

# Catchments of Plešné and Čertovo Lakes (Bohemian Forest) 2007-2022. Data set 1 - Vegetation sampling<sup>1</sup>

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## Abstract

In two catchments of the Plešné Lake and the Čertovo Lake there are predominantly near-to-nature and natural forests with dominant Norway spruce (*Picea abies*). In consequence to the wind disturbance and bark beetle gradation, research of the dynamics of plant communities has been carried out between 2007 and 2022. The catchment area of Plešné Lake and its surroundings is characterized by 7 permanent research plots. In all plots, the tree canopy disturbance occurred between 2004 and 2010. In the catchment of Čertovo Lake, 5 research plots were monitored. All plots are located in the 6th to 8th forest altitudinal zone (FAZ). Only in one plot (CU) there was total wind disturbance in 2017.

Tree regeneration was rapid, new shrub/tree layer has high coverage (near to complete) in 6<sup>th</sup> and 7<sup>th</sup> FAZ. Lack of light in ground is a limit for next herb layer development. The stands are relatively stable in 8<sup>th</sup> FAZ where regeneration progress is slow with sufficient light sums in the ground. Plant communities have a stable species composition in both catchments, yet the disturbance has been manifested in greater variability (temporal  $\beta$ -diversity) around Plešné Lake.

Commonly, it is possible to distinguish two to three periods during the vegetation development.

**Keywords:** bark beetle, classification, forest vegetation, stand regeneration, succession, Šumava Mts.

The observatory research within two forested catchments of the glacial lakes in the Šumava Mts. (= Bohemian Forest) was carried out since 2007 within several research projects managed by the Hydrobiological Institute BC AS CR at České Budějovice (HBI).

Goal of this first data set is description of plant communities in the areas. Similar compilation over 2007-2018 was prepared earlier (MATĚJKA 2018a). It is accompanied with two next parts:

- [Data set 2](#) - Plant biomass
- [Data set 3](#) - Chemical elements in the plant biomass

All results and publications are collected within web pages <https://infodatasys.cz/proj002/povodijezer.htm>, where photos from all plots are available too.

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<sup>1</sup> Preparation of this paper was founded by the project GACR 22-05421S *Effects of nitrogen availability and forest status on soil microbiome, nutrient cycling, and biological recovery of acidified waters in mountain ecosystems* solved by Hydrobiological Institute BC AS CR at České Budějovice and private sources of IDS.

## Methods

### Research plots

Basic information on all research is summarized by MATĚJKA (2008). Both catchments differ mainly in biogeochemical parameters, which are well comparable on the basis of differences in the chemical properties of soils (KAŇA ET AL. 2014) or water (KOPÁČEK ET AL. 2013). These differences are also reflected in the species composition of plant communities, or in the content of elements in biomass (SVOBODA ET AL. 2006b). Although Šumava Mts. belonged to areas with relatively clean air in the past, even here both catchments were significantly acidified (OULEHLE ET AL. 2017).

### Catchment of the Plešné Lake

In the forests of this catchment, the damage of the tree layer took place due to the spruce of the spruce bark beetle in the years 2004 to 2010, following the climatically extreme year 2003 and the storm in January 2007 (which did not directly damage these forests in the mountain ridge at the state border of the Czech Republic). It was the damage of the forest that enabled the accelerated restoration of the local ecosystems after acidification, which peaked in the 1980s (OULEHLE ET AL. 2018). Permanent research plots in or near this catchment were sampled:

- PJ1 - north of the lake, to the left of the path to the Stifter's memorial, in front of a dense younger spruce stand;
- PJ2 - above the PJ1 plot, to the left of the touristic trail;
- PJ3 - permanent plot of HBI above the monument;
- PJ4 - permanent plot of HBI near the lake;
- T - the permanent plot "Trojmezí" has been monitored since 1990 (MATĚJKA 2000, 2008);
- P19 - permanent research plot P19 lying on the high transect on Plechý, see VACEK ET AL. (2009);
- P20 - permanent research plot P20 lying on the high transect on Plechý, see VACEK ET AL. (2009).

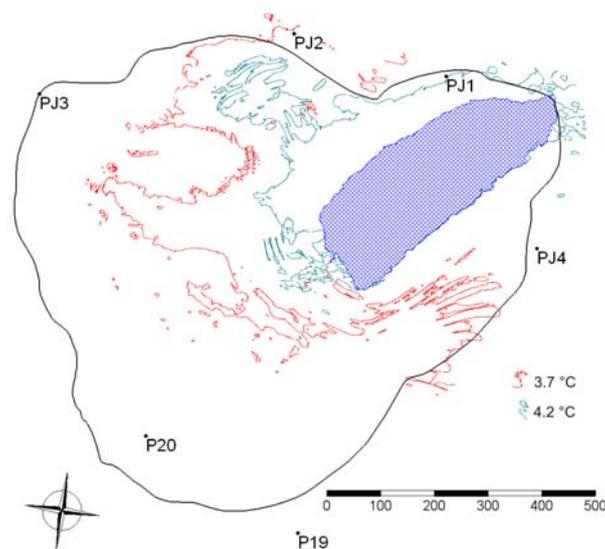


Fig. 1. Permanent research plots in the catchment of Plešné Lake. Isolines for average air temperature 4.2 and 3.7 °C (for period 1961-1990) are drawn according to the PlotOA thermal model with 0.2 m in pixel size. They represent lower limit of 7<sup>th</sup> and 8<sup>th</sup> forest altitudinal zones (FAZ<sup>2</sup>; Matějka 2015)

