

# The present size, protection status, threats and restoration requirements of *Carex caryophyllea* -populations in continental Finland

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*Carex caryophyllea* Latourr. is a declining species typical to semi-natural dry meadows, and considered both vulnerable and of urgent conservation concern in Finland. Because the species is rare and difficult to notice in the field, and because the resources for endangered species surveys have diminished in recent years, comprehensive inventories of the species' populations have lacked. These are instrumental in assessing the conservation status of the species, and in planning and prioritizing conservation action among the populations. In this study, I visited 57 *Carex caryophyllea* populations in south-western continental Finland, and surveyed the size, flowering, surrounding species, protection status and restoration requirements of 43 located populations. The results indicate, that while several populations ( $n = 20$ ) are protected with various legislative instruments, only few are currently managed ( $n = 9$ ). Because of the lack of management, the main threats the populations face include successional overgrowth and eutrophication. As such, restoration measures, such as clearing of bushes and mowing, are needed in the majority of populations ( $n = 36$ ) in the near future. In addition to protecting the currently unprotected populations, continuing the present management and introducing restoration efforts into unmanaged sites are the most important measures for ensuring the long-term persistence of the species in the study area. However, possibilities to include the species in *ex situ* -conservation measures should be investigated as well.

## Introduction

*Carex caryophyllea* Latourr. is an early-flowering, rhizomatous sedge characteristic to dry semi-natural meadows across Eurasia (Hultén & Fries 1986, Grime et al. 1988, Hämet-Ahti et al. 1998) (Fig. 1). Traits that distinguish *C. caryophyllea* from other low-growing species of sedge include the early flowering period and the transparent, acuminate sheath formed by the bract supporting the lowest spike in the culm (Hämet-Ahti et al. 1998). In Finland, *C. caryophyllea* is restricted to the south-western parts of the coun-

try, being relatively common in the Åland islands (Häggström & Häggström 2011), but rare on the mainland (Rautiainen 2012). The species favors the habitat types *Avenula pubescens* dry meadows and acid low herb dry meadows, which are both considered critically endangered according to the Finnish Assessment of Threatened Habitat Types (Schulmann et al. 2008). The species also prefers southerly and south-easterly slopes with warm microclimates and somewhat calcareous soils (Jalas 1958, Valta & Luoto 1991, Rautiainen 2012). Due to its tendency to occur in the vicinity of Iron Age -ancient findings, the species is re-



**Fig. 1.** *Carex caryophyllea* in May 2015 on Juhannuskukkula -hill, Turku, Finland. The species in the surrounding meadow include *Trifolium medium*, *Achillea millefolium*, *Rumex acetosa*, and *Helictotrichon pubescens*. Photograph J. Lampinen.

garded an archaeophyte in Finland (Valta & Luoto 1991, Suominen & Hämet-Ahti 1993).

Considered to be of urgent conservation concern (Kemppainen & Anttila 2011, Kemppainen 2013), the most recent conservation assessment of *Carex caryophyllea* designated the species as vulnerable (Rassi et al. 2010). The cover of different types of dry meadows in Finland has reduced over 90 % since the 1950s (Schulman et al. 2008), and with them much of suitable habitat for *C. caryophyllea* has vanished as well. Causes for the decline in dry meadow area have included successional overgrowth due to the cessation of grazing and eutrophication, and, close to urban areas, building activity (Rautiainen 2012). In south-western Finland, on the northern edge of the species' distribution, suitable habitat for *C. caryophyllea* has likely always been scarce and the species itself uncommon. This, and the species' poor dispersal ability (Grime et al. 1988), accentuate the negative effects of habitat loss in the current range of the species in Finland.

Information on the present size and condition of individual populations of endangered species, and the possible threats facing them, is important for planning and prioritizing restoration action among the populations. On the other hand, information on the current level of protection and type of management in each population allows generalizations of the future of the species beyond the population level. Besides active restoration and continued management of the species' habitats, the most urgent action to enhance the conservation status of *C. caryophyllea* has been suggested to be increasing information on the ecology and status of its present populations (Kemppainen & Anttila 2011, Kemppainen 2013). This has proven to be difficult, as the species is not easy to detect in the field outside its early flowering period (Rautiainen 2012) and may be mixed with co-occurring similar species of sedge, such as *C. ericetorum*. Records of historical occurrences of the species also often have imprecise coordinates or lack habitat description. All of these issues, as

well as the diminishing resources for endangered species surveys, have hindered field visits to the populations and comprehensive assessments of the species' status in Finland.

The purpose of this study is to assess the size and present protection status of *C. caryophyllea* populations and the threats facing them in continental Finland. The purpose is also to produce information suitable for conservation assessment and restoration planning of the populations.

## Materials and Methods

The study was begun by extracting known *Carex caryophyllea* -population locations from the Hattikka-database (Finnish museum of natural history 2015), municipal nature surveys (e.g. Yli-Tuomi & Turkulainen 2013) and previous publications concerning the species (e.g. Valta & Luoto 1991). Records interpreted to describe the

same populations were combined, resulting in 72 known populations from continental south-western Finland (Fig. 2, Table 1). To ease the relocation of the populations in the field, populations with records older than 30 years or those with imprecise coordinates (with a kilometer grain) and no habitat description were for the most part omitted from the further steps of the study. As the focus of the study was continental Finland, populations from the Åland Islands and the south-western archipelago were likewise omitted, resulting in records from 57 populations. These were visited in the field in May 2015.

In the field, the species was systematically searched for in the area indicated by each record. Populations that could be relocated were first delineated onto aerial images, and the amount and size of *C. caryophyllea* patches in each population were estimated. The number of shoots in each patch was estimated on a logarithmic scale of 1, 1–10, 10–100, 100–1000 and >1000 shoots

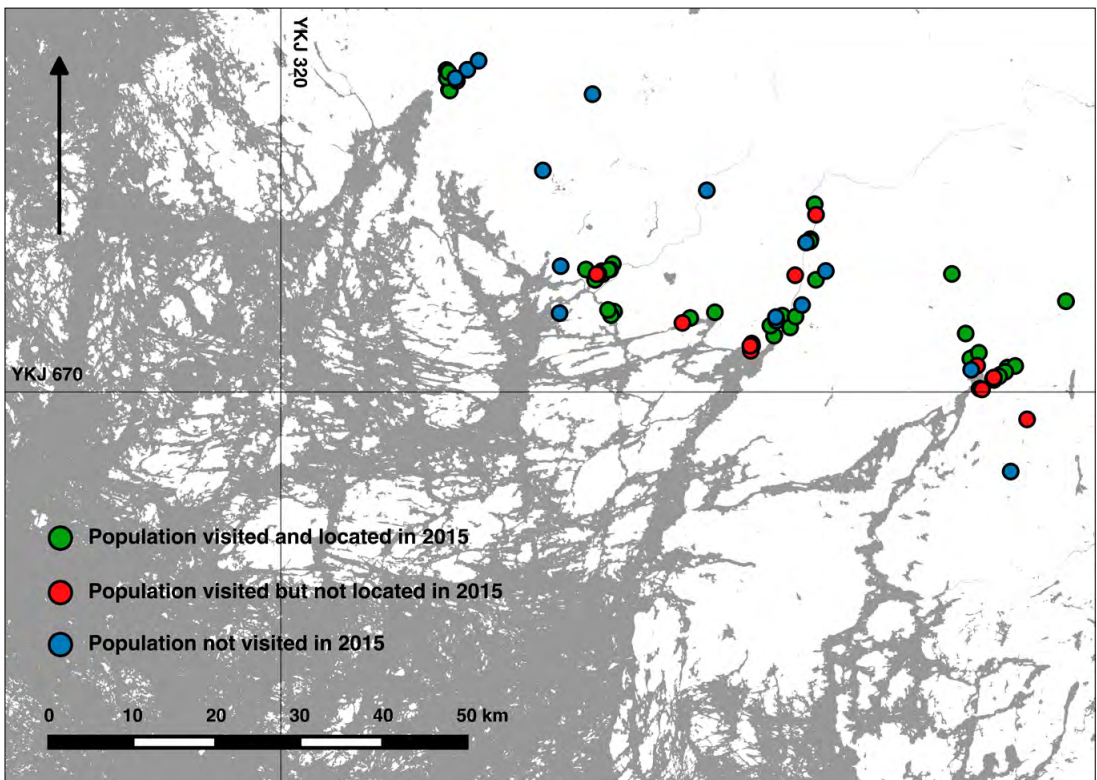


Fig. 2. Known *Carex caryophyllea* -populations in continental south-western Finland. Green dots represent populations visited and located in 2015 ( $n = 43$ ), red dots those that were searched for but not located in the field ( $n = 14$ ), and blue dots those not visited during the study ( $n = 15$ ).

**Table 1.** Known *Carex caryophyllea* -populations in the municipalities of south-western Finland (according to present administrative borders), based on herbaria -collections and other sources.

Municipality	Visited and located in 2015	Visited, not located in 2015	Not visited
Kaarina	3	4	0
Lieto	0	0	1
Masku	0	0	1
Mynämäki	6	2	3
Nousiainen	0	0	1
Paimio	9	3	5
Salo	14	4	2
Turku	11	1	2

per patch. The number of flowering culms was, in turn, estimated per population, and calculated with one to four 25m<sup>2</sup> plots placed among the patches. The threats and restoration requirements of each population and patch were estimated in the field based on the management status and degree of successional overgrowth in the populations. In June 2015, the species in the surrounding grassland communities were surveyed with the same plots used to calculate the number of culms in each population. The presence or absence of species on each plot was listed on a square meter basis, resulting in abundance frequencies from 1 to 25 for each observed species on each plot. Altogether, 77 plots consisting of 1925 one square meters were surveyed in the 43 populations.

## Results and discussion

### Population relocation

Out of the visited 57 populations, 43 populations consisting of altogether 167 patches could be relocated in May 2015. Reasons for not locating the rest 14 populations may have been due to the actual local extinction of the species, although imprecisely reported coordinates of the records or simply not finding the species were also likely reasons. In cases where it was apparent that the species was no longer present in the area indi-

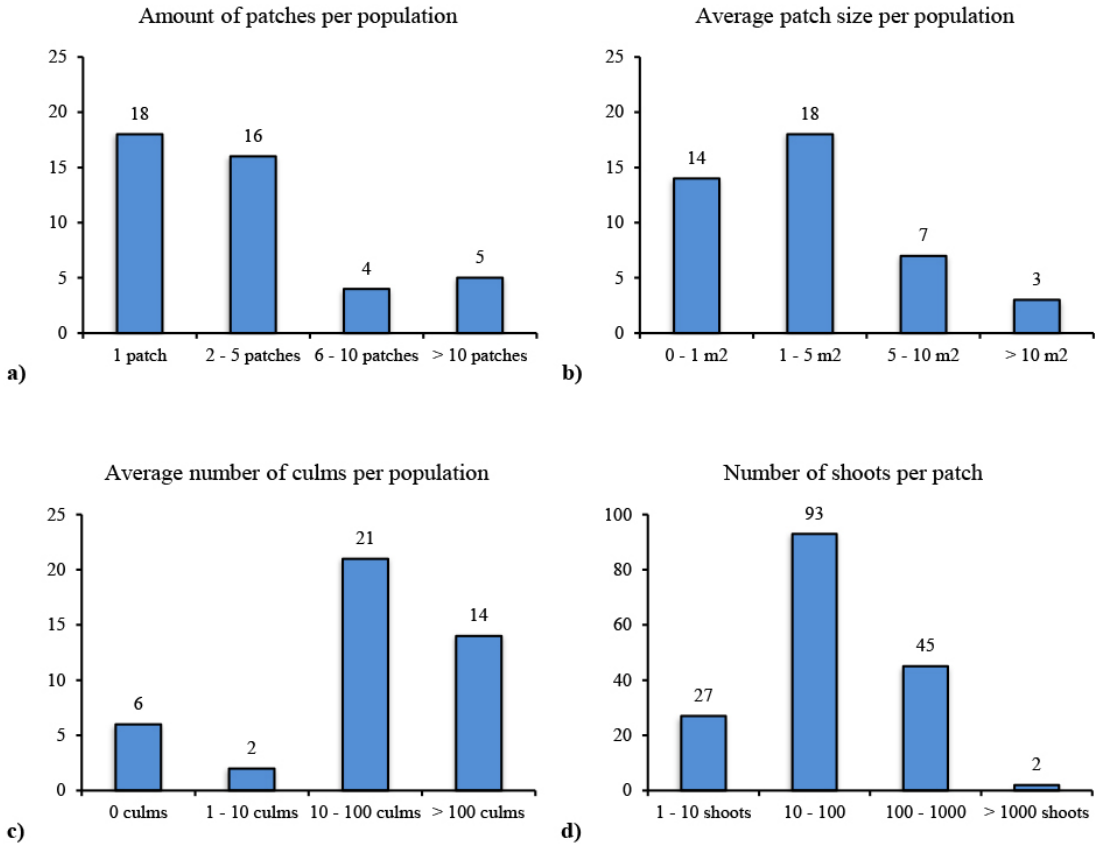
cated by the record, successional overgrowth appeared to be the cause of local extinction in 5 populations. For example in *Falkki*, a site pictured by Valta & Luoto (1991) as an open meadow, a secondary succession of pines (partly planted) covered almost the entire area during the fieldwork for this study in May 2015. One other population, *Iilikenmäki* in Salo, could not be relocated due to housing construction in the area. The actual reason behind this may either be habitat destruction due to building activity, or the fact that the newly built houses prevented exhaustive searches of the area. Random chance may also have affected the search result in 8 populations: despite some degree of overgrowth, the sites *Heikkilä 1* and *2* in Mynämäki appeared suitable for the species, but after extensive searches the species still remained unfound at the site. For description of each 57 visited populations, see Appendix 1.

### Population size and condition

Based on the relocated 43 populations, a typical *C. caryophyllea* -population in continental Finland comprises only one or a few patches, all the size of a few square meters, with ten to one hundred shoots in each patch. Based on the sampled 25m<sup>2</sup> study plots in each population, the average number of culms in the populations is typically between ten and one hundred (Fig. 3 a-d). Only certain populations (such as *Juhamuskukula 1* in Turku and *Alhainen* in Paimio) comprise over ten patches and only a fraction of all patches in all populations consist of over a thousand shoots, producing several hundreds of culms (such as *Raunistula* in Turku and *Kärkkä3* in Salo). The smallest located populations, such as *Pyheen Seurojentalo* in Mynämäki and *Linnunpää* in Piikkiö consist of only a single or a few shoots and zero to few culms.

