

Nordic Journal of Botany

NJB-02175

Lampinen, J. 2019. Disturbance, microclimate and historical habitat connectivity determine the population performance of the threatened grassland specialist *Carex caryophylla* in remnant grasslands.
– Nordic Journal of Botany 2019: e02175

Appendix 1

| Article: Disturbance, microclimate and historical habitat connectivity determine the population performance of the threatened grassland specialist <i>Carex caryophylla</i> in remnant grasslands. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|--|--|-------------------|------------------------|-------------------------|---------------------------------|----------------|--------------|-------------|--------------|--------------|--------------|-----------------|------------|--------------|--------------|--------------|-----------------|-------------|---------------|--------------|-------------------|--------------|---------------|---------------|--------------|--------------|---|--------|--------|--------|--|--|
| Supplementary material 1. Pearson correlation matrix between the performance variables and the local and landscape scale environmental variables used in the study. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | Number of patches | Number of n Patch area | Number of n Shoot cover | Number of n Number of Leaf area | Influorescence | Spike length | Shrub cover | Litter cover | Ground cover | Slope aspect | Slope steepness | Management | Habitat area | Running date | Running date | Light abundance | Temperature | Soil moisture | Soil calcium | Soil productivity | Cover of sun | Length of sun | Present cover | 19th century | 19th century | cover of dry grasslands within 250 m buffer | | | | | |
| Population performance measures: | Number of patches | 1 | 0.084 | 0.394 | 0.291 | -0.012 | -0.016 | -0.137 | 0.078 | 0.081 | -0.234 | 0.004 | 0.047 | 0.776 | -0.162 | -0.119 | -0.075 | -0.107 | 0.102 | -0.11 | 0.063 | 0.299 | -0.07 | -0.062 | 0.351 | 0.518 | | | | | | |
| | Patch area | 0.084 | 1 | 0.202 | 0.466 | 0.27 | -0.222 | -0.017 | 0.111 | 0.116 | 0.01 | -0.1 | -0.018 | 0.157 | 0.148 | 0.204 | 0.198 | -0.007 | 0.045 | -0.051 | 0 | 0.014 | -0.062 | 0.245 | 0.011 | 0.246 | -0.021 | 0.022 | | | | |
| | Number of inflorescences | 0.394 | 0.202 | 1 | 0.407 | 0.26 | 0.055 | -0.088 | 0.224 | 0.279 | -0.208 | -0.072 | 0.516 | 0.251 | 0.289 | 0.185 | 0.286 | -0.278 | -0.184 | 0.427 | 0.24 | 0.127 | 0.152 | 0.192 | 0.31 | 0.307 | 0.134 | 0.366 | 0.311 | | | |
| | Shoot cover | 0.291 | 0.466 | 0.407 | 1 | 0.385 | 0.082 | -0.292 | -0.074 | -0.104 | 0.315 | 0.048 | 0.213 | 0.194 | -0.01 | 0.382 | 0.467 | -0.108 | -0.153 | -0.001 | 0.003 | -0.007 | -0.179 | -0.151 | 0.444 | 0.141 | -0.034 | -0.029 | 0.091 | | | |
| | Number of ramets | -0.012 | 0.27 | 0.26 | 0.385 | 1 | 0.016 | 0.354 | 0.491 | 0.298 | 0.239 | 0.09 | 0.038 | 0.305 | 0.122 | -0.101 | -0.092 | 0.271 | 0.292 | -0.124 | 0.079 | -0.049 | 0.028 | -0.199 | -0.079 | -0.238 | -0.069 | 0.009 | -0.103 | | | |