<sup>2</sup> Also forest vegetation zone (FVZ) of some authors.

## Catchment of the Čertovo Lake

This catchment was not affected by the large-scale damage of forest stands, although the stands were damaged locally. Sanitary cutting against the bark beetle were carried out in a number of places. Permanent plots were sampled

- CU - upper permanent plot of HBI, by summit of Jezerní Mt.;
- CL - lower permanent plot of HBÚ, near the lake;
- C1 - about 80 m to the right of the touristic trail from the top crossroads to the lake (before the stream across the road);
- C2 - south of the lake, to the right under the closed path (when walking from the lake dam);
- C4 - northern of the lake, on the left side of small tributary.

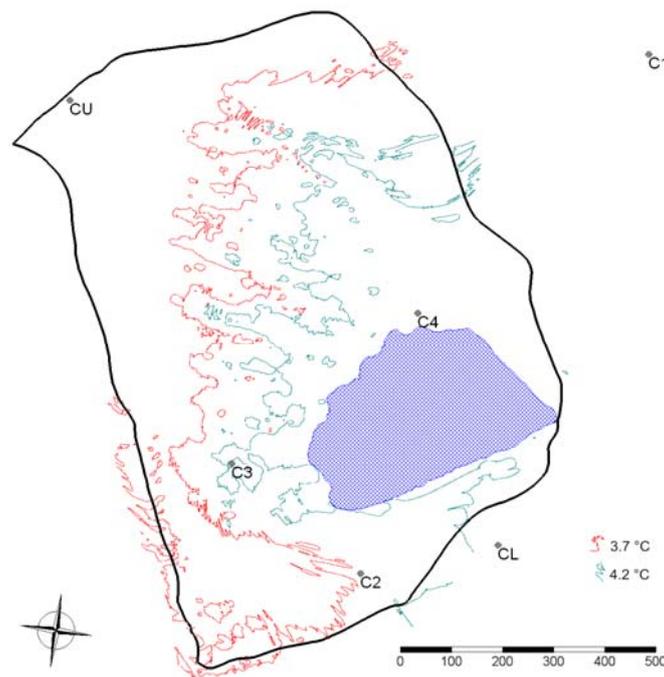


Fig. 2. Permanent research plots in the catchment of Čertovo Lake. Isolines for average air temperature 4.2 and 3.7 °C (for period 1961-1990) are drawn according to the PlotOA thermal model with 0.2 m in pixel size. They represent lower limit of 7<sup>th</sup> and 8<sup>th</sup> forest altitudinal zones (FAZ; Matějka 2015)

## Phytocoenological relevés

The research plots were sampled according to the methodology of the Zurich-Montpellier school using the Braun-Blanquet combined scale for abundance-dominance to determine the representation of species in the herbaceous layer. The scale was supplemented by intermediate levels (e.g. +1, 1-2, ...), which were used at the border cover of the given species. The total coverage of etages  $E_0$  (moss) to  $E_3$  (tree) is given as a percentage. The share of species in the layers  $E_3$  and  $E_2$  was estimated as a percentage, so the cover of each tree species is given by the product of the total cover of the etage and the representation of this species. The presence of a completely dead tree etage is indicated by the symbol D. The size of the sampled area was 400 m<sup>2</sup> as standard.

The relevés were recorded in the DBreleve database (MATĚJKA 2018a). In this software, the basic processing of these data and their export for subsequent processing by other mathematical and statistical methods was also performed. To determine the change in the species structure of communities over time, relevés were always classified separately for each

locality by the HSCA/Sq procedure (MATĚJKA 1993, 2018b), which enabled the determination of different stages in community development. The highest value of the coefficient Sq (complement of sum of species variance) can be used as a measure of temporal  $\beta$ -diversity for a given locality and time period.

Plant nomenclature follows KUBÁT ET AL. (2002).

## Results

The collected relevés are listed in tables 2-12.

The variability of vegetation in the plots is summarized in table 1: The highest variability was observed in the plots PJ2 and PJ1 in 7<sup>th</sup> FAZ with complete damage of tree layer earlier. Tree regeneration there was rapid, new shrub/tree layer has high coverage (near to complete). The light lack in ground is a limit for next herb layer development now.

The most stable plots are CL (tree damage is gradual in the observing interval end), C4 (tree damage is rapid in the observing interval end) and P19 (with only gradual tree regeneration).

It is possible to distinguish some periods in each plot according to the vegetation development (figs. 3-13). Main driver was tree regeneration which influence light conditions in the ground. Species typical for clear-cuts (e.g. *Epilobium angustifolium* and *Rubus idaeus*) were present only for short time with relatively low importance.

**Table 1.** Maximal cluster level of the procedure HSCA/Sq for individual research plots and possible periodization of vegetation development

| Plot | Cluster level (Sq) | Periodization                            |
|------|--------------------|--|
| PJ1  | 0.052              | 2007-2014 / 2015-2022                    |
| PJ2  | 0.065              | 2007-2011 / 2012-2022                    |
| PJ3  | 0.033              | 2007-2010 / 2011-2017 / 2018-2021 / 2022 |
| PJ4  | 0.022              | 2007-2009 / 2010-2018 / 2019-2022        |
| P19  | 0.008              | 2007 / 2009-2014 / 2015-2022             |
| P20  | 0.043              | 2007-2009 / 2011-2018 / 2019-2022        |
| CU   | 0.026              | 2007-2017 / 2018 / 2019-2022             |
| CL   | 0.003              | 2007-2009 / 2010-2021 (2022)             |
| C1   | 0.039              | 2007-2014 / 2015-2021 / 2022             |
| C2   | 0.021              | 2007-2008 / 2010-2016 / 2017-2022        |
| C4   | 0.006              | 2008 / 2009-2018 / 2019-2022             |

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Table 2. Plant community in the plot PJ1

| Column                       | 1             | 2             | 3             | 4             | 5             | 6             | 7            | 8             | 9            | 10            | 11           | 12            | 13            | 14            | 15            | 16            |
|------------------------------|---------------|---------------|---------------|---------------|---------------|---------------|--------------|---------------|--------------|---------------|--------------|---------------|---------------|---------------|---------------|---------------|
| Relevé                       | 106/07        | 107/08        | 111/09        | 52/10         | 22/11         | 22/12         | 1/13         | 12/14         | 78/15        | 1/16          | 8/17         | 53/18         | 9/19          | 28/20         | 5/21          | 17/22         |
| Date                         | 15.8.<br>2007 | 30.7.<br>2008 | 10.8.<br>2009 | 16.8.<br>2010 | 10.8.<br>2011 | 15.8.<br>2012 | 1.8.<br>2013 | 17.7.<br>2014 | 6.8.<br>2015 | 26.7.<br>2016 | 7.8.<br>2017 | 25.7.<br>2018 | 23.7.<br>2019 | 28.7.<br>2020 | 21.7.<br>2021 | 25.7.<br>2022 |
| Area (m <sup>2</sup> )       | 400           | 400           | 400           | 400           | 400           | 400           | 400          | 400           | 400          | 400           | 400          | 400           | 400           | 400           | 400           | 400           |
| Cover of E <sub>3</sub> (%)  | 0             | 0             | 0             | 0             | 0             | 0             | 0            | 0             | 5            | 5             | 5            | 10            | 15            | 20            | 25            | 25            |
| Cover of E <sub>2</sub> (%)  | 60            | 65            | 70            | 75            | 75            | 80            | 80           | 85            | 85           | 90            | 90           | 90            | 95            | 95            | 95            | 95            |
| Cover of E <sub>1</sub> (%)  | 75            | 70            | 70            | 50            | 60            | 60            | 60           | 50            | 50           | 40            | 20           | 20            | 10            | 5             | 3             | 3             |
| Cover of E <sub>0</sub> (%)  | 10            | 10            | 10            | 10            | 20            | 20            | 25           | 25            | 25           | 25            | 30           | 30            | 20            | 20            | 25            | 25            |
| E <sub>3</sub> :             |               |               |               |               |               |               |              |               |              |               |              |               |               |               |               |               |
| <i>Abies alba</i>            |               |               |               |               |               |               |              |               | 5%           | 5%            | 5%           | 5%            | +             | +             | +             | +             |
| <i>Picea abies</i>           | D             | D             | D             | D             | D             | D             | D            |               | 35%          | 35%           | 35%          | 45%           | 5%            | 40%           | 60%           | 75%           |
| <i>Sorbus aucuparia</i>      |               |               |               |               |               |               |              |               | 60%          | 60%           | 60%          | 45%           | 60%           | 40%           | 20%           | 15%           |
| <i>Fagus sylvatica</i>       |               |               |               |               |               |               |              |               |              |               | +            | 5%            | 35%           | 20%           | 20%           | 10%           |
| E <sub>2</sub> :             |               |               |               |               |               |               |              |               |              |               |              |               |               |               |               |               |
| <i>Abies alba</i>            | +             | +             | +             | 5%            | 2%            | 2%            | 1%           | 1