### Population protection status, threats and restoration requirements

Whether examined on the level of entire populations or individual patches, the protection status of the species in the study area appears somewhat positive: roughly half of the studied popula-



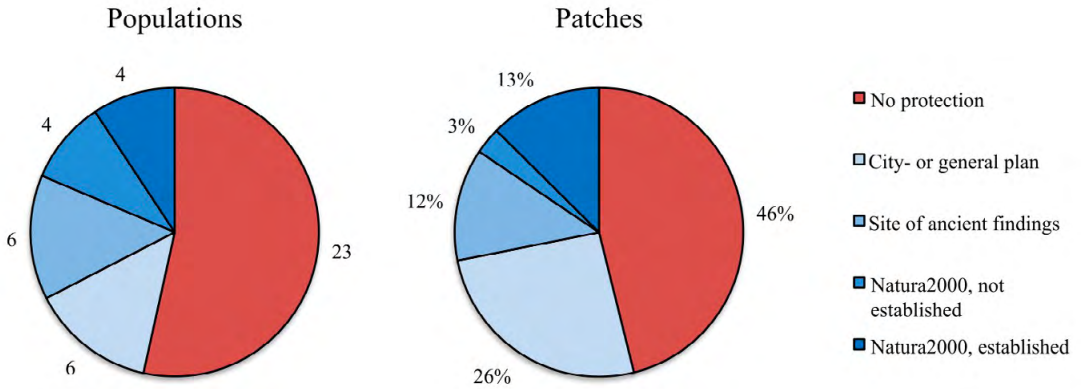
**Fig. 3.** The amount (a) and average size (b) of patches and the average number of culms (c) in the observed populations, and the amount of shoots in all observed patches (d).

tions and patches have some form of protection status, although only 4 populations and 13 % of all patches are situated within actual protected areas. City- and general plans and legislation concerning ancient findings yield some protection to approximately a quarter of the populations and third of the patches (Fig. 4). However, as a species adapted to open, low-growing meadows, protection alone is not sufficient to ensure the long-term persistence of the present populations. Management, such as grazing is required as well, but only a few ( $n = 9$ ) of the studied populations are currently in constant management (Fig. 5). Four populations are grazed (such as *Tattula* in Salo and *Alhainen* in Paimio), and three have been recently partly cleared of bushes and trees by volunteer work (such as *Juhauskukkula 1* in Turku). Two populations at the Uskela- and Pyhän Jaakobin kirkko -churches in Salo and Paimio (*Uskela*

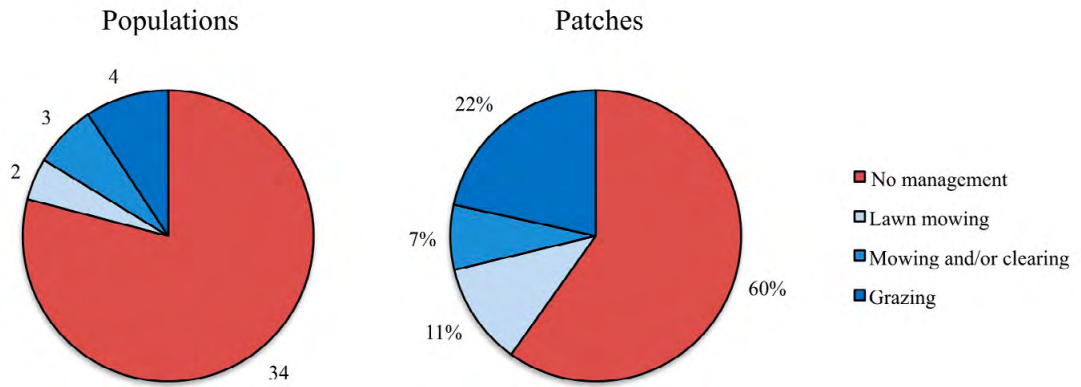
2 and *Jaakobinkirkko*) are regularly cut with lawn mowers, resulting in cut culms and reduced flowering. This type of improper management does not appear to kill individual shoots, but effectively hinders sexual reproduction by preventing seed development.

The two most severe threats estimated to face the studied populations are successional overgrowth and eutrophication (Fig. 6), both resulting from a lack of management and thus mirroring the poor management status of the populations. A less common, but more dramatic threat is habitat destruction due to building activity, which targets two populations (*Juhauskukkula 2* and *Kaakelitehtaanmäki*) in Turku. The different threats faced by the populations can be averted by different means of restoration, with the most relevant being the clearing of bushes and trees and restorative mowing (Fig. 7). 22 Populations and

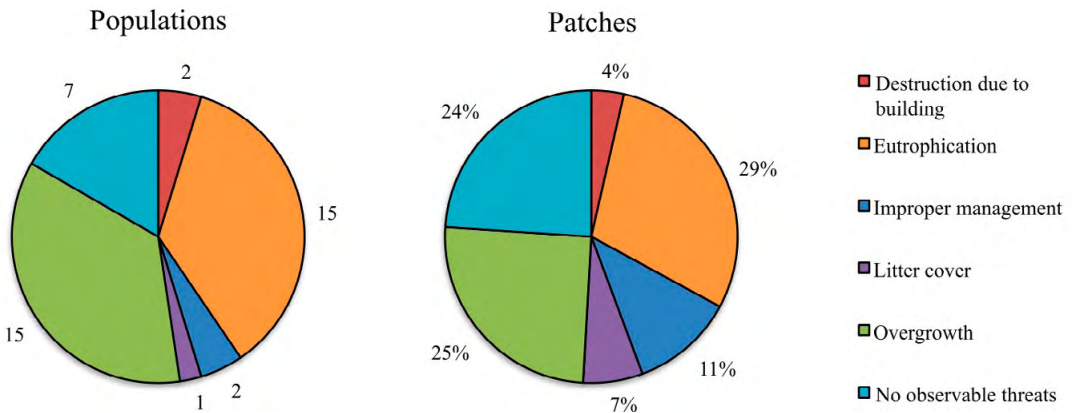




**Fig. 4.** The protection status of entire populations ( $n = 43$ , expressed as totals) and individual patches ( $n = 167$ , expressed as percentages) of *Carex caryophyllaea* in south-western Finland.



**Fig. 5.** The management status of entire populations ( $n = 43$ , expressed as totals) and individual patches ( $n = 167$ , expressed as percentages) of *Carex caryophyllaea* in south-western Finland.



**Fig. 6.** The foremost threats to entire populations ( $n = 43$ , expressed as totals) and individual patches ( $n = 167$ , expressed as percentages) of *Carex caryophyllaea* in south-western Finland.

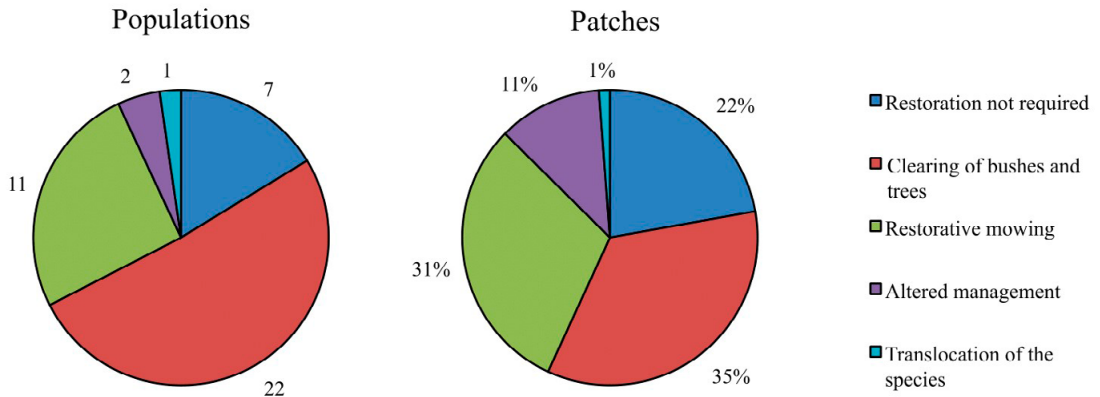


Fig. 7. The most important required restoration measures of entire populations ( $n = 43$ , expressed as totals) and individual patches ( $n = 167$ , expressed as percentages) of *Carex caryophyllea* in south-western Finland.

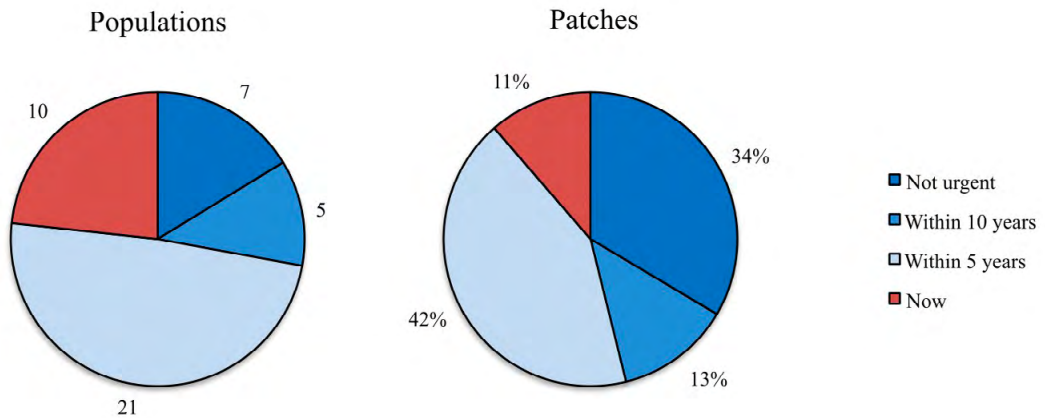


Fig. 8. The restoration urgency of entire populations ( $n = 43$ , expressed as totals) and individual patches ( $n = 167$ , expressed as percentages) of *Carex caryophyllea* in south-western Finland.

35 % of patches require clearing due to successional overgrowth, and 11 populations and 31% of patches mowing due to eutrophication. In addition to manual clearing and mowing, introduction of grazing should be investigated in certain populations (such as *Härkämäki* in Turku), as it is ultimately one of the few means to ensure the long-term persistence of the species.

The urgency of the required restoration measures varies between the populations and the measures themselves: some form of restoration is immediately required in 10 populations and 11% of all patches, and only 7 populations and 34% of the patches require no urgent restoration measures (Fig. 8). Populations requiring the most ur-

gent restoration are either extremely small (such as *Pyheen Seurojentalo* in Mynämäki or *Uskela 1* in Salo) or extremely overgrown, such as (*Pahkavuori* in Salo and *Ispoinen* in Turku). Larger and less overgrown populations may persist for many years without management (Grime et al. 1988), as the species is somewhat shade-tolerant, perennial and capable of vegetative reproduction. In cases where habitat destruction due to building activity threatens the survival of the species (such as in *Juhannuskukkula 2* and *Kaakelitehtaanmäki* in Turku), urgent measures to e.g. collect seeds of the threatened populations or to translocate entire individuals into nearby extant populations should be investigated.

### Accompanying species

Altogether 217 vascular plant species were recorded in the meadows surrounding *C. caryophyllea*. The most frequent species were *Galium verum* (VU), *Achillea millefolium*, *Filipendula vulgaris*, *Poa angustifolia* and *Trifolium medium* (Table 2). Previous studies have emphasized the presence of especially *F. vulgaris*, *Helictotrichon pratense* and *Luzula campestris* in the meadows surrounding *C. caryophyllea* (Cajander 1902, Jalas 1958, Valta & Luoto 1991). In their study on the community ecology of grasslands in south-western Finland, Hinneri & Lehtomaa (1994) also classify *C. caryophyllea* in the same group of species inhabiting moraine mounds in areas of old habitation as *Viscaria vulgaris*, *Thymus serpyllum* (NT, RT) and *Lathyrus linifolius*. The results in this study partly support these findings,

as *F. vulgaris* was indeed the third and *H. pratense* the sixth most frequent species in the surveyed meadows. *L. campestris* was less common, although among the 25 most frequent species. While *Viscaria vulgaris* was very common in the studied meadows, other species mentioned by Hinneri & Lehtomaa (1994) were not, such as *Thymus serpyllum*. The differences between the two studies are likely due to partly different study areas: the majority of the data used by Hinneri & Lehtomaa (1994) originated from the archipelago southwest of the meadows surveyed in this study.

In addition to ordinary meadow species, such as *Achillea millefolium* and *Viscaria vulgaris*, several notable species of traditional rural biotopes were present in the surveyed communities as well. Such species are either rare or declining, often threatened and indicate long-lasting traditional agriculture in the surrounding area (Vainio

**Table 2.** The most common species in the meadow communities surrounding 43 *Carex caryophyllea* -populations in continental south-western Finland. Frequency describes the average number of species occurrences (0-25) on 77 plots of 25m<sup>2</sup> placed into the populations.

Scientific name	Name in Finnish	Frequency (1-25)
<i>Galium verum</i> , VU (= vulnerable)	Keltamatara	17,3
<i>Achillea millefolium</i>	Siankärsämö	14,5
<i>Filipendula vulgaris</i>	Sikoangervo	11,4
<i>Poa angustifolia</i>	Hoikkanurmikka	10,3
<i>Trifolium medium</i>	Metsäapila	10,3
<i>Helictotrichon pratense</i>	Ahdekaura	9,7
<i>Deschampsia flexuosa</i>	Metsälauha	9,6
<i>Helictotrichon pubescens</i>	Mäkikaura	9,5
<i>Agrostis</i> sp.	Röllit	9,4
<i>Pimpinella saxifraga</i>	Ahopukinjuuri	8,8
<i>Stellaria graminea</i>	Heinätähtimö	8,7
<i>Viscaria vulgaris</i>	Mäkitervakko	8,6
<i>Festuca rubra</i>	Punanata	8,5
<i>Festuca ovina</i>	Lampaannata	7,6
<i>Galium boreale</i>	Ahomatara	7,6
<i>Fragaria vesca</i>	Ahomansikka	7,4
<i>Ranunculus polyanthemos</i>	Aholeinikki	6,4
<i>Veronica chamaedrys</i>	Nurmitädyke	6,4
<i>Rumex acetosa</i>	Niittysuolaheinä	6,3
<i>Pilosella officinarum</i>	Huopakeltano	6,2
<i>Centaurea jacea</i>	Ahdekaunokki	6,2
<i>Silene nutans</i>	Nuokkukohokki	5,7
<i>Luzula campestris</i>	Ketopiippo	4,8
<i>Alopecurus pratensis</i>	Nurmipuntarpää	4,8
<i>Campanula rotundifolia</i>	Kissankello	4,5



et al. 2001, Raatikainen 2009). They were typically infrequent in the studied meadows and restricted to only certain parts of the study area, such as *Armeria maritima* subsp. *elongata* (EN) in Mynämäki, *Seseli libanotis* and *Vincetoxicum hirundinaria* in Turku and *Phleum pratense*

subsp. *serotinum* (NT, RT) in Paimio and Salo. Only few notable species, such as *Silene nutans*, *Helictorichon pubescens* and *Ranunculus polyanthemos*, were abundant and common throughout the study area (Table 3).