| | Number of leaves | -0.016 | -0.222 | 0.055 | 0.082 | 0.016 | 1 | -0.051 | 0.129 | 0.086 | 0.251 | 0.481 | 0.124 | 0.056 | -0.199 | -0.041 | -0.159 | -0.261 | -0.521 | 0.057 | 0.31 | -0.282 | 0.067 | -0.253 | 0.061 | 0.129 | -0.172 | 0.006 | 0.043 | | | |
| | Leaf area | -0.137 | -0.017 | -0.088 | -0.292 | 0.354 | -0.051 | 1 | 0.576 | 0.397 | -0.162 | 0.074 | -0.322 | 0.026 | 0.186 | -0.36 | -0.255 | 0.152 | 0.433 | -0.246 | -0.057 | 0.185 | -0.006 | 0.09 | -0.377 | -0.266 | -0.039 | -0.098 | -0.166 | | | |
| | Influorescence length | 0.078 | 0.111 | 0.224 | -0.074 | 0.491 | 0.129 | 0.576 | 1 | 0.822 | -0.012 | -0.084 | -0.198 | 0.39 | 0.138 | -0.239 | -0.083 | -0.042 | 0.212 | -0.098 | -0.032 | 0.029 | -0.033 | -0.119 | -0.214 | -0.246 | 0.042 | -0.012 | -0.052 | | | |
| | Spike length | 0.081 | 0.116 | 0.279 | -0.104 | 0.298 | 0.086 | 0.397 | 0.822 | 1 | -0.289 | -0.053 | -0.113 | 0.385 | 0.351 | -0.163 | -0.012 | -0.043 | 0.198 | 0.07 | -0.04 | 0.243 | 0.071 | 0.072 | -0.183 | -0.234 | -0.079 | -0.074 | -0.07 | | | |
| | Local environmental conditions: | Shrub cover | -0.234 | 0.01 | -0.208 | 0.315 | 0.239 | 0.251 | -0.162 | -0.012 | -0.289 | 1 | 0.202 | 0.157 | 0.156 | -0.622 | -0.11 | -0.213 | 0.13 | 0.038 | -0.206 | 0.052 | -0.459 | -0.205 | -0.541 | 0.071 | 0.043 | -0.012 | -0.062 | -0.102 | | |
| Litter cover | | -0.178 | -0.1 | -0.072 | 0.048 | 0.09 | 0.481 | 0.074 | -0.084 | -0.053 | 0.202 | 1 | 0.041 | -0.181 | 0.008 | -0.251 | -0.143 | -0.064 | -0.095 | -0.021 | 0.285 | 0.019 | 0.111 | 0.182 | 0.054 | 0.143 | -0.118 | 0.044 | -0.042 | | | |
| Ground erosion | | 0.01 | -0.018 | 0.516 | 0.213 | 0.038 | 0.124 | -0.322 | -0.198 | -0.113 | 0.157 | 0.041 | 1 | 0.179 | 0.139 | -0.05 | 0.033 | -0.129 | -0.136 | 0.515 | 0.479 | -0.054 | 0.242 | -0.122 | 0.178 | 0.246 | -0.018 | 0.041 | 0.037 | | | |
| Slope aspect | | 0.004 | 0.157 | 0.251 | 0.194 | 0.305 | 0.056 | 0.026 | 0.39 | 0.385 | 0.156 | -0.181 | 0.179 | 1 | 0.259 | -0.013 | 0.026 | -0.026 | 0.111 | 0.144 | 0.105 | 0.037 | -0.183 | -0.23 | -0.093 | -0.23 | 0.045 | 0.071 | | | | |
| Slope steepness | | 0.047 | 0.148 | 0.289 | -0.01 | 0.122 | -0.199 | 0.186 | 0.138 | 0.351 | -0.622 | 0.008 | 0.139 | 0.259 | 1 | 0.067 | 0.118 | -0.148 | 0.056 | 0.119 | 0.095 | 0.551 | -0.28 | 0.416 | -0.151 | -0.237 | -0.138 | -0.049 | -0.031 | | | |
| Management syn | | 0.645 | 0.204 | 0.185 | 0.382 | -0.101 | -0.041 | -0.36 | -0.239 | -0.163 | -0.11 | -0.251 | -0.05 | -0.013 | 0.067 | 1 | 0.626 | -0.012 | -0.137 | -0.243 | -0.182 | 0.012 | -0.252 | -0.037 | 0.274 | -0.119 | -0.117 | 0.082 | 0.213 | | | |
| Habitat area | | 0.776 | 0.198 | 0.286 | 0.467 | -0.092 | -0.159 | -0.255 | -0.083 | -0.012 | -0.213 | -0.143 | 0.033 | 0.026 | 0.118 | 0.626 | 1 | -0.076 | -0.034 | 0.054 | -0.158 | 0.218 | -0.149 | 0.095 | 0.302 | 0.012 | -0.069 | 0.113 | 0.322 | | | |
| Running date 1 | | -0.162 | -0.007 | -0.278 | -0.108 | 0.271 | -0.261 | 0.152 | -0.042 | -0.043 | 0.13 | -0.064 | -0.129 | -0.026 | -0.148 | -0.012 | -0.076 | 1 | 0.725 | -0.258 | -0.334 | -0.261 | -0.255 | -0.306 | -0.544 | -0.404 | -0.526 | -0.355 | -0.416 | | | |
| Running date 2 | | -0.119 | 0.045 | -0.184 | -0.153 | 0.292 | -0.521 | 0.433 | 0.212 | 0.198 | 0.038 | -0.095 | -0.136 | 0.111 | 0.056 | -0.137 | -0.034 | 0.725 | 1 | -0.165 | -0.237 | 0.089 | -0.065 | -0.105 | -0.433 | -0.349 | -0.295 | -0.212 | -0.257 | | | |
| Light abundance | | -0.075 | -0.049 | 0.427 | -0.001 | -0.124 | 0.057 | -0.246 | -0.098 | 0.07 | -0.206 | -0.021 | 0.515 | 0.144 | 0.119 | -0.243 | 0.054 | -0.258 | -0.165 | 1 | 0.586 | 0.232 | 0.491 | 0.222 | 0.19 | 0.279 | 0.325 | 0.182 | 0.118 | | | |
| Temperature | -0.107 | -0.051 | 0.24 | 0.003 | 0.079 | 0.31 | -0.057 | -0.032 | -0.04 | 0.052 | 0.285 | 0.479 | 0.105 | -0.182 | -0.334 | -0.237 | 0.586 | 1 | 0.1 | 0.578 | 0.016 | 0.344 | 0.204 | 0.289 | 0.273 | 0.123 | | | | | | |
| Soil moisture | 0.102 | 0 | 0.127 | -0.007 | -0.049 | -0.282 | 0.185 | 0.029 | 0.243 | -0.459 | 0.019 | -0.054 | 0.103 | 0.551 | 0.012 | -0.218 | -0.261 | 0.089 | 0.232 | 0.1 | 1 | 0.36 | 0.72 | -0.011 | -0.108 | 0.081 | 0.048 | 0.043 | | | | |
| Soil calcium | -0.11 | 0.014 | 0.152 | -0.179 | 0.028 | 0.067 | -0.006 | -0.033 | 0.071 | -0.205 | 0.111 | 0.242 | 0.037 | 0.28 | -0.252 | -0.149 | -0.255 | -0.065 | 0.491 | 0.778 | 0.36 | 1 | 0.324 | 0.063 | -0.057 | 0.214 | 0.197 | 0.059 | | | | |
| Soil productivity | 0.063 | -0.062 | 0.192 | -0.151 | -0.199 | -0.253 | 0.09 | -0.119 | 0.072 | -0.541 | 0.182 | -0.122 | -0.183 | 0.416 | -0.037 | 0.095 | -0.306 | -0.105 | 0.222 | 0.016 | 0.72 | 0.324 | 1 | 0.086 | 0.071 | 0.281 | 0.243 | 0.167 | | | | |
| Landscape level conditions: | Cover of surrounding urbanisation | 0.299 | 0.245 | 0.31 | 0.444 | -0.079 | 0.061 | -0.377 | -0.214 | -0.183 | 0.071 | 0.054 | 0.178 | -0.116 | -0.151 | 0.274 | 0.302 | -0.544 | -0.433 | 0.19 | 0.344 | -0.011 | 0.063 | 0.086 | 1 | 0.603 | 0.566 | 0.522 | 0.584 | | | |
| | Length of surrounding roads (km) | -0.07 | 0.011 | 0.307 | 0.141 | -0.238 | 0.129 | -0.246 | -0.246 | -0.234 | 0.043 | 0.143 | 0.246 | -0.093 | -0.237 | -0.119 | 0.012 | -0.404 | -0.349 | 0.279 | 0.204 | -0.108 | -0.057 | 0.071 | 0.603 | 1 | 0.364 | 0.324 | 0.292 | | | |
| | Present connectivity between populations | -0.062 | 0.246 | 0.134 | -0.034 | -0.069 | -0.172 | -0.039 | 0.042 | -0.079 | -0.012 | -0.118 | -0.018 | -0.23 | -0.138 | -0.117 | -0.069 | -0.526 | -0.295 | 0.225 | 0.289 | 0.081 | 0.214 | 0.281 | 0.566 | 0.364 | 1 | 0.4 | 0.364 | | | |
| | 19th century cover of dry grasslands within 500 m buffer | 0.351 | -0.021 | 0.366 | -0.029 | 0.009 | 0.006 | -0.098 | -0.012 | -0.074 | -0.062 | 0.044 | 0.041 | 0.045 | -0.049 | 0.082 | 0.113 | -0.355 | -0.212 | 0.182 | 0.273 | 0.048 | 0.197 | 0.245 | 0.522 | 0.324 | 0.4 | 1 | 0.891 | | | |
| 19th century cover of dry grasslands within 250 m buffer | 0.518 | 0.022 | 0.311 | 0.091 | -0.103 | 0.043 | -0.166 | -0.052 | -0.07 | -0.102 | -0.042 | 0.037 | 0.071 | -0.031 | 0.213 | 0.322 | -0.416 | -0.257 | 0.118 | 0.123 | 0.043 | 0.059 | 0.167 | 0.584 | 0.292 | 0.364 | 0.891 | 1 | | | | |

Article: Disturbance, microclimate and historical habitat connectivity determine the population performance of the threatened grassland specialist *Carex caryophylla* in remnant grasslands.

Supplementary material 2. Schematics of sampling and population performance data collection in individual *Carex caryophylla* populations.

Figure 1. A schematic of a typical *C. caryophylla* population, with examples of study plots.

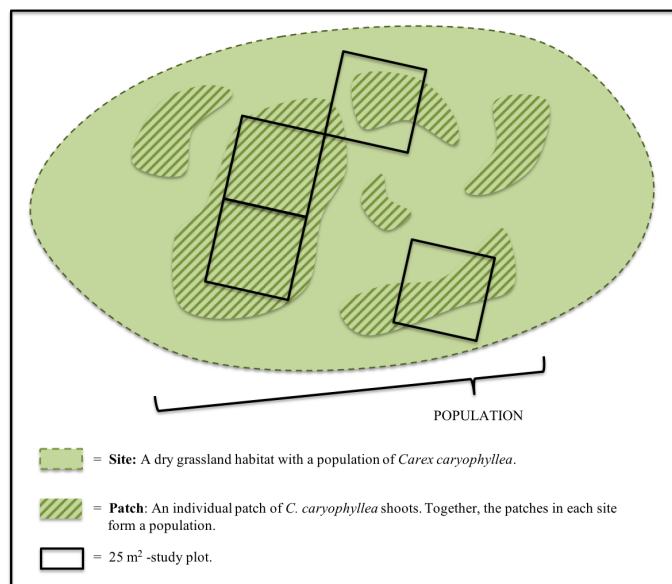


Figure 2. A schematic of study plots used to collect the data for the study.

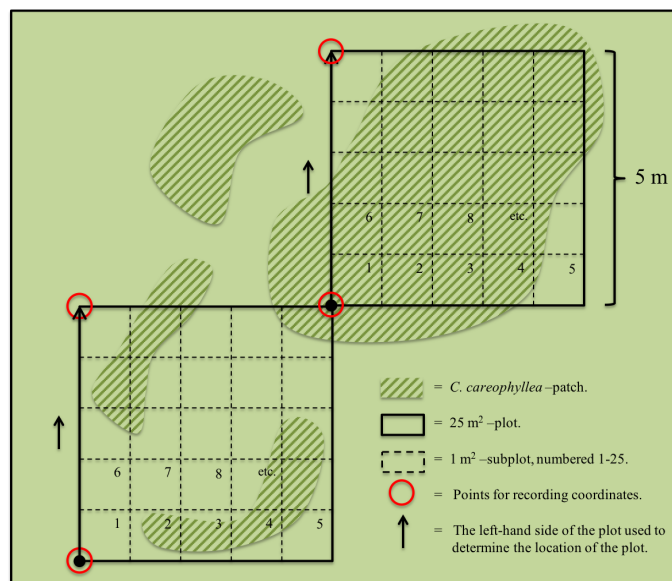
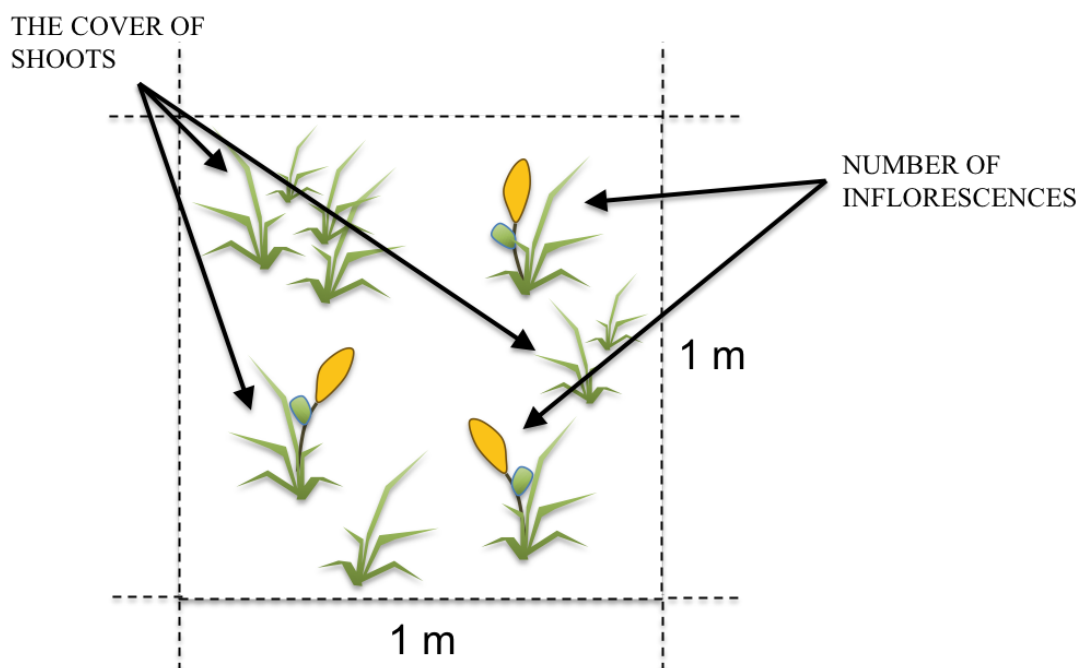


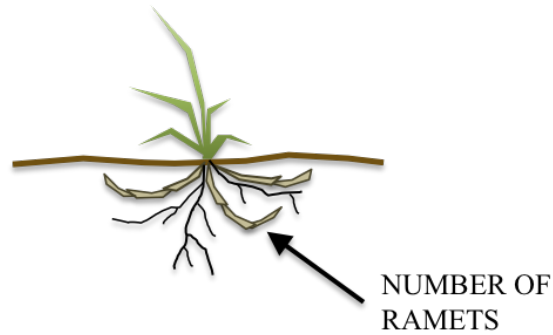
Figure 3. Descriptions for each performance variable.



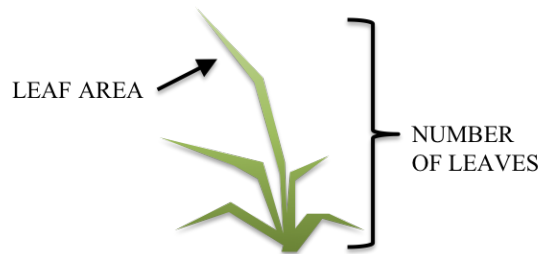
a-b) Number of and area of patches: The number of *Carex caryophyllea* patches in the population and their average area (length x width in meters).



c-d) Number of inflorescences and shoot cover: The number of inflorescences and the percentage cover of shoots of *Carex caryophyllea* per 1 m², averaged over the 25 subplots that comprise each 25 m² plot.



e) Number of ramets: The number of daughter ramets per shoot, averaged over 10 random *Carex caryophyllea* shoots excavated from each 25 m² plot.



f-g) Number of leaves and the area of the largest leaf: The number of leaves per shoot and the product of the length and width (at ligule) of the longest leaf in a shoot, averaged over 10 random *Carex caryophyllea* shoots, respectively, per each 25 m² plot.



h-i) Inflorescence and spike length: Length (in cm) of the inflorescence, measured from base to the female spike, and the sum length (in cm) of all female spikes, averaged over 10 random *Carex caryophyllea* inflorescences, respectively, during seed maturation per each 25 m² plot.