola rotundifolia</i>	-	7	-	-	-	-	10	-					
249 <i>Viola</i> spp.	-	7	-	-	-	-	-	-					
250 <i>Brassica rapa</i>	-	6	-	-	-	-	-	-	1				
251 <i>Hieracium rigida</i> coll.	-	6	-	-	-	-	-	17					
252 <i>Hieracium sylvatica</i> coll.	-	6	-	-	-	-	-	2					
253 <i>Milium effusum</i>	-	6	-	-	-	6	1	1		1			
254 <i>Orthilia secunda</i>	-	6	-	-	-	1	10	14					
255 <i>Pedicularis palustris</i>	-	6	-	18	7	-	7	-					
256 <i>Peucedanum palustre</i>	-	6	-	3	5	7	8	-					
257 <i>Stellaria</i> spp.	-	6	-	-	-	-	-	-					
258 <i>Vaccinium oxycoccos</i>	-	6	-	1	3	-	15	-			1		
259 <i>Agrostis gigantea</i>	-	4	-	3	8	19	33	23					
260 <i>Andromeda polifolia</i>	-	4	-	-	3	-	5	3			1		
261 <i>Avenula pubescens</i>	-	4	-	-	-	-	-	-	1				1
262 <i>Carex ericetorum</i>	-	4	-	-	-	1	1	20					
263 <i>Carex globularis</i>	-	4	-	-	-	-	16	1			1		
264 <i>Daphne mezereum</i>	-	4	-	-	-	-	-	2		1			

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	Used	Abandoned	<i>Equisetum</i>	Tall <i>Carex</i>	Wet grass	Tall herb	Moist grass	Small herb	Overgrowing indicator	Ruderal /cultural influence	Forest species	Mire / swamp species	Grazing / mowing
265 <i>Eleocharis acicularis</i>	-	4	7	3	-	-	-	-					
266 <i>Eriophorum vaginatum</i>	-	4	-	-	5	-	4	-			1		
267 <i>Fragaria vesca</i>	-	4	-	-	-	-	-	-					
268 <i>Luzula pallidula</i>	-	4	-	1	-	5	8	10					
269 <i>Lycopodium annotinum</i>	-	4	-	-	-	1	-	-			1		
270 <i>Matteuccia struthiopteris</i>	-	4	-	-	2	-	-	-			1		
271 <i>Pilosella cymosa</i>	-	4	-	-	-	-	-	-					
272 <i>Pyrola minor</i>	-	4	-	1	-	6	14	23					
273 <i>Ranunculus sceleratus</i>	-	4	-	-	-	-	-	-	1				
274 <i>Selaginella selaginoides</i>	-	4	-	-	-	11	8	22					
275 <i>Actaea erythrocarpa</i>	-	2	-	-	-	-	-	-					
276 <i>Alopecurus geniculatus</i>	-	2	-	-	-	-	-	-	1				
277 <i>Alopecurus pratensis</i>	-	2	-	5	7	14	-	-	1				
278 <i>Botrychium boreale</i>	-	2	-	-	-	-	1	2					
279 <i>Botrychium lunaria</i>	-	2	-	-	-	3	-	22					
280 <i>Calla palustris</i>	-	2	-	-	-	-	25	-					
281 <i>Callitriche cophocarpa</i>	-	2	-	-	-	-	-	-					
282 <i>Callitriche</i> spp.	-	2	11	1	1	-	-	-					
283 <i>Carduus crispus</i>	-	2	-	-	-	-	-	-	1				
284 <i>Carex magellanica</i>	-	2	-	-	4	-	5	-			1		
285 <i>Chaerophyllum prescottii</i>	-	2	-	-	-	-	-	-	1				
286 <i>Cicuta virosa</i>	-	2	8	10	2	-	-	-					
287 <i>Cirsium palustre</i>	-	2	-	2	-	-	-	-					
288 <i>Crepis paludosa</i>	-	2	-	-	1	1	2	1					
289 <i>Elatine</i> spp.	-	2	-	-	-	-	-	-					
290 <i>Elymus fibrosus</i>	-	2	-	-	1	-	1	20				1	
291 <i>Epilobium alsinifolium</i>	-	2	-	-	-	-	-	-			1		
292 <i>Eriophorum russeolum</i>	-	2	-	-	-	-	-	-			1		
293 <i>Erysimum strictum</i>	-	2	-	-	-	-	-	5					
294 <i>Galeopsis</i> spp.	-	2	-	-	-	-	-	-	1				
295 <i>Gnaphalium sylvaticum</i>	-	2	-	-	-	-	-	-					
296 <i>Hydrocharis morsus-ranae</i>	-	2	-	-	-	-	-	-					
297 <i>Lactuca sibirica</i>	-	2	-	-	-	2	-	-					
298 <i>Melampyrum</i> spp.	-	2	-	-	-	-	-	-					
299 <i>Montia fontana</i>	-	2	1	1	-	-	-	-					
300 <i>Myosotis</i> spp.	-	2	-	-	-	-	-	-					
301 <i>Oxytropis campestris</i>	-	2	-	-	-	-	-	14					
302 <i>Pedicularis lapponica</i>	-	2	-	1	-	-	1	-					
303 <i>Pilosella peleteriana</i>	-	2	-	-	-	-	-	-				1	
304 <i>Potentilla erecta</i>	-	2	-	-	-	-	1	-			1	1	
305 <i>Rosa pimpinellifolia</i>	-	2	-	-	-	-	-	-	1				
306 <i>Rubus x castoreus</i>	-	2	-	-	-	2	2	2					
307 <i>Salix triandra</i>	-	2	-	-	-	-	-	-	1				
308 <i>Saussurea alpina</i>	-	2	-	-	-	-	1	-					
309 <i>Silene tatarica</i>	-	2	-	-	-	-	-	9					
310 <i>Sonchus arvensis</i>	-	2	-	-	-	-	-	-					
311 <i>Tofieldia pusilla</i>	-	2	-	-	-	-	-	-			1		
312 <i>Trichophorum cespitosum</i>	-	2	-	-	-	-	-	-			1		
313 <i>Vaccinium microcarpum</i>	-	2	-	-	-	-	-	-			1		
314 <i>Viola arvensis</i>	-	2	-	-	-	-	-	-	1				
315 <i>Agrostis mertensii</i>	-	-	1	7	-	7	12	6					
316 <i>Alchemilla glabra</i>	-	-	-	-	-	-	1	1					
317 <i>Alchemilla glomerulans</i>	-	-	-	-	-	3	-	-					
318 <i>Allium schoenoprasum</i>	-	-	-	-	-	3	-	-					
319 <i>Archangelica archangelica</i>	-	-	-	1	-	4	1	-					
320 <i>Arctagrostis latifolia</i>	-	-	-	1	-	1	-	-					
321 <i>Arctostaphylos uva-ursi</i>	-	-	-	-	-	-	-	1					
322 <i>Arenaria serpyllifolia</i>	-	-	-	-	-	-	-	5					
323 <i>Astragalus frigidus</i>	-	-	-	-	-	-	-	2		1			
324 <i>Bidens</i> spp.	-	-	1	4	8	3	-	-					
325 <i>Botrychium lanceolata</i>	-	-	-	-	-	-	-	1					
326 <i>Botrychium multifidum</i>	-	-	-	-	-	1	4	4					
327 <i>Butomus umbellatus</i>	-	-	2	-	-	-	-	-					
328 <i>Calamagrostis arundinacea</i>	-	-	-	-	-	-	-	5					
329 <i>Callitriche hamulata</i>	-	-	3	3	-	-	-	-					
330 <i>Cardamine pratensis</i>	-	-	12	47	7	3	3	2					
331 <i>Carex bigelowii</i>	-	-	-	-	-	-	-	4					
332 <i>Carex elongata</i>	-	-	-	1	-	-	-	-					

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333 <i>Carex glareosa</i>	-	-	-	-	4	-	2	-					1
334 <i>Carex limosa</i>	-	-	-	3	-	-	-	-				1	
335 <i>Carex marina</i>	-	-	-	3	4	-	-	-				1	
336 <i>Carex rariflora</i>	-	-	-	-	1	-	-	-				1	
337 <i>Carex salina</i>	-	-	-	-	2	-	-	-				1	
338 <i>Carex tenuiflora</i>	-	-	-	1	-	-	-	-				1	
339 <i>Carex viridula</i>	-	-	-	-	-	-	1	-					
340 <i>Cerastium spp.</i>	-	-	-	-	-	3	-	-					
341 <i>Chamaedaphne calyculata</i>	-	-	-	-	1	-	-	-				1	
342 <i>Cochlearia officinalis</i>	-	-	-	-	1	-	2	-					
343 <i>Conioselinum tataricum</i>	-	-	-	-	-	1	-	-					
344 <i>Crepis tectorum</i>	-	-	-	-	-	-	1	-	1				
345 <i>Draba incana</i>	-	-	-	-	-	-	1	-					
346 <i>Dryopteris expansa</i>	-	-	-	-	1	-	-	-		1			
347 <i>Eleocharis quinqueflora</i>	-	-	-	-	-	-	-	1					
348 <i>Elymus fibrosus x caninus</i>	-	-	-	-	-	-	-	11					
349 <i>Elymus mutabilis</i>	-	-	-	-	-	-	8	1				1	
350 <i>Equisetum hyemale</i>	-	-	-	-	-	-	-	5					
351 <i>Equisetum scirpoides</i>	-	-	-	-	-	-	-	1					
352 <i>Equisetum variegatum</i>	-	-	-	-	-	-	1	-					
353 <i>Erigeron acer</i>	-	-	-	-	-	-	3	20					
354 <i>Eriophorum scheuzeri</i>	-	-	17	10	-	-	1	-			1		
355 <i>Erysimum cheiranthoides</i>	-	-	-	-	-	-	-	2	1				
356 <i>Euphrasia nemorosa</i>	-	-	-	-	-	-	-	6	1				
357 <i>Festuca spp.</i>	-	-	-	-	-	-	-	1					
358 <i>Galeopsis tetrahit</i>	-	-	-	-	1	-	-	-	1				
359 <i>Gnaphalium norvegicum</i>	-	-	-	-	-	-	1	-					
360 <i>Hieracium crocatum</i>	-	-	-	-	-	-	-	1					
361 <i>Hypericum maculatum</i>	-	-	-	-	1	-	-	-	1				
362 <i>Juncus gerardii</i>	-	-	-	-	1	-	1	-					
363 <i>Juncus spp.</i>	-	-	-	-	-	-	-	1					
364 <i>Ligusticum scoticum</i>	-	-	-	-	3	-	1	-					
365 <i>Lychnis flos-cuculi</i>	-	-	-	-	1	-	-	-					
366 <i>Lycopodium alpinum</i>	-	-	-	-	-	-	-	1					
367 <i>Moehringia lateriflora</i>	-	-	-	-	-	5	1	14					
368 <i>Myosotis cespitosa</i>	-	-	-	4	-	-	-	-					
369 <i>Myosotis decumbens</i>	-	-	-	-	-	1	-	-					
370 <i>Myriophyllum alterniflorum</i>	-	-	2	3	-	-	-	-					
371 <i>Nuphar pumila</i>	-	-	2	-	-	-	-	-					
372 <i>Nymphaea candida</i>	-	-	1	-	-	-	-	-					
373 <i>Plantago maritima</i>	-	-	-	-	-	-	-	1					
374 <i>Poa alpina</i>	-	-	-	-	-	-	-	1					
375 <i>Potamogeton alpinus</i>	-	-	8	-	-	-	-	-					
376 <i>Potamogeton gramineus</i>	-	-	9	-	-	-	-	-					
377 <i>Potamogeton perfoliatus</i>	-	-	2	-	-	-	-	-					
378 <i>Potamogeton spp.</i>	-	-	-	2	-	-	-	-					
379 <i>Potentilla anserina ssp. egedii</i>	-	-	-	-	-	-	1	-					
380 <i>Potentilla cranzii</i>	-	-	-	-	-	1	-	-					
381 <i>Ranunculus flammula</i>	-	-	15	13	8	-	-	-					
382 <i>Ranunculus hyperboreus</i>	-	-	1	-	-	-	-	-					
383 <i>Ranunculus polyanthemos</i>	-	-	-	-	1	-	-	1	1				
384 <i>Ranunculus spp.</i>	-	-	3	-	-	-	-	-					
385 <i>Rhamnus frangula</i>	-	-	-	-	-	-	3	-					
386 <i>Rhodiola rosea</i>	-	-	-	-	2	-	2	-					
387 <i>Sagittaria sagittifolia</i>	-	-	11	-	-	-	-	-					
388 <i>Salix glauca</i>	-	-	-	3	1	-	2	2					
389 <i>Salix hastata x phyllicifolia</i>	-	-	-	-	-	-	-	1	1				
390 <i>Salix lanata</i>	-	-	-	-	-	-	2	-	1				
391 <i>Salix myrtilloides</i>	-	-	-	-	2	-	-	-	1		1		
392 <i>Salix phyllicifolia x cinerea</i>	-	-	-	-	-	-	-	1	1				
393 <i>Scheuzeria palustris</i>	-	-	-	1	-	-	2	-			1		
394 <i>Scrophularia nodosa</i>	-	-	-	1	1	-	-	-					
395 <i>Sparganium angustifolium</i>	-	-	10	3	-	-	-	-					
396 <i>Sparganium hyperboreum</i>	-	-	1	-	-	-	-	-					
397 <i>Sparganium minimum</i>	-	-	2	5	-	-	-	-					
398 <i>Stellaria borealis</i>	-	-	1	-	7	3	12	1					
399 <i>Stellaria fennica</i>	-	-	-	-	12	-	3	1					
400 <i>Stellaria humifusa</i>	-	-	-	-	-	-	1	-					

Appendix 4. Species frequencies discovered during the nationwide inventory of valuable rural landscapes in Finland along with their combined occurrence in earlier classifications (see material and methods). Highest record in classifications and zone character species are in bold. Indication characteristics for species was given if it was unambiguously possible.

Species name	Frequency in NWI		Occurrence in classifications						Indication				
	Used	Abandoned	<i>Equisetum</i>	Tall <i>Carex</i>	Wet grass	Tall herb	Moist grass	Small herb	Overgrowing indicator	Ruderal /cultural influence	Forest species	Mire / swamp species	Grazing / mowing
401 <i>Subularia aquatica</i>	-	-	5	1	-	-	-	-					
402 <i>Taraxacum croceum</i>	-	-	-	-	-	4	12	-					
403 <i>Triglochin maritima</i>	-	-	-	-	4	-	3	-					
404 <i>Triglochin palustre</i>	-	-	-	-	-	-	-	-					
405 <i>Tripleurospermum maritimum</i> ssp. <i>subpolare</i>	-	-	-	-	-	-	2	-		1			
406 <i>Utricularia</i> spp.	-	-	-	1	-	-	-	-					
407 <i>Utricularia vulgaris</i>	-	-	3	-	-	-	-	-					
408 <i>Vahlodea atropurpurea</i>	-	-	-	-	-	-	-	1					
409 <i>Veratrum album</i>	-	-	-	-	-	2	-	-					
410 <i>Viola biflora</i>	-	-	-	-	-	3	-	-					
Number of plots			127	254	254	235	256	244					
Number of species			90	181	184	174	213	208					
Average number of species / plot			9.4	12.4	12.5	19.3	19.3	25.2					
S.E.			1.7	1.87	1.6	1.8	1.9	2.3					

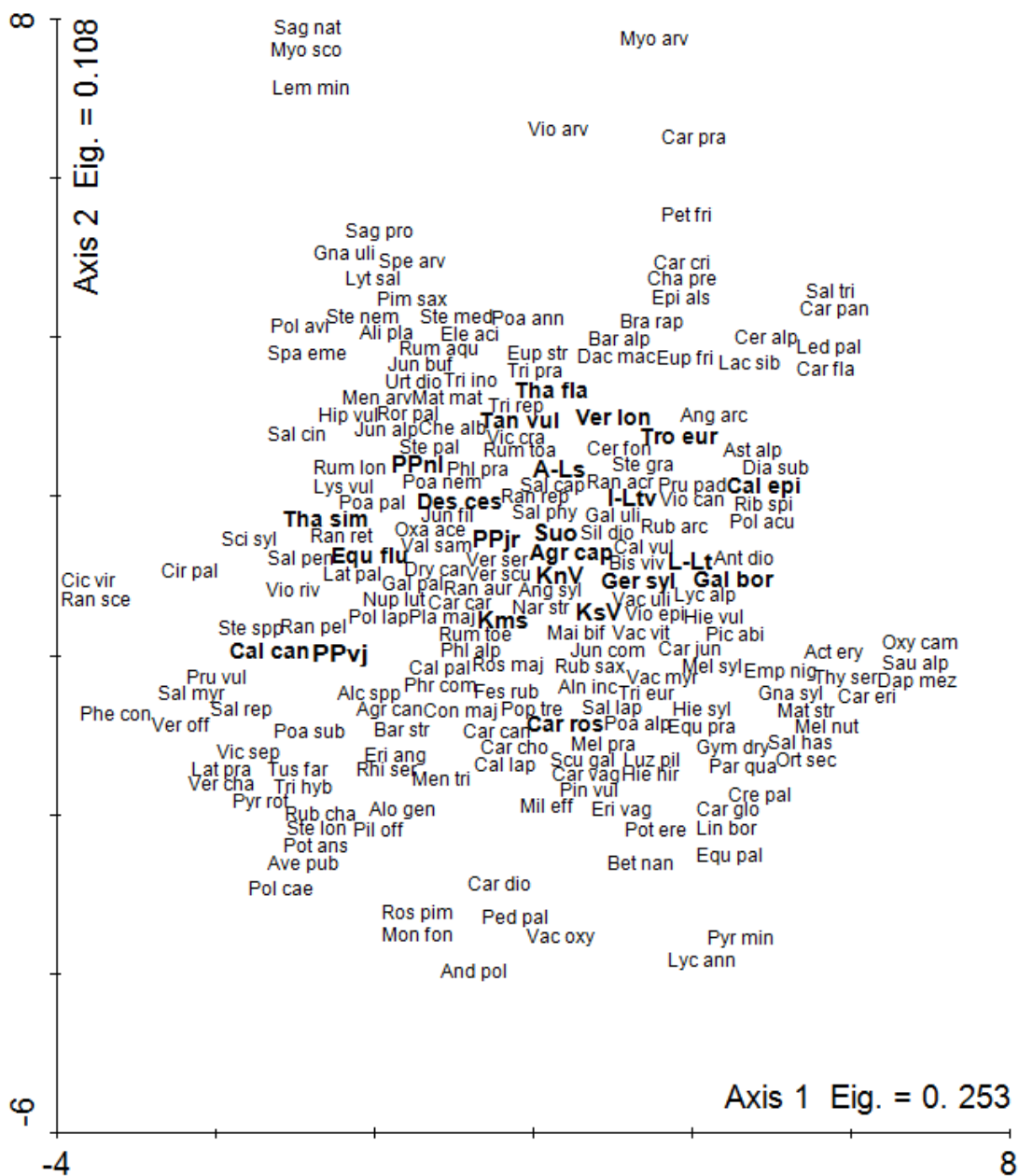


Figure A1. DCA ordination for NWI 's species. 194 most abundant species (out of total 315) found in NWI. Approximate placing for different Landscapes and dominant association formers are indicated in bold. Species (see complete list in Appendix 3) are presented as four three abbreviations (exceptions: Cat pal = *Caltha palustris*, cf. Cal pal = *Callitriche palustris*), Ran ret = *Ranunculus reptans*, cf. Ran rep = *Ranunculus repens*), Rum toa = *Rumex acetosa*. Symbols refer to meadows in different landscapes: KnV = Kainuu hillside, KsV = Kuusamo hillside, Kms = Keminmaa region, A-Ls = Aapa-Lapland region, PPvj = Ostrobothnia ultima hillside, PPjr = North Ostrobothnia riverside and coast, PPnl = North Ostrobothnia mire expanse, Suo = Suomenselkä