**Table 3.** Notable species of traditional rural biotopes (Raatikainen 2009) and their conservation statuses (Rassi et al. 2010, Ryttylä et al. 2012) in the surrounding meadow communities of 43 *Carex caryophyllea*-populations in continental south-western Finland.

Scientific name	Name in Finnish	Frequency
<i>Allium oleraceum</i>	Nurmilaukka	0,1
<i>Antennaria dioica</i> , NT, RT*	Ahokissankäpälä	0,05
<i>Arabis glabra</i>	Pölkkyruoho	0,5
<i>Arabis hirsuta</i>	Jäykkäpitkäpalko	0,03
<i>Armeria maritima</i> subsp. <i>elongata</i> , EN	Niitty-laukaneilikka	0,02
<i>Botrychium lunaria</i> , NT, RT	Ketonoidanlukko	0,01
<i>Carex ericetorum</i> , RT	Kanervisara	0,02
<i>Carex muricata</i>	Törrösara	0,1
<i>Carex panicea</i>	Hirssisara	0,02
<i>Carex spicata</i>	Hakarasara	0,8
<i>Cotoneaster scandinavicus</i>	Kalliotuhkapensas	0,2
<i>Dianthus deltooides</i> , NT	Ketoneilikka	1,4
<i>Filipendula vulgaris</i>	Sikoangervo	11,4
<i>Fraxinus excelsior</i> , RT	Saarni	0,6
<i>Galium verum</i> , VU	Keltamatara	17,3
<i>Helictotrichon pratense</i>	Ahdekaura	9,7
<i>Helictotrichon pubescens</i>	Mäkikaura	9,5
<i>Hypochoeris maculata</i>	Harjuhäränsilmä	0,2
<i>Lathyrus linifolius</i>	Syylälinnunherne	0,6
<i>Lotus corniculatus</i>	Keltamaite	0,7
<i>Luzula campestris</i>	Ketopiippo	4,8
<i>Myosotis ramosissima</i>	Mäkilemmikki	0,1
<i>Myosotis stricta</i>	Hietalemmikki	0,4
<i>Origanum vulgare</i>	Mäkimeirami	0,1
<i>Phleum pratense</i> subsp. <i>serotinum</i> , NT, RT	Ketotähkiö	0,3
<i>Poa compressa</i>	Litteänurmikka	1,0
<i>Potentilla crantzii</i>	Keväthanhikki	0,1
<i>Primula veris</i>	Kevätesikko	0,2
<i>Quercus robur</i>	Tammi	1,4
<i>Ranunculus polyanthemos</i>	Aholeinikki	6,4
<i>Rosa villosa</i> subsp. <i>mollis</i>	Iharuusu	0,05
<i>Satureja acinos</i>	Ketokäenminttu	0,1
<i>Seseli libanotis</i>	Hirvenputki	1,0

Table 3 cont.

Scientific name	Name in Finnish	Frequency
<i>Silene nutans</i>	Nuokkukohokki	5,7
<i>Sorbus hybrida</i>	Suomenpihlaja	0,02
<i>Sorbus intermedia</i> <sup>1</sup> , <b>VU</b>	Ruotsinpihlaja	0,01
<i>Thymus serpyllum</i> , <b>NT, RT</b>	Kangasajuruoho	0,4
<i>Trifolium arvense</i>	Jänönapila	1,2
<i>Ulmus glabra</i> <sup>1</sup> , <b>VU</b>	Vuorijalava	0,3
<i>Verbascum nigrum</i>	Tummatulikukka	0,1
<i>Veronica verna</i>	Kevättädyke	0,1
<i>Vicia tetrasperma</i>	Mäkivirvilä	1,7
<i>Vincetoxicum hirculinaria</i>	Käärmeenpistonyrtti	0,3

\* = **NT** = Near threatened, **VU** = Vulnerable, **EN** = Endangered, **RT** = Regionally threatened.

<sup>1</sup> = Likely of cultivated origin.

## Conclusion

Based on the results, the future of *C. caryophyllea* in continental Finland appears somewhat bleak. Despite a high proportion of the populations enjoying some level of protection, management such as grazing, clearing and mowing is needed in the majority of populations in the near future. Furthermore, while the restoration measures required are straightforward to identify, their practical application on a large scale is likely difficult. For example, grazing may be difficult to organize in the meadows inhabited by the species, due to their small size, rockiness and long distances to other similar meadows. Arranging restorative mowing and clearing of bushes and trees as volunteer work can be effective, but is likely not a viable option on the long run, due to inadequate resources of the organizers, whether they are environmental officials or volunteer organizations.

Still, facilitating the protection and restoration of the unprotected and unmanaged populations is just as important for the future of the species as continuing the management in those presently managed. The 25 most common species in the surrounding meadows consist almost entirely of meadow species, and only some are considered eutrophication indicators (such as *Alopecurus pratensis*). In addition, several rare species inhabit the same meadows, meaning that the res-

toration of *C. caryophyllea* -populations would help maintain diverse meadow communities in the study area.

Possibilities to include the species in *ex situ* -conservation projects should be investigated as well. For example, seeds could be collected from large populations and sown into nearby grazed meadows with similar environmental conditions as meadows presently inhabited by the species. A less orthodox measure worth studying would be to include the species in sown lawn mixtures used in sandy, dry slopes with poor potential for regular lawn growth and little need for mowing. Should the species form new populations this way, its nature as an Iron Age -archeophyte would undoubtedly suffer. This is, however, a small price to pay for the continued existence of the species as a part of the flora of continental Finland.

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**Appendix 1.** Description of 57 *Carex caryophyllea* -populations in continental south-western Finland visited during the study.

Each site described in this appendix is named based on a location close to the site, followed by coordinates of the population expressed in the Finnish Uniform Coordinate system (YKJ). The general description of the site includes information on the habitat types and vegetation, but also on the topography, soil and other traits related to habitat conditions at each site. The rest of the site description includes information exemplified below:

**Size:** The amount and area of the study species' patches at each site.

**Surrounding notable species:** Notable species of traditional rural biotopes of southern Finland (according to Vainio et al. 2001, Raatikainen 2009) found on the study plots.

**Threats:** Possible threats facing the patches of the species or the entire meadow surrounding them:

Successional overgrowth: Overgrowth resulting from shrub and sapling encroachment.

Eutrophication: Overgrowth resulting from tall, dominant grasses that increase with increasing productivity and lack of management.

Litter cover: Accumulation of leaf and grass litter caused by overgrowth and eutrophication.

Improper management: Management, such as mowing, with possible adverse effects on the study species.

Destruction: The site or a part of it faces destruction due to e.g. building projects.

**Restoration needs:** Specific suggestions for restoration action at each site.

**Conservation status, ownership:** Information on whether the site is designated as a conservation area or protected through city zonation. Ownership status is indicated as either public (state or city) or private when known.

**Additional information:** Other relevant information for restoration action at each site, such as mentions of the study species or the site in the literature, or the most recent herbaria collections of the study species at the site.

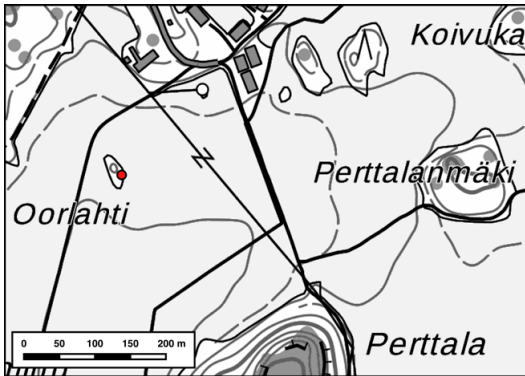
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## Kaarina

### LINNUNPÄÄ 670552:325647 (YKJ)

A midfield islet approximately 0.5 ha in size, with small patches of dry meadow vegetation between the rocky center of the islet and the forested north-eastern edge. The study species occurs on the eastern corner of the islet, as a very small population susceptible to random events.



**Size:** 1 patch, 0.6 m<sup>2</sup> in area, with 1–10 shoots.

**Surrounding notable species:** *Filipendula vulgaris*, *Galium verum* (VU), *Silene nutans*.

**Threats:** Successional overgrowth, eutrophication: Trees and bushes have covered the north-eastern edge of the islet, while *Calamagrostis epigejos* and other competitive grasses have invaded the majority of the meadow patches on it.

**Restoration needs:** Partial clearing of bushes, mowing the field layer and/or introduction of grazing on the islet.

**Conservation status, ownership:** Unprotected, privately owned.

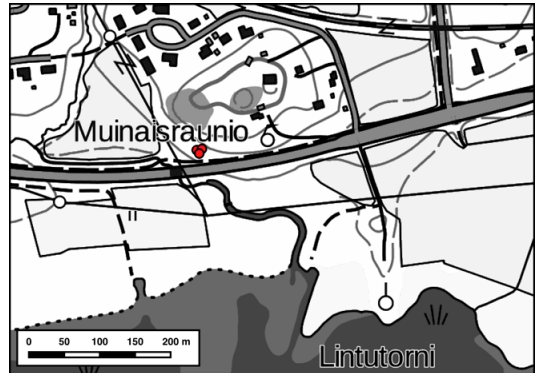
**Additional information:** The species has been collected from several locations in the surrounding Linnunpää-estate (e.g. TUR289073 by Koskinen A, Virtanen T & Silkkilä OK 1986), described with partly imprecise coordinates. It is unclear which, if any, of the previous collections originate from the site described here.

### MYRSKYLINNA 670955:325202 (YKJ)

A rocky, southwards sloping patch of dry meadow on a hill facing the Piikkiönlahti -bay, approximately 10-15 meters north of the 101 road, surrounded by a sparse xeric heath forest. Possibly previously used as wooded pasture, due to old, sturdy pine trees and an otherwise young tree layer surrounding the meadow. With sturdy, large shoots and long (~30 cm) culms, a part of the population may consist of hybrid individuals.

**Size:** 3 patches, 21 m<sup>2</sup> in area in total, with 10-100 or 100-1000 shoots in each patch.

**Surrounding notable species:** *Dianthus deltoides* (NT), *Filipendula vulgaris*, *Galium verum* (VU), *Helictotrichon pratense*, *Luzula campestris*, *Silene nutans*, *Vicia tetrasperma*.



**Threats:** Eutrophication, successional overgrowth: Tall, competitive grasses cover a part of the meadow, and saplings and bushes advance towards it from the surrounding forest.

**Restoration needs:** Removing the saplings, mowing the field layer every few years and raking away the resulting hay.

**Conservation status, ownership:** Unprotected. Ancient findings are present west of the population and yield some protection to the hill.

**Additional information:** Several collections, e.g. H627942 by Koskinen A 1986.

### TUORLA 670885:324907 (YKJ)

A dry, partly rocky meadow sloping towards south-east, dominated by *Helictotrichon pubescens*, and surrounded by a more mesic hay meadow and a xeric pine heath forest. Partly fenced, possibly due to the occasional presence of grazing animals.



**Size:** 3 patches, 8.42 m<sup>2</sup> in area in total, with 10-100 shoots in each patch.

**Surrounding notable species:** *Dianthus deltoides* (NT), *Filipendula vulgaris*, *Galium verum* (VU), *Helictotrichon pratense*, *Helictotrichon pubescens*, *Luzula campestris*, *Quercus robur*, *Ranunculus polyanthemos*, *Rosa villosa* subsp. *mollis*, *Seseli libanotis*, *Silene nutans*, *Vicia tetrasperma*.



**Threats:** No observable threats, in case that the meadow truly is grazed.

**Restoration needs:** Continuing or introducing grazing with either sheep or cattle in the meadow.

**Conservation status:** Unprotected.

**Additional information:** Mentioned by Silkkilä & Koskinen (1990) and Yli-Tuomi & Turkulainen (2013).

## Mynämäki

### KATAVAINEN 1 673614:322024 (YKJ)

A rocky, eutrophicated patch of species-poor dry meadow partly covered by birches and other trees, on the south-western edge of a forest-covered midfield islet.



**Size:** 3 patches, approximately 1.45 m<sup>2</sup> in area in total, with 10–100 shoots in each patch.

**Surrounding notable species:** *Filipendula vulgaris*, *Galium verum* (VU), *Helictotrichon pratense*, *Luzula campestris*, *Ranunculus polyanthemos*.

**Threats:** Successional overgrowth, litter cover: Without management, the surrounding young forest or birches, rowans and willows will enclose over the population. Litter and felled trunks already cover a part of the patches.

**Restoration needs:** Clearing away a part of the bushes and forest surrounding the meadow, restorative mowing of the field layer.

**Conservation status, ownership:** Unprotected.

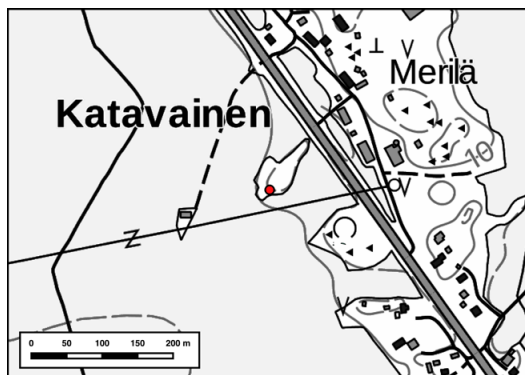
**Additional information:** Two collections, e.g. TURA 364089 by Syrjänen K & Rautiainen P 2001.

### KATAVAINEN 2 673622:322015 (YKJ)

A small patch of rocky, species-rich dry meadow on the south-western tip of a forest-covered midfield islet, on a gentle slope towards the south, surrounded by cultivated field and a dense, mature forest.

**Size:** 1 patch, approximately 7 m<sup>2</sup> in area, with 10–100 shoots.

**Surrounding notable species:** *Filipendula vulgaris*, *Galium verum* (VU), *Helictotrichon pubescens*, *Hypochoeris maculata*, *Luzula campestris*, *Ranunculus polyanthemos*, *Silene nutans*.



**Threats:** Successional overgrowth, eutrophication: A forest has covered the center of the islet and young bushes (*Ribes alpinum*, *Amelanchier spicata*) its edges. Without management, the small meadow patch will be covered in bushes as well. Also, nutrient inflow from the nearby field may increase the cover of tall, dominant grasses.

**Restoration needs:** Clearing away a part of the bushes and forest surrounding the meadow.

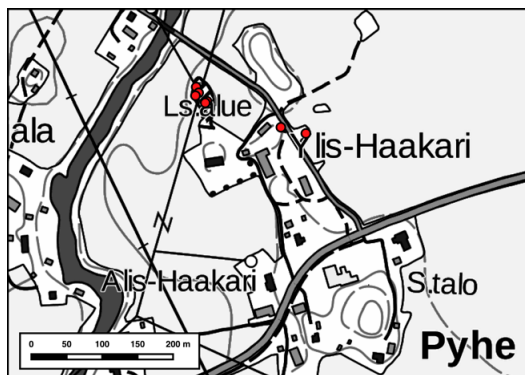
**Conservation status, ownership:** Unprotected.

**Additional information:** Collection TURA364090 by Rautiainen P & Syrjänen K 2001.

### PYHEEN LUONNONSUOJELUALUE 6738605-589:

3219850-865, 6738551:3219967, 6738544:3220003 (YKJ)

The central parts and westerly slopes of a midfield islet, covered by a large, species-rich, *Helictotrichon pratense*-dominated dry meadow in the middle of a private estate and cultivated fields. The islet has been mown and raked since 1995, and sheep have begun grazing there in recent years. Two patches of the study species are situated also on other similar, yet unmanaged and eutrophicated islets some 100 meters south-east, along the road passing the estate.



**Size:** 8 patches, approximately 7.9 m<sup>2</sup> in area in total, with 1–10 or 10–100 shoots in each patch.

**Surrounding notable species:** *Armeria maritima* subsp. *elongata* (EN), *Dianthus deltoideus* (NT), *Filipendula vul-*

*garis*, *Galium verum* (VU), *Helictotrichon pratense*, *H. pubescens*, *Hypochoeris maculata*, *Luzula campestris*, *Ranunculus polyanthemus*.

**Threats:** No observable threats on the majority of *C. caryophyllea* -patches, due to long management history and present grazing. Eutrophication forms a potential problem only for the two patches on the ungrazed islets.

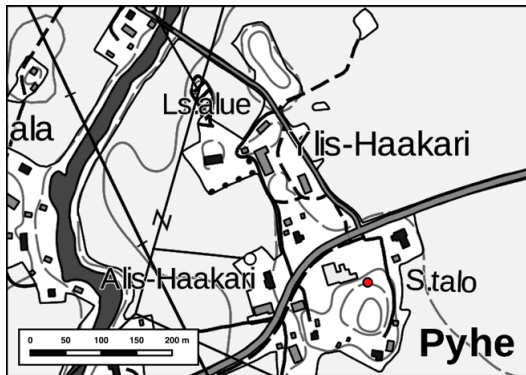
**Restoration needs:** Continuing the present grazing and management regime, and mowing the field layer on the ungrazed islets every few years.

**Conservation status, ownership:** Designated as a Natura2000 -area (Vakka-Suomen kedot FI0200025), and as a habitat for a species of special protection. Two patches outside the Natura2000 -area are unprotected.

**Additional information:** A regionally valuable traditional rural biotope ("Ylis-Haakarinen keto"), mentioned by Lehtomaa (2000). Two collections, e.g. TUR294266 by Syrjänen K 1987.

#### PYHEEN SEUROJENTALO 6738336:3220090 (YKJ)

A forested, eutrophicated, rocky dry meadow sloping gently towards the north. Another population has been reported some 100 metres south-west (from the "Pyheen keto"-traditional rural biotope -site), but was not examined during this inventory.



**Size:** 1 patch, approximately 0.1 m<sup>2</sup> in area, with 1-10 shoots.

**Surrounding notable species:** *Filipendula vulgaris*, *Galium verum* (VU), *Helictotrichon pratense*, *H. pubescens*, *Ranunculus polyanthemus*.

**Threats:** Successional overgrowth, eutrophication: The surrounding forest and bilberries will cover the population in nearby future.

**Restoration needs:** Clearing the bilberry and bushes away from the immediate surrounding of the species.

**Conservation status, ownership:** Unprotected.

**Additional information:** Close to a regionally valuable traditional rural biotope ("Pyheen keto"), mentioned by Lehtomaa (2000). Recorded by Rautiainen P (personal communication 2015).

#### VALASKALLIO 1 673740:322006 (YKJ)

The eastern end of a rocky, narrow midfield islet covered in part by bushes and trees, in part by a species-rich dry meadow. Parts of the islet have been mown by local volunteers.



**Size:** 2 patches, approximately 2.5 m<sup>2</sup> in area in total, with 10-100 and 100-1000 shoots in each patch.

**Surrounding notable species:** *Dianthus deltooides* (NT), *Filipendula vulgaris*, *Galium verum* (VU), *Helictotrichon pubescens*, *Luzula campestris*, *Ranunculus polyanthemus*, *Silene nutans*.

**Threats:** Eutrophication, successional overgrowth: Large parts of the islet are covered either in tall, dominant grasses (e.g. *Calamagrostis epigejos* especially around the edges) or in bushes of rowan and raspberry, both indicative of a lack of management. The immediate surroundings of the study species are, however, in good condition, except for the dense stands of juniper next to them.

**Restoration needs:** Restorative mowing of the field layer surrounding the study species. Introduction of sheep grazing is also a valid, if impractical option due to the small area of the islet.

**Conservation status, ownership:** Designated as a Natura2000 -area (Vakka-Suomen kedot FI0200025), and as a habitat for a species of special protection.

**Additional information:** A regionally valuable traditional rural biotope ("Kauppilan keto") mentioned by Lehtomaa (2000). Record by Syrjänen K 1990.

#### VALASKALLIO 2 673769:321987, 673774:321988 (YKJ)

A small patch of species-poor, forest-covered dry meadow on the edge of a forest, in the south-eastern part of the Kallivuori -hill. A separate, small patch of the study species is situated some 50 meters north along the forest edge.

**Size:** 2 patches, approximately 0.6 m<sup>2</sup> in area in total, with 10-100 shoots in each patch.

**Surrounding notable species:** *Dianthus deltooides* (NT), *Galium verum* (VU), *Quercus robur*, *Ranunculus polyanthemus*, *Silene nutans*.

**Threats:** Successional overgrowth, litter cover: The surrounding forest will eventually enclose over the small



meadow patch, and abundant litter from a nearby oak already covers the field layer. Bushes and trees have been cleared from the fields edge, relieving the situation somewhat.

**Restoration needs:** Clearing away a part of the trees and bushes, especially those on the fields edge, and raking away the resulting litter.

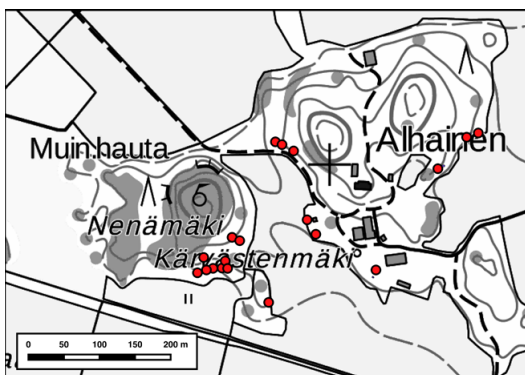
**Conservation status, ownership:** Designated as a Natura2000 -area (Vakka-Suomen kedot FI0200025), but not established as a conservation area.

**Additional information:** Mentioned by Valta (1991). Collection TUR283052 by Syrjänen K 1985.

### Paimio

ALHAINEN 67077-8:32610, 67078:32609, 67076:32611, 67078:32612, 67076:32608-9 (YKJ)

A large complex of grazed and ungrazed midfield islets east of the Paimionlahti -bay, grazed with both sheep and cattle for decades. The islets are partly forested with mixed heath forests, but the edges and currently grazed areas are covered with rocky, species-rich, low-growing dry meadow patches dominated by *Filipendula vulgaris* and, in certain patches, *Thymus serpyllum*.



**Size:** 19 patches, approximately 79.5 m<sup>2</sup> in area in total, with 1–10, 10–100 or 100–1000 shoots in each patch. The largest studied population of the species in the study area.

**Surrounding notable species:** *Arabis glabra*, *Carex spicata*, *Dianthus deltoides* (NT), *Filipendula vulgaris*, *Galium verum* (VU), *Helictotrichon pubescens*, *Luzula campestris*, *Myosotis stricta*, *Ranunculus polyanthemus*, *Silene nutans*, *Thymus serpyllum* (NT, RT).

**Threats:** No observable threats on the majority of *C. caryophyllea* -patches. Eutrophication and successional overgrowth form a potential problem only should the grazing cease.

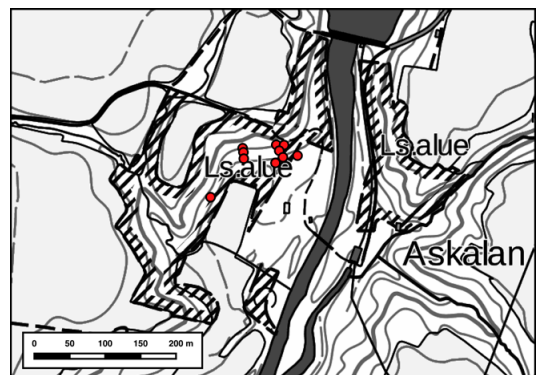
**Restoration needs:** Continuing the present grazing and management regime.

**Conservation status, ownership:** Unprotected, privately owned.

**Additional information:** A nationally valuable traditional rural biotope ("Alhaisten niityt") mentioned by Lehtomaa (2000). Several collections, e.g. TUR289075 by Silkkilä OK 1986.

### ASKALA 1 67183:32634, 671828:326339 (YKJ)

A large complex of southerly riverside slopes west of the Askala power plant, with a long history of traditional agriculture and grazing. Grazing ceased in the 1950-60s, but has been reintroduced as infrequent and modest horse grazing since the 1990s. The main form of management is annual mowing and raking on some portions of the hills, initiated in the 1990s (Lehtomaa 2000).



**Size:** 11 patches, approximately 31.7 m<sup>2</sup> in area in total, with 1–10, 10–100 or 100–1000 shoots in each patch.

**Surrounding notable species:** *Carex panicea*, *Carex spicata*, *Dianthus deltoides* (NT), *Filipendula vulgaris*, *Galium verum* (VU), *Helictotrichon pratense*, *H. pubescens*, *Lathyrus linifolius*, *Luzula campestris*, *Myosotis ramosissima*, *Origanum vulgare*, *Phleum pratense* subsp. *serotinum* (NT, RT), *Primula veris*, *Quercus robur*, *Ranunculus polyanthemus*, *Silene nutans*, *Verbascum nigrum*.

**Threats:** Eutrophication: The grazing pressure is too low on large portions of the hills with *C. caryophyllea* patches, which (together with the productive soils of the area) has



led to the partial dominance of *Trifolium medium*, *Taraxacum officinale* and *Alopecurus pratensis* at the site.

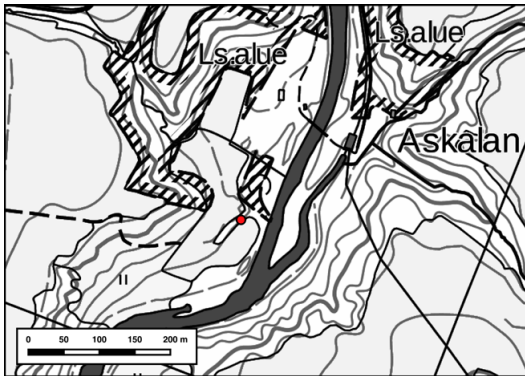
Restoration needs: Increasing the grazing pressure and restorative mowing on the most tall-growing, mesic parts of the meadow.

**Conservation status, ownership:** Protected as a Natura2000 -area (Paimionjokilaakso FI0200103) and as privately and state-owned conservation areas.

**Additional information:** A nationally valuable traditional rural biotope ("Askalan niityt") (Lehtomaa 2000) with a management plan (Lehtomaa & Lammi 2001). Several collections, e.g. H673250 by Silkkilä OK 1991.

#### ASKALA 2 671807:326343 (YKJ)

A narrow, steeply sloping ridge of mesic grassland between two field sections, dominated by *Alopecurus pratensis* and situated approximately 300 meters south of the Askala 1 -site. The study species occurs on a small patch of species-rich, yet currently eutrophicated and overgrown dry meadow extending on the south-eastern edge of the ridge, close to the fields edge.



**Size:** 1 patch, 0.5 m<sup>2</sup> in area, with 10–100 shoots.

**Surrounding notable species:** *Allium oleraceum*, *Arabis glabra*, *Filipendula vulgaris*, *Galium verum* (VU), *Helictotrichon pubescens*, *Ranunculus polyanthemos*, *Silene nutans*, *Verbascum nigrum*.

**Threats:** Eutrophication: Without grazing or mowing, tall-growing grasses and bushes have covered large parts of the ridge, partly due to nutrient flow from the adjacent fields.

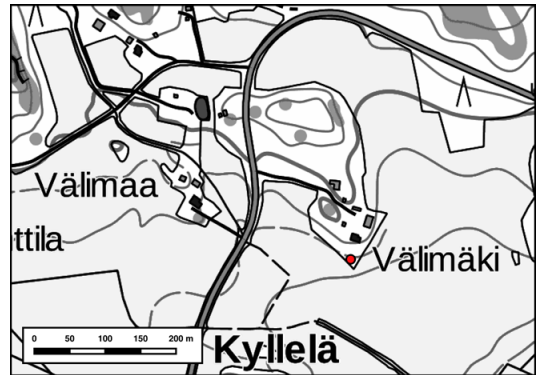
**Restoration needs:** Restorative mowing and raking away the resulting hay. Grazing may be difficult to reintroduce, due to the small area of the narrow islet.

**Conservation status, ownership:** Designated, but not yet established as Natura2000 area.

**Additional information:** A part of a nationally valuable traditional rural biotope ("Askalan niityt") (Lehtomaa 2000) with a management plan (Lehtomaa & Lammi 2001). Collection TUR305403 by Koskinen A, Virtanen T & Silkkilä OK 1988. It is unclear whether the collection originated from the site described here.

#### HEVONPÄÄ 670794:325866 (YKJ)

The southern, sunny edge of a large, forested islet with housing, surrounded by cultivated fields. The study species occurs on a narrow strip of rocky, dry grassland situated some 25 meters south of the house on the islet. With sturdy, large shoots and long (~ 30 cm) culms, a part of the population may consist of hybrid individuals.



**Size:** 1 patch, 10 m<sup>2</sup> in area, with 10–100 shoots.

**Surrounding notable species:** *Filipendula vulgaris*, *Galium verum* (VU), *Helictotrichon pubescens*, *Luzula campestris*, *Poa compressa*.

**Threats:** Successional overgrowth: Young pine trees and, to a minor extent, *Phragmites australis*, have invaded the meadow patch from the surrounding forest and field side ditch.

**Restoration needs:** Clearing away the pine trees and saplings of other trees, and restorative mowing of the field layer every few years. Grazing may be difficult to organize, due to the small area of the meadow patch.

**Conservation status, ownership:** Unprotected, privately owned.

**Additional information:** Two collections, e.g. TUR313835 by Silkkilä OK 1992.

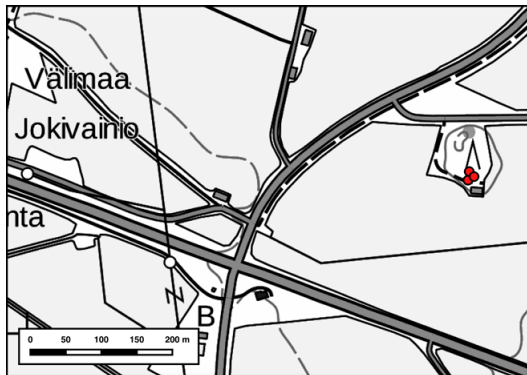
#### ILOLA 670903:326168 (YKJ)

The southern edge of a forest on a midfield islet, few meters north of the road circling the islet. The study species occurs as sparse, poorly flowering patches in what previously might have been either wooded pasture or open dry grassland. Due to the sturdy, exceptionally large culms and long leaves, some individuals of the population may be hybrids with the co-occurring *Carex vaginata*.

**Size:** 3 patches, 4.25 m<sup>2</sup> in area in total, with 10–100 shoots in each patch.

**Surrounding notable species:** *Filipendula vulgaris*, *Galium verum* (VU), *Lathyrus linifolius*, *Luzula campestris*, *Ranunculus polyanthemos*.

**Threats:** Eutrophication, successional overgrowth: *Deschampsia flexuosa* and other grasses dominate the species-poor field layer, and a sparse tree layer of rowans, pines and other trees already covers the site. Without man-



agement, the study species is unlikely to persist at the site longer than a few decades.

**Restoration needs:** Clearing away the trees and saplings, and restorative mowing of the field layer every other year. Grazing may be difficult to organize, due to the small area of the meadow patch.

**Conservation status, ownership:** Protected as a site of Iron Age ancient findings (Kerossaaren kankare 577040002), privately owned.

**Additional information:** Collection H678414 by Silkkilä OK 1991.

**JAAKOBINKIRKKO** 670914:326011, 670915-7:326009 (YKJ)

The lawn in the south-western corner of a small, sandy soiled graveyard on a very gentle slope towards the south. The study species occurs as distinct patches of small shoots among the tombstones and cultivated maples and lindens.



**Size:** 4 patches, 11.9 m<sup>2</sup> in area in total, with 10–100 or 100–1000 shoots in each patch.

**Surrounding notable species:** *Arabis glabra*, *Carex spicata*, *Galium verum* (VU), *Luzula campestris*, *Myosotis stricta*, *Silene nutans*.

**Threats:** Improper management: The lawns of the graveyard are often mown, and while this does not appear to kill the shoots, it cuts away the culms and damages the leaves.

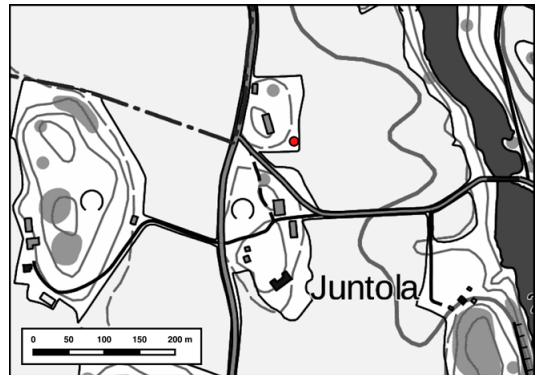
**Restoration needs:** Sparing certain parts of the *C. caryophyllaea* -patches from mowing in May-June so as to allow the culms to flower and the seeds to mature before being mown away.

**Conservation status, ownership:** Unprotected.

**Additional information:** Mentioned by Silkkilä & Koskinen 1990. Several collections, e.g. TUR281835 by Silkkilä OK 1983.

**JUNTOLA** 672250:326398 (YKJ)

A rocky, shallow-soiled islet surrounded by cultivated fields and roads. The study species occurs as a small patch some 10 meters south-east of a barn on the islet, on gently sloping ground on the south-eastern edge of the islet. The small patch of dry meadow surrounding the shoots is among the last representative patches of meadow vegetation on the islet, the rest being dominated by tall grasses (e.g. *Alopecurus pratensis*) or bushes (especially *Amelanchier spicata*).



**Size:** 1 patch, 0.4 m<sup>2</sup> in area, with 10–100 shoots.

**Surrounding notable species:** *Galium verum* (VU), *Helictotrichon pubescens*, *Ranunculus polyanthemos*.

**Threats:** Successional overgrowth, eutrophication: Dense stands of *Amelanchier spicata* surround the shoots of the study species, and tall competitive grasses partly dominate the surrounding species-poor dry meadow.

**Restoration needs:** Clearing away the bushes, and restorative mowing of the field layer every few years. Grazing may be difficult to organize, due to the small area of the meadow.

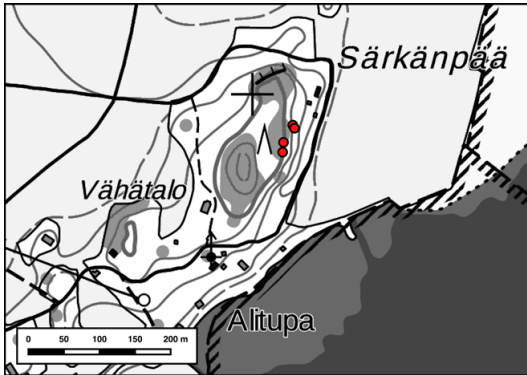
**Conservation status, ownership:** Unprotected, privately owned.

**Additional information:** Two collections, e.g. TUR332253 by Silkkilä O 1991.

**KAISTILA** 670674-7:325912 (YKJ)

A forested, rocky hill facing the Paimionlahti -bay, with large openings of species-rich dry and rocky meadow vegetation, partly covered by bushes. The study species occurs in two areas separated by some 20 meters, both on level and steeply sloping ground, close to trails.





**Size:** 4 patches, 12.9 m<sup>2</sup> in area in total, with 10–100 or 100–1000 shoots in each patch.

**Surrounding notable species:** *Arabis glabra*, *Galium verum* (VU), *Helictotrichon pubescens*, *Myosotis ramosissima*.

**Threats:** Successional overgrowth, eutrophication: Trees and bushes from the surrounding forest slowly encroach on the remaining open meadow patches, and cover the field layer with leaf litter. Meadow patches that have thus far remained open are also partly dominated by tall-growing grasses.

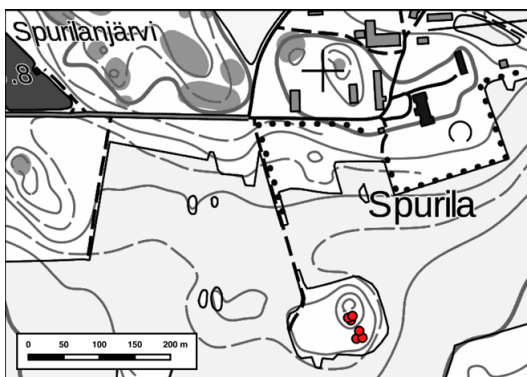
**Restoration needs:** Clearing away the bushes and saplings. Grazing or mowing are likely to be difficult to organize, due to the small area of the meadow patch and difficult terrain.

**Conservation status, ownership:** Unprotected.

**Additional information:** Several collections, e.g. TUR 332282 by Silkkilä O 1991.

**SPURILA** 671347:326411, 671344:326412 (YKJ)

A large, previously open mid-field islet that has partly been covered with a secondary succession of pines and cultivated bushes, such as *Prunus* sp. and *Amelanchier spicata*. The study species is widespread in the central, open parts of the islet, occurring in species-rich patches of *Helictotrichon pubescens*-dominated meadow on gentle southerly slopes or level ground. The site is an important location for ancient findings, and was restoratively mown during the 1990s (Lehtomaa 2000).



**Size:** 7 patches, 6.48 m<sup>2</sup> in area in total, with 1–10, 10–100 or 100–1000 shoots in each patch.

**Surrounding notable species:** *Allium oleraceum*, *Carex spicata*, *Dianthus deltoides* (NT), *Filipendula vulgaris*, *Galium verum* (VU), *Helictotrichon pubescens*, *Luzula campestris*, *Ranunculus polyanthemus*, *Thymus serpyllum* (NT, RT), *Vicia tetrasperma*.

**Threats:** Eutrophication: Only small portions of the meadow patches remain low-growing and species-rich, with the majority being covered by more nitrophilous and tall-growing grasses. Shrubs and saplings also encroach towards the remaining open areas from the surrounding thickets and forest.

**Restoration needs:** Restorative mowing and raking of the field layer, and to some extent also clearing away the bushes and saplings. Introduction of grazing by sheep or cattle is also a viable option, if it does not conflict with the protection of the ancient findings at the site.

**Conservation status, ownership:** Protected as a site of ancient findings (Spurila 577010020).

**Additional information:** A locally valuable traditional rural biotope ("Spurilan kallioketo") mentioned by Lehtomaa (2000). The study species is mentioned by Silkkilä & Koskinen 1990. Several collections from the nearby outcrops and the one described here, e.g. TUR305468 by Silkkilä O 1988.

## Salo

**ALHAISI** 670185:328612, 670187:328608 (YKJ)

A forested, rocky hill with patches of dry meadow vegetation on the southern edges of the hill. The study species occupies small patches of species-poor meadow all partly enclosed by forest and adjacent to trails passing through the hill. The site is an important location for ancient findings. Parts of the hill have been cleared of bushes as a volunteer work in 2008.



**Size:** 3 patches, 3.5 m<sup>2</sup> in area in total, with 10–100 shoots in each patch.

**Surrounding notable species:** *Arabis glabra*, *Carex spicata*, *Filipendula vulgaris*, *Galium verum* (VU), *Helictotri-*

*chon pratense*, *H. pubescens*, *Luzula campestris*, *Ranunculus polyanthemos*, *Silene nutans*.

**Threats:** Successional overgrowth, eutrophication: Only small patches of open meadow vegetation remain in the interior parts of the hill, and shrubs (such as *Amelanchier spicata*), saplings and dense stands of dominant grasses are rapidly invading these as well. Clearing residue of trunks and branches resulting from previous management has been piled on top of one of the patches.

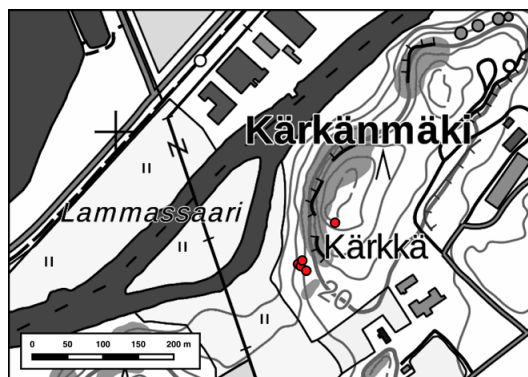
**Restoration needs:** Clearing away the bushes, trees and saplings and burning the old clearing residue. Introduction of grazing by sheep or cattle is also a viable option, if it does not conflict with the protection of the ancient findings at the site.

**Conservation status, ownership:** Protected as a site of ancient findings (Kirjolanmäki 734010065) and designated as an important area for biodiversity in the general plan of the area (Salon kaupunki 2009).

**Additional information:** Mentioned by Valta (1991). A locally valuable traditional rural biotope ("Kiljolan keto") mentioned by Lehtomaa (2000). Collection TUR306534 by Valta M 1989.

#### KÄRKKÄ 1 670168:328539, 670161:328534 (YKJ)

A tall, rocky hill with terraces of dry, rocky meadow vegetation opening towards the south and south-west, surrounded by xeric to mesic heath-forests. The hill has a possible history of wooded pasture, based on the relatively young tree layer and stands of few sturdy, old pine trees. The study species occurs in two distinct areas: close to the hill top between two old pines, and lower, on the south-western terrace towards the Halikonlahti -bay.



**Size:** 5 patches, 17,75 m<sup>2</sup> in area in total, with 1–10, 10–100 or 100–1000 shoots in each patch.

**Surrounding notable species:** *Arabis glabra*, *Filipendula vulgaris*, *Galium verum* (VU), *Helictotrichon pubescens*, *Luzula campestris*, *Quercus robur*, *Ranunculus polyanthemos*, *Silene nutans*, *Ulmus glabra* (VU).

**Threats:** Successional overgrowth, eutrophication: Trees and non-native bushes (*Amelanchier spicata*, *Cotoneas-*

*ter lucidus*) and to some extent tall, dominant grasses surround each patch of the study species, and will eventually cover them.

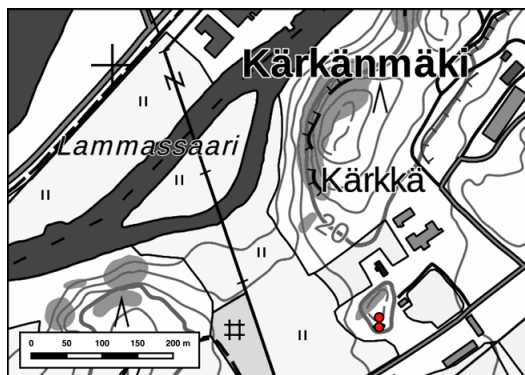
**Restoration needs:** Clearing away the bushes and mowing the grasses away every other year. Introduction of grazing by sheep or cattle is also possible.

**Conservation status, ownership:** Designated as an important area for biodiversity in the general plan of the area (Salon kaupunki 2009).

**Additional information:** Mentioned by Valta (2009). A regionally valuable traditional rural biotope ("Kärkkän kedot") mentioned by Lehtomaa (2000). Several collections, e.g. TUR306537 by Valta M 1989.

#### KÄRKKÄ 3 670143:328545 (YKJ)

A low, shallow-soiled and rocky hill next to the Kärkkä-estate, covered almost entirely by species-rich, *Helictotrichon pratense*-*Filipendula vulgaris*-dominated dry meadow, especially on the southern, exposed side of the hill.



**Size:** 2 patches, 10 m<sup>2</sup> in area in total, with 10–100 and 100–1000 shoots in each patch.

**Surrounding notable species:** *Dianthus deltooides* (NT), *Filipendula vulgaris*, *Galium verum* (VU), *Helictotrichon pratense*, *H. pubescens*, *Luzula campestris*, *Quercus robur*, *Trifolium arvense*, *Vicia tetrasperma*.

**Threats:** Successional overgrowth: Pines have been planted on top of the hill and bird cherries surround the hill on the western side, and may spread to cover the meadow patches.

**Restoration needs:** Clearing away the pine trees, mowing the field layers every few years and raking away the resulting hay. Sheep grazing would suit the site well.

**Conservation status, ownership:** Designated as an important area for biodiversity in the general plan of the area (Salon kaupunki 2009), privately owned.

**Additional information:** Mentioned by Valta & Luoto (1991). A regionally valuable traditional rural biotope ("Kärkkän kedot") mentioned by Lehtomaa (2000). Several collections, e.g. TUR306538 by Valta M 1989.

**JOENSUU (HALIKKO) 670470:328366 (YKJ)**

A steeply sloping, small patch of dry meadow on the upper parts of the banks of the Halikonjoki river, dominated by *Helictotrichon pratense* in the species-rich parts and *Alopecurus pratensis* in the lower, eutrophicated parts.



**Surrounding notable species:** *Carex spicata*, *Filipendula vulgaris*, *Galium verum* (VU), *Helictotrichon pratense*, *H. pubescens*, *Lotus corniculatus*, *Phleum pratense* subsp. *serotinum* (NT, RT), *Primula veris*, *Ranunculus polyanthemos*, *Silene nutans*.

**Threats:** Eutrophication, successional overgrowth: Tall, competitive grasses are dominant especially in the lower parts of the meadow, while bushes, such as roses and bird cherry, encroach on the meadow from the upper, forested parts of the bank.

**Restoration needs:** Restorative mowing and raking away the resulting hay every other year, and clearing away the bushes from the upper parts of the meadow. Introduction of grazing by sheep or cattle is also possible, especially if the nearby river banks already serve as pasture.

**Conservation status, ownership:** Unprotected.

**Additional information:** A regionally valuable traditional rural biotope ("Halikonjoen jokivarsiiniitty") mentioned by Lehtomaa (2000). Collection TUR309978 by Valta M 1990.

**LUKKARINMÄKI 670290:328709 (YKJ)**

A narrow strip of somewhat rocky dry meadow on the southern tip of a rocky hill covered with pine heath forest, on the border between the hill above and an old abandoned field on level ground below.

**Size:** 1 patch, 25 m<sup>2</sup> in area, with 10–100 shoots.

**Surrounding notable species:** *Filipendula vulgaris*, *Galium verum* (VU), *Helictotrichon pratense*, *H. pubescens*, *Silene nutans*.

**Threats:** Eutrophication, successional overgrowth: Tall, competitive grasses (*Alopecurus pratensis*, *Elymus repens*) dominate on the eutrophicated level ground, likely as a result of past field use. Pine trees and young saplings of *Sorbus aucuparia* and *Amelanchier spicata* cover parts of the narrow meadow patch.



**Restoration needs:** Restorative mowing and raking away the resulting hay every few years, and clearing away some of the pines and shrubs above the meadow. A trail passes through the meadow, which has likely contributed to the study species remaining on the site.

**Conservation status, ownership:** Unprotected.

**Additional information:** Collection TUR309991 by Valta M 1990.

**PAHKAVUORI 670312:328801 (YKJ)**

The rocky, southerly upper parts of a sloping, partly eutrophicated meadow next to managed pine-forest covering the Pahlkavuori -hill. The study species occurs only in the species-rich upper parts of the meadow, while the lower parts are species-poor, eutrophicated and covered with dominant grasses and herbs.



**Size:** 1 patch, 1 m<sup>2</sup> in area, with 10–100 shoots.

**Surrounding notable species:** *Filipendula vulgaris*, *Galium verum* (VU), *Helictotrichon pubescens*, *Luzula campestris*, *Silene nutans*, *Quercus robur*, *Ranunculus polyanthemos*.

**Threats:** Successional overgrowth, eutrophication: Pines and broad-leaved trees and saplings cover the meadow almost entirely, and tall, dominant grasses cover the field layer especially south of the study species.

**Restoration needs:** Clearing away the trees and bushes covering the meadow, and restorative mowing of the



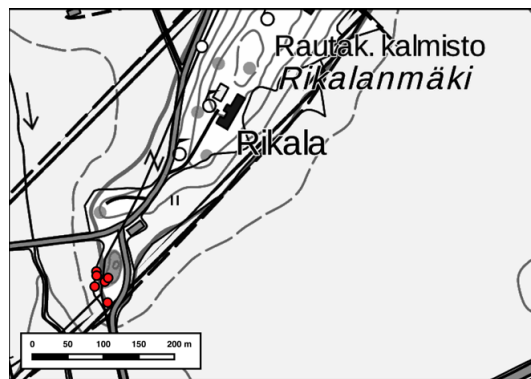
field layer every few years. A trail passes right through the meadow, which has likely contributed to the study species remaining on the site.

**Conservation status, ownership:** Unprotected.

**Additional information:** Collection TUR308628 by Valta M 1990.

**RIKALA 1 (HALIKKO)** 670415-7:328299-300, 670413-5:328300-1 (YKJ)

A rocky hill surrounded by cultivated fields, dominated especially on the western and southern edges by a species-rich dry meadow. The site is an important location for Iron Age ancient findings, and following management in the recent decades, the hill has remained free of bushes and trees, with the exception of planted oak trees on the eastern side of the hill.



**Size:** 6 patches, 23.25 m<sup>2</sup> in area in total, with 10–100 and 100–1000 shoots in each patch.

**Surrounding notable species:** *Arabis glabra*, *Botrychium lunaria* (NT, RT), *Carex spicata*, *Dianthus deltooides* (NT), *Galium verum* (VU), *Helictotrichon pratense*, *H. pubescens*, *Lotus corniculatus*, *Luzula campestris*, *Ranunculus polyanthemos*, *Silene nutans*, *Thymus serpyllum* (NT, RT), *Vicia tetrasperma*.

**Threats:** Eutrophication: While shrubs and saplings are scarce, tall, competitive grasses, such as *Calamagrostis epigejos*, have become dominant on parts of the meadow closest to the top of the hill.

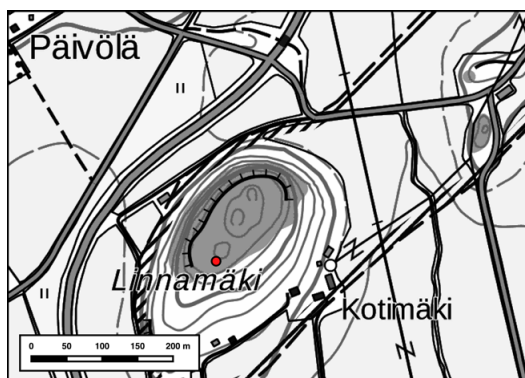
**Restoration needs:** Restorative mowing of the field layer every other year and raking away the resulting hay. Introduction of grazing by sheep or cattle is also a viable option, if it does not conflict with the protection of the ancient findings at the site.

**Conservation status, ownership:** Protected as a site of ancient findings (Rikalanmäki 73010022), and designated as a conservation area in the general plan of the area (Halikko 2002).

**Additional information:** Mentioned by Valta & Luoto (1991) and Valta (2009). A regionally valuable traditional rural biotope ("Rikalanmäen kedot") mentioned by Lehtomaa (2000). Collection TUR306535 by Valta M 1989.

**RIKALA 2 (HALIKKO)** 670400:328263 (YKJ)

The upper parts of a rocky, steep cliff on the south-western tip of the forest covered Halikon linnamäki-hill, a central site for Iron Age ancient findings. The study species occupies a small patch of rocky dry meadow on a narrow strip of open vegetation along a trail circling the xeric, rocky top of the hill. Due to the large, sturdy culms and long leaves, the individuals at the site may be of hybrid origin.



**Size:** 1 patch, 1.2 m<sup>2</sup> in area in total, with 10–100 shoots.

**Surrounding notable species:** *Arabis glabra*, *Filipendula vulgaris*, *Galium verum* (VU), *Helictotrichon pratense*, *H. pubescens*, *Trifolium arvense*.

**Threats:** Successional overgrowth: Almost entirely surrounded by forest, the meadow may eventually be covered in pines, junipers and other trees.

**Restoration needs:** Partial clearing of the trees and bushes from the upper parts of the rocky cliff surrounding the patch.

**Conservation status, ownership:** Protected as a site of ancient findings (Rikalanmäki 73010022), and designated as a conservation area in the general plan of the area (Halikko 2002).

**Additional information:** Collection TUR581528 by Kulmala H 2004.

**TATTULA (PERTTELI)** 671088:329409 (YKJ)

A low-growing, species-rich dry meadow patch on the sloping upper parts of a riverbank facing south-west and surrounded by more mesic and tall-growing hay-meadows, grazed with cattle for decades.

**Size:** 1 patch, 12 m<sup>2</sup> in area in total, with 100–1000 shoots.

**Surrounding notable species:** *Galium verum* (VU), *Luzula campestris*, *Myosotis stricta*, *Potentilla crantzii*, *Ranunculus polyanthemos*.

**Threats:** No observable threats apart from possible future cessation of grazing.

**Restoration needs:** No need for restoration.

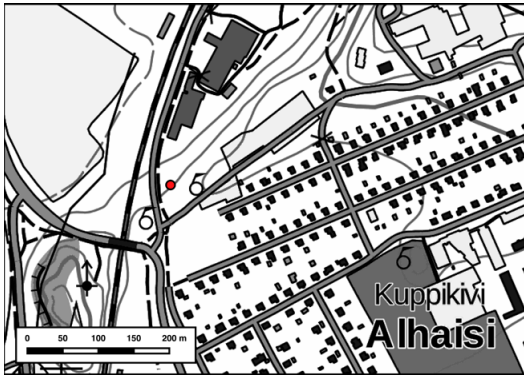
**Conservation status, ownership:** Protected as a Natura2000 area (Kuivakosken niitty FI0200183), but not established as an actual conservation area.



**Additional information:** Mentioned by Valta (2009). A nationally valuable traditional rural biotope ("Kuivakosken niitty") mentioned by Lehtomaa (2000). Several records, e.g. by Saaranen J, Havia P & Nurmi J 1996.

**USKELA 1** 670206:328623 (YKJ)

Partly forested, eutrophicated meadow with ancient findings and signs of recent (21st century) habitation, surrounded by roads and suburban areas. The study species occurs adjacent to a large stand of juniper, as a small group of shoots susceptible to random events.



**Size:** 1 patch, 0.5 m<sup>2</sup> in area in total, with 1–10 shoots.

**Surrounding notable species:** *Filipendula vulgaris*, *Galium verum* (VU), *Helictotrichon pratense*, *H. pubescens*, *Luzula campestris*, *Ranunculus polyanthemos*, *Vicia tetrasperma*.

**Threats:** Eutrophication, successional overgrowth: Without management, the tall and competitive grasses as well as bushes and saplings will cover the rest of the meadow patch.

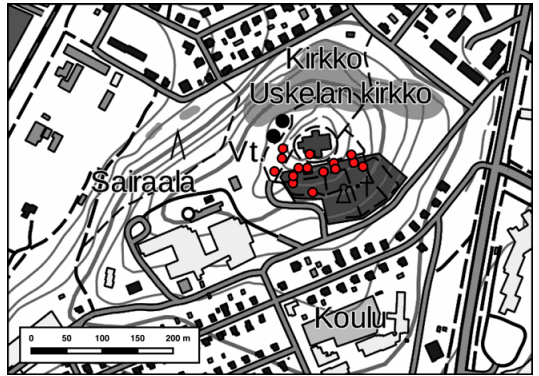
**Restoration needs:** Clearing away the bushes, mowing the field layer and raking away the resulting hay. Introduction of grazing by sheep or cattle is also a viable option, if it does not conflict with the protection of the ancient findings at the site.

**Conservation status, ownership:** Protected as a site of Iron Age ancient findings (Pappilanhaka 734010060).

**Additional information:** Mentioned by Valta & Luoto (1991) and Valta (2009). Several collections, e.g. TURA 367595 by Valta M 1998.

**USKELA 2** 670238-241:328677-687 (YKJ)

The dry, sandy lawns and old stone walls of the cemetery surrounding the Uskela -church. The species occurs in dense and large patches, but as small, low-growing individuals, especially in the upper parts of the southerly, slightly terraced cemetery hill rising up to the church. One of the largest populations in the study area. Some individuals are likely to have been miss-identified due to recent mowing.



**Size:** 15 patches, 163 m<sup>2</sup> in area in total, with 10–100, 100–100 or >1000 shoots in each patch.

**Surrounding notable species:** *Carex spicata*, *Dianthus deltooides* (NT), *Galium verum* (VU), *Lotus corniculatus*, *Luzula campestris*, *Myosotis stricta*, *Potentilla crantzii*, *Silene nutans*, *Ulmus glabra*, *Vicia tetrasperma*.

**Threats:** Improper management: Lawn mowing early in the summer (May–June) cuts away the majority of the culms before the spikes mature, leaving the species to cope with only vegetative reproduction at the site.

**Restoration needs:** Sparing certain parts of the lawn from mowing until July to let the culms flower and the spikes mature before being cut, with different areas spared in different years.

**Conservation status, ownership:** Unprotected.

**Additional information:** Mentioned by Valta (2009). Record by Holmiluoto A 2007.

**VASKIO (HALIKKO)** 671414:328042 (YKJ)

A steep riverbank terrace with clay soils, dominated by nitrophilous grasses and surrounded by cultivated fields and a forested riverside. The study species occurs in sparse patches on the steepest and most species-rich parts of the meadow. The site has a history of cattle grazing, but no evidence of recent grazing was present.

**Size:** 2 patches, 5.5 m<sup>2</sup> in area in total, with 1–10 and 100–100 shoots in each patch.

**Surrounding notable species:** *Carex spicata*, *Dianthus deltooides* (NT), *Filipendula vulgaris*, *Galium verum* (VU),





*Helictotrichon pubescens*, *Lotus corniculatus*, *Potentilla crantzii*, *Ranunculus polyanthemus*.

**Threats:** Eutrophication, successional overgrowth: Without grazing, nutrient inflow from the cultivated fields above has resulted in the dominance of tall-growing, dominant grasses, such as *Alopecurus pratensis*, on much of the terraced hill. Broad-leaved trees, such as alders, have also covered much of the riverside view and advance on the meadow.

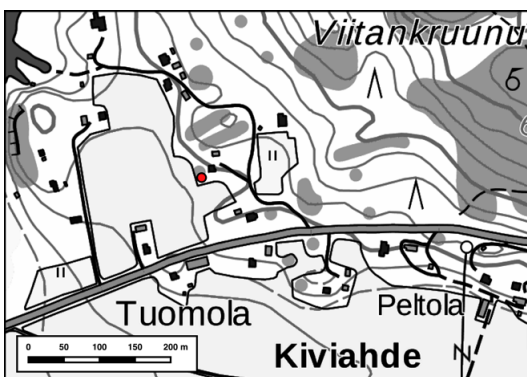
**Restoration needs:** Restorative mowing or re-introduction of grazing in the area, as well as clearing away the surrounding alders and other trees and saplings.

**Conservation status, ownership:** Protected as a Natura 2000 area (Päivärinteen laidun FI0200175), but not established as an actual conservation area.

**Additional information:** Mentioned by Valta (2009). A regionally valuable traditional rural biotope ("Päivärinteen laidun") mentioned by Lehtomaa (2000). Collection TURA366235 by Valta 1998.

**VIITANKRUUNU 1** 670039:328374 (YKJ)

A small, rocky and gently sloping meadow patch in the backyard of an old house, surrounded by a forest, cultivated fields and a large stand of bird cherry. The few shoots of the study species occur on a low-growing patch of meadow that the owner mows every now and then during the summer.



**Size:** 1 patch, 0.25 m<sup>2</sup> in area, with 1–10 shoots.

**Surrounding notable species:** *Carex spicata*, *Dianthus deltooides* (NT), *Filipendula vulgaris*, *Galium verum* (VU), *Helictotrichon pubescens*, *Ranunculus polyanthemus*, *Trifolium arvense*, *Veronica verna*, *Vicia tetrasperma*.

**Threats:** Eutrophication: Should the infrequent mowing stop, the tall, competitive grasses now dominant on the unmown portions of the meadow would most likely cover the entire meadow, smothering the few shoots of the study species.

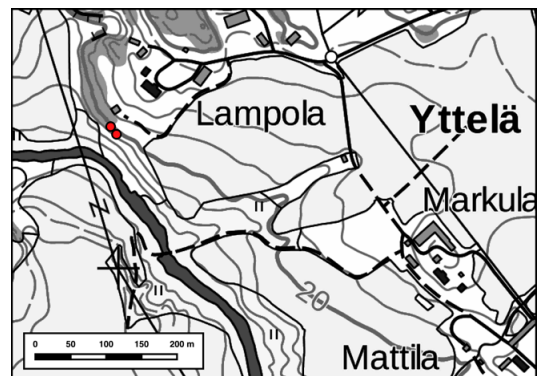
**Restoration needs:** Continued restorative mowing of the field layer.

**Conservation status, ownership:** Unprotected, privately owned.

**Additional information:** Mentioned by Valta (1991, 2009). Collection TUR310092 by Valta M 1990.

**YTTELÄ (HALIKKO)** 670701:328206 (YKJ)

A steep, south-westerly slope with rocky outcrops and species-rich dry meadow vegetation, surrounded by hay-meadows below and a farm estate above. The rocky meadow has withstood overgrowth likely due to the shallow soils, exposure and steepness of the slope, but signs of overgrowth and eutrophication are already present.



**Size:** 2 patches, 11.1 m<sup>2</sup> in area in total, with 10–100 and 100–1000 shoots in each patch.

**Surrounding notable species:** *Carex spicata*, *Dianthus deltooides* (NT), *Filipendula vulgaris*, *Galium verum* (VU), *Helictotrichon pubescens*, *Ranunculus polyanthemus*, *Trifolium arvense*, *Veronica verna*, *Vicia tetrasperma*.

**Threats:** Eutrophication, successional overgrowth: Without grazing or mowing, tall grasses and dense stands of juniper and bird cherry will increase their cover at the expense of the study species.

**Restoration needs:** Clearing of bushes and trees directly surrounding the patches of the study species. Restorative mowing may be difficult due to the sloping terrain, but introduction of sheep or goat grazing might be efficient.

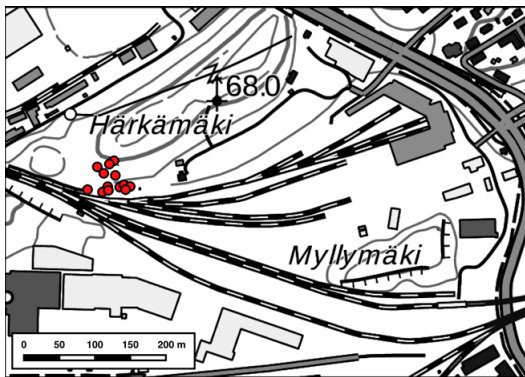
**Conservation status, ownership:** Unprotected, privately owned.

**Additional information:** Mentioned by Lampinen & Rautiainen (2015). A valuable traditional rural biotope ("Lampolan keto") mentioned by Ikonen et al. (2006), with an Iron Age ancient finding (Lampola 5, 100006081). Collection from a nearby rocky hill TUR309989 by Valta M 1990, but not from the site described here.

## Turku

### HÄRKÄMÄKI 671416-422:323803-811 (YKJ)

A large, species-rich dry meadow sloping gently towards the south-west, north of the railway, and characterized by dense stands of *Helictotrichon pratense*, *H. pubescens* and tall, pillar-like junipers. The study species occurs as large, yet sparse, patches on the meadow, comprising one of the largest populations in Turku. The meadow has avoided eutrophication, but is slowly being covered by encroaching shoots of aspen and other trees.



**Size:** 13 patches, 67.6 m<sup>2</sup> in area in total, with 1–10 and 10–100 shoots in each patch.

**Surrounding notable species:** *Arabis glabra*, *Filipendula vulgaris*, *Galium verum* (VU), *Helictotrichon pratense*, *H. pubescens*, *Lotus corniculatus*, *Luzula campestris*, *Myosotis ramosissima*, *Primula veris*, *Ranunculus polyanthemus*, *Silene nutans*.

**Threats:** Litter cover, successional overgrowth: Without grazing or mowing, litter formed by tall grasses (*H. pratense*) and the encroaching aspens will cover the meadow.

**Restoration needs:** Restorative mowing every other year and clearing away the aspens and other trees (except junipers) from the meadow. Introduction of sheep grazing could be efficient.

**Conservation status, ownership:** Designated as an important area for biodiversity in the general plan of the area (Turun kaupunki 2012).

**Additional information:** Mentioned by Kemppainen (2012). A locally valuable traditional rural biotope ("Iso-Heikkilän radanvarren keto") mentioned by Lehtomaa (2000). Several collections, e.g. TUR358941 by Virtanen T 1999.

### ISPOINEN 6709635:3239947 (YKJ)

A small patch of species-rich dry meadow surrounded by an overgrown, rocky slope and covered by oaks and other broad-leaved trees. The study species occurs as dense, but sparsely flowering tufts amid bilberry shoots and rocks.



**Size:** 1 patch, 6 m<sup>2</sup> in area, with 100–1000 shoots.

**Surrounding notable species:** *Carex muricata*, *Filipendula vulgaris*, *Galium verum* (VU), *Helictotrichon pratense*, *H. pubescens*, *Quercus robur*, *Ranunculus polyanthemus*, *Seseli libanotis*, *Silene nutans*.

**Threats:** Successional overgrowth, litter cover: Without intervention, the surrounding forest will become increasingly dense and the bilberries and other forbs will cover the rest of the meadow.

**Restoration needs:** Clearing of bushes and trees (except the oaks and junipers) directly surrounding the study species. Restorative mowing after the clearing may be difficult due to the rocky terrain.

**Conservation status, ownership:** Unprotected.

**Additional information:** Collection TUR284266 by Rautiainen P 1985.

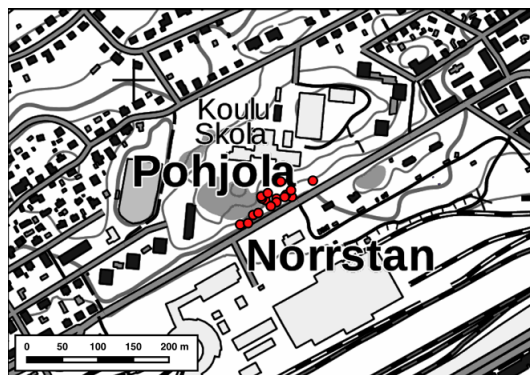
### JUHANNUSKUKKULA I 6714611-675:3239216-314 (YKJ)

A steep, rocky hill towards south-east, with a nutrient-rich amphibolite bedrock, species-rich patches of dry meadow, several pillar-like junipers and numerous endangered species. The study species occurs on the hill as dense, large patches and flowers abundantly due to continued restoration efforts since the early 2000's. One of the largest populations in the study area.

**Size:** 17 patches, 63.04 m<sup>2</sup> in area in total, with 1–10, 10–100 and 100–1000 shoots in each patch.

**Surrounding notable species:** *Arabis glabra*, *Carex ericetorum* (RT), *Cotoneaster scandinavicus*, *Filipendula vulgaris*, *Fraxinus excelsior* (RT), *Galium verum* (VU), *Helictotrichon pratense*, *H. pubescens*, *Lathyrus linifolius*, *Lotus corniculatus*, *Luzula campestris*, *Poa compressa*, *Ranunculus polyanthemus*, *Silene nutans*, *Vincetoxicum hircundinarum*.

**Threats:** Successional overgrowth, eutrophication: The majority of the patches face no threats besides the cessa-



tion of management, but few are still covered by thickets of juniper and other bushes, and some are surrounded by tall, competitive grasses due to nutrient input from the nearby road.

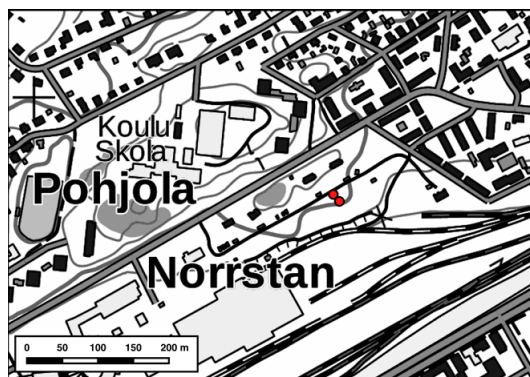
**Restoration needs:** Clearing of bushes and trees (except the pillar-like junipers and *C. scandinavicus*) surrounding the study species. Restorative mowing may be difficult in some areas due to the rocky terrain. Possibilities to introduce sheep grazing should be investigated.

**Conservation status, ownership:** Designated as a conservation area both in the general and city plan of the area (Turun kaupunki 2015).

**Additional information:** Mentioned by Kemppainen (2012) and Lampinen & Koskela (2016). A nationally valuable traditional rural biotope ("Juhannuskukkulan keto") mentioned by Lehtomaa (2000). Several collections, e.g. TUR343158 by Mäkinen Y & Rinne L 1996.

#### JUHANNUSKUKKULA 2 671463:323942 (YKJ)

A small fragment of rocky, species-rich, *Helictotrichon pratense*-dominated dry meadow between the Köydenpunojankatu -road and the railway yard. The meadow has likely been a part of the same complex as the nearby Juhannuskukkula 1 -site before the Köydenpunojankatu -road was cut through the rocky terrain.



**Size:** 2 patches, 7 m<sup>2</sup> in area in total, with 10–100 shoots in each patch.

**Surrounding notable species:** *Dianthus deltooides* (NT), *Filipendula vulgaris*, *Fraxinus excelsior* (RT), *Galium verum* (VU), *Helictotrichon pratense*, *H. pubescens*, *Lathyrus linifolius*, *Luzula campestris*, *Poa compressa*, *Quercus robur*, *Ranunculus polyanthemos*, *Silene nutans*.

**Threats:** Destruction, successional overgrowth, eutrophication: While the surrounding meadow is partly covered by a secondary succession of broad-leaved trees and partly eutrophicated, the most imminent threat is destruction due to a new housing area being currently built at the site.

**Restoration needs:** Translocation of the species to the nearby Juhannuskukkula 1 -site is urgently needed to avoid losing the individuals.

**Conservation status, ownership:** Unprotected.

**Additional information:** Collection TURA409829 by Rautiainen P 2012.

#### KAAKELITEHTAANMÄKI 6714471-505:3238447-487 (YKJ)

A large, species-rich complex of nutrient-rich amphibolite outcrops and rocky dry meadow, dominated in part by *Helictotrichon pratense* and *Filipendula vulgaris*, on the property of an old factory.



**Size:** 4 patches, 26.97 m<sup>2</sup> in area in total, with 10–100 and 100–1000 shoots in each patch.

**Surrounding notable species:** *Arabis glabra*, *A. hirsuta*, *Carex muricata*, *Dianthus deltooides* (NT), *Filipendula vulgaris*, *Fraxinus excelsior* (RT), *Galium verum* (VU), *Helictotrichon pratense*, *H. pubescens*, *Lathyrus linifolius*, *Lotus corniculatus*, *Luzula campestris*, *Myosotis stricta*, *Poa compressa*, *Quercus robur*, *Satureja acinos*, *Silene nutans*, *Trifolium arvense*, *Vicia tetrasperma*.

**Threats:** Destruction, litter cover, successional overgrowth: While the meadow has withstood eutrophication and overgrowth to a large extent, the dominance of *H. pratense* and *F. vulgaris* indicate a need for management to reduce the amount of litter and to open up the field layer for a larger number of annual species to thrive at the site. The most imminent threat, however, is that the entire factory area is currently under planning for a new housing area.



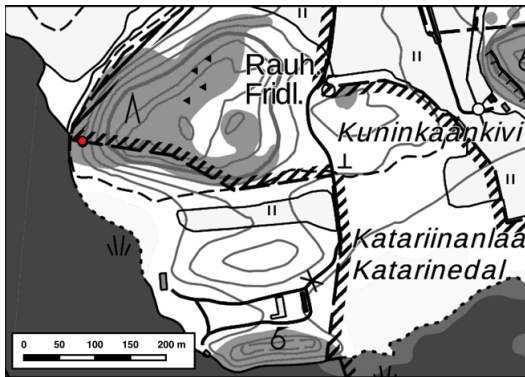
**Restoration needs:** Restorative mowing of the field layer, raking away the litter, and clearing the few bushes growing on the meadow.

**Conservation status, ownership:** Unprotected, privately owned.

**Additional information:** Mentioned by Kempainen (2012). Collection TURA391027 by Rautiainen P 2008.

**KATARIINANLAAKSO** 6709201:3239559 (YKJ)

A small, shallow-soiled patch of dry meadow some 10–15 meters above the seashore, surrounded by boulders, a young, partly xeric forest, and a narrow trail.



**Size:** 2 patches, 2.5 m<sup>2</sup> in area in total, with 1–10 and 10–100 shoots in each patch.

**Surrounding notable species:** *Arabis glabra*, *Filipendula vulgaris*, *Galium verum* (VU), *H. pubescens*, *Hypochoeris maculata*, *Lotus corniculatus*, *Poa compressa*, *Potentilla crantzii*, *Quercus robur*, *Ranunculus polyanthemos*, *Seseli libanotis*, *Silene nutans*.

**Threats:** Successional overgrowth, litter cover, eutrophication: Young aspen trees have spread to cover the other patch of the study species, and bilberry and other forbs encroach on the meadow from the surrounding forest. Tall, dominant grasses are also become increasingly dense and indicate both eutrophication and lack management.

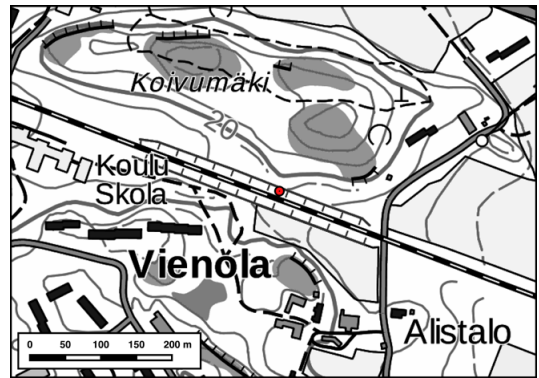
**Restoration needs:** Clearing of bushes and aspen saplings surrounding the study species and raking away the litter. Restorative mowing of the field layer is likely impossible due to the rocky terrain.

**Conservation status, ownership:** Protected as a Natura 2000 area (Rauvolanlahti FI0200060) and as a conservation area owned by the city of Turku.

**Additional information:** Mentioned by Kempainen (2012). A regionally valuable traditional rural biotope ("Katariinanlaakson niitty") mentioned by Lehtomaa (2000). Several collections from the surrounding Katariinanlaakso -area, e.g. TUR284265 by Rautiainen P 1985. It is unclear which, if any, of the previous collections originate from this particular site.

**KOIVUMÄKI** 6714683:3236576 (YKJ)

A narrow, south-west sloping stripe of meadow between the forest edge and a railroad bank.



**Size:** 1 patch, 0.04 m<sup>2</sup> in area, with 1–10 shoots.

**Surrounding notable species:** *Arabis glabra*, *Dianthus deltoides* (NT), *Filipendula vulgaris*, *Galium verum* (VU), *Helictotrichon pratense*, *H. pubescens*, *Luzula campestris*, *Quercus robur*, *Ranunculus polyanthemos*, *Silene nutans*, *Trifolium arvense*.

**Threats:** Eutrophication: Tall, dominant grasses and dense stands of *Trifolium medium* cover the majority of the bank rising up from the railway, indicating lack of management and possible eutrophication.

**Restoration needs:** Restorative mowing of the field layer and raking away the resulting hay.

**Conservation status, ownership:** Unprotected.

**Additional information:** Record by Syrjänen K 2015.

**MYLLYMÄKI** 6714112:3238547 (YKJ)

A partly forest-covered patch of north-facing meadow, on the eastern tip of an islet in the middle of railroads and industrial areas.



**Size:** 1 patch, 0.5 m<sup>2</sup> in area, with 10–100 shoots.

**Surrounding notable species:** *Antennaria dioica* (NT, RT), *Filipendula vulgaris*, *Fraxinus excelsior* (RT), *Ga-*

*lium verum* (VU), *Helictotrichon pratense*, *H. pubescens*, *Lathyrus linifolius*, *Luzula campestris*, *Vicia tetrasperma*.

**Threats:** Successional overgrowth, eutrophication: Young aspens, pines and rowans already cover the slopes surrounding the meadow and spread towards the species-rich center. *Convallaria majalis*, *Calamagrostis epigejos* and *Rubus idaeus* have partly covered the most species-rich parts of the meadow, indicating both eutrophication and lack of management.

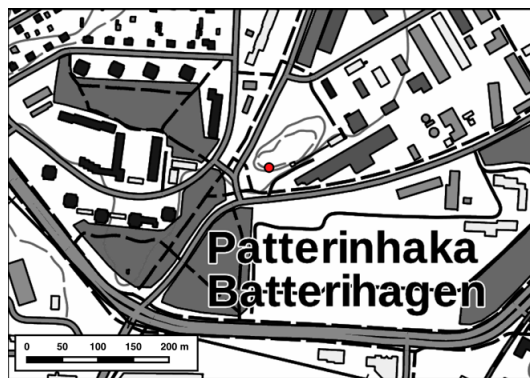
**Restoration needs:** Clearing away the bushes and saplings from the meadow, restorative mowing of the field layer and raking away the resulting hay.

**Conservation status, ownership:** Unprotected.

**Additional information:** Recorded by Rautiainen P (personal communication 2015).

#### PATTERINHAKA 6713438:3237657 (YKJ)

A sandy-soiled, rocky and sunny hilltop with species-rich dry meadow vegetation, along an eroded trail to the top of the hill, on a steep slope towards the south. The hill was cleared of trees in 2010 and has remained open for the most part.



**Size:** 1 patch, 1.5 m<sup>2</sup> in area, with 10–100 shoots.

**Surrounding notable species:** *Arabis glabra*, *Filipendula vulgaris*, *Galium verum* (VU), *Helictotrichon pratense*, *H. pubescens*, *Hypochoeris maculata*, *Lotus corniculatus*, *Luzula campestris*, *Poa compressa*, *Silene nutans*, *Trifolium arvense* (outside the study plot also *Carex ericetorum*, *Cotoneaster scandinavicus*, and *Vincetoxicum hirsutinaria*).

**Threats:** No observable threats, despite some saplings of rowan and other trees that may eventually grow to form dense stands should they not be cleared away.

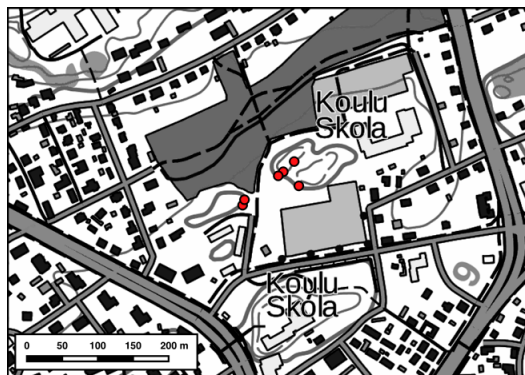
**Restoration needs:** No urgent restoration requirements, but in the future, clearing of bushes and trees.

**Conservation status, ownership:** Designated as an important area for biodiversity in the general plan of the area (Turun kaupunki 2012).

**Additional information:** Mentioned by Kemppainen (2012). A nationally valuable traditional rural biotope ("Patterinhaan keto") mentioned by Lehtomaa (2000). Several collections, e.g. H613473 by Silkkilä 1985.

#### RAUNISTULAN KOULU 671530:323973, 671533:323982, 6715353-369:3239796-813 (YKJ)

A complex of three rocky hills with shallow soils and patches of species-rich, yet eutrophicated and slightly overgrown, dry meadow. The study species occurs on all three hills, always on southerly or south-easterly slopes.



**Size:** 6 patches, 50.6 m<sup>2</sup> in area in total, with 10–100 or 100–1000 shoots in each patch.

**Surrounding notable species:** *Dianthus deltooides* (NT), *Filipendula vulgaris*, *Fraxinus excelsior* (RT), *Galium verum* (VU), *Helictotrichon pratense*, *H. pubescens*, *Lathyrus linifolius*, *Lotus corniculatus*, *Luzula campestris*, *Ranunculus polyanthemos*, *Silene nutans*.

**Threats:** Eutrophication, successional overgrowth: Many patches of the study species occur on slopes that are dominated by large, dense grasses on the edges, indicating eutrophication likely due to nitrogen deposition and dog litter. In addition, both old (maples and rowans) and young trees (especially aspens) cover the majority of the meadow surrounding the patches, shedding abundant leaf litter on the ground.

**Restoration needs:** Clearing of bushes and large trees, restorative mowing of the field layer every few years, and raking away the resulting hay and litter.

**Conservation status, ownership:** Designated as an important area for biodiversity in the city plan of the area (Turun kaupunki 2004), except for one patch of the study species.

**Additional information:** Mentioned by Kemppainen (2012). Collection TURA370507 by Syrjänen K 2001.

#### UITTAMO 670982:323921 (YKJ)

A sunny, narrow patch of species-rich, yet somewhat eutrophicated dry meadow on the sandy edge of a xeric heath forest, some 5–10 meters north from a parking lot, on a slope directly towards the south. The study species occurs as two sparse patches, with the other one right next to a trail.

**Size:** 2 patches, 2.25 m<sup>2</sup> in area in total, with 1–10 or 10–100 shoots in each patch.

**Surrounding notable species:** *Carex spicata*, *Filipendula vulgaris*, *Galium verum* (VU), *Helictotrichon pratense*,



*H. pubescens*, *Lathyrus linifolius*, *Lotus corniculatus*, *Luzula campestris*, *Ranunculus polyanthemos*, *Seseli libanotis*, *Silene nutans*.

**Threats:** Eutrophication: Tall, dominant grasses indicative of eutrophication (e.g. *Dactylis glomerata*) are somewhat common throughout the entire meadow. In addition, a dense cover of litter has covered the ground layer, indicating a lack of management.

**Restoration needs:** Restorative mowing of the field layer every few years and raking away the resulting hay and litter.

**Conservation status, ownership:** Unprotected.

**Additional information:** Two collections, e.g. TUR578953 by Valta M & Routio I 2005.

## Unlocated populations

### Kaarina

**KARPANMÄKI**, record indicated to 6708:3248 (YKJ)

**Status:** Likely disappeared.

The study species is indicated to occur on a "slope of dry meadow in an oak forest", but no meadow patches were found during the survey. The area indicated by the record (TUR188394 by Nurmi J 1964) consists of a protected area of oak-dominated herb-rich forest sloping towards the south and large outcrops and cliffs of bare bedrock. It is likely, that the study species has disappeared from the site due to successional overgrowth.

**LINNUNPÄÄ 1, 2 AND 3**, records indicated to 67049:32563, 67057:32564 and 67055:32562 (YKJ).

**Status:** Unclear.

Several collections of *C. caryophyllea* originate from the field edges, road verges and forests surrounding the Linnunpää -estate (e.g. TUR289073 by Koskinen A, Virtanen T & Silkkilä OK 1986). In 2015, no suitable habitat of the species could be found in the area indicated by the records, but only clear-cuts, mature spruce forests and eutrophicated

midfield islets. The only population found from the area (the Linnunpää -site) was not indicated by any of the collections here. Either the study species has disappeared from the area of the collections or the coordinates indicate a different location.

### Mynämäki

**HEIKKILÄ 1 AND 2**, records indicated to 67373:32216 and 67373:32211 (YKJ)

**Status:** Unclear.

Several collections (e.g. TUR305484 by Koskinen A, Virtanen T & Silkkilä O 1988) of *C. caryophyllea* originate from the Heikkilä -estate in Mynämäki, but some have clearly erroneous coordinates. The first coordinates above indicate a bare field, while the others appear to indicate a grassy mound east of the Heikkilä -main building. Despite extensive searches, the study species was not found at the location. The mound was somewhat overgrown, with only a few low-growing and species-rich meadow patches.

### Paimio

**KRUUVAINEN**, records indicated to 67212:32641 (YKJ)

**Status:** Likely disappeared.

Two collections (e.g. TUR317111 by Pärnä V, Koskinen A & Silkkilä OK 1993) have been made from the area indicated above, described as a forest edge some ten meters from the Paimionjoki -river. At the site, only dead pillar-like junipers and some meadow species under a mature spruce forest indicated a history of meadow vegetation. It is likely that the study species has disappeared from the site due to successional overgrowth.

**NAKOLINNA 1 AND 2**, records indicated to 67139:32616 and 67140:32616 (YKJ)

**Status:** Unclear.

The study species has been collected several times from the Nakolinna -area (e.g. TUR334776 by Silkkilä OK 1994), particularly from a "southerly slope between a field and a forest". However, the species was not found in the area indicated by the coordinates after extensive searches. Some patches of low-growing meadow vegetation were still present, and it is unclear whether the species still occurs at the site.

### Salo

**FALKKI**, records indicated to 66967:2894 (YKJ)

**Status:** Likely disappeared.

Since the study species was collected from the site (collection TUR308625 by Valta M 1990), the previously open



patches of meadow have been covered by a secondary succession of pines (partly planted) and other trees. It is likely that the species is no longer present at least in large numbers, but has disappeared due to successional overgrowth.

**IIIKENMÄKI**, records indicated to 67031:32834 (YKJ)

**Status:** Likely disappeared

The study species has been collected from what was previously a forested hill (TUR308626 by Valta M 1990), but nowadays a newly built housing area. It is likely, that the species has disappeared from the site due to building activity.

**KÄRKKÄ 2**, records indicated to 67017:32854-32855 (YKJ)

**Status:** Likely disappeared.

While the study species is still extant on two other nearby locations in Kärkkä (the sites *Kärkkä 1* and *Kärkkä 3*), the area indicated by a previous collection (TUR309990 by Valta M 1990) consists mostly of young broad-leaved forest and a factory yard used to store wood. It is likely that the species has disappeared from the site due to successional overgrowth.

**VIITANKRUUNU 2**, records indicated to 67002:32841 (YKJ)

**Status:** Unclear.

The study species has been recorded from a small patch of dry meadow on a steep, rocky hill above a private yard,

with partly planted areas (TUR310094 by Valta M 1990). While the habitat still appears partly suitable for the species, no patches of *C. caryophyllea* could be found, only *C. ericetorum*. However, extensive searches were not possible due to the nearby houses.

## Turku

**ISO-HEIKKILÄ**, records indicated to e.g. 6713:3237 (YKJ)

**Status:** Likely disappeared

*C. caryophyllea* has been collected from the hill surrounding the observatory at Iso-Heikkilä several times during the 20th century (e.g. TUR132386 by Laine U 1954). While patches of species-rich dry meadow still exist in some parts of the hill, the majority of area around the observatory is presently covered by apartment buildings, a young forest and dense stands of *Anthriscus sylvestris* and other species indicative of eutrophication. It is likely that the study species has disappeared from the site due to eutrophication and successional overgrowth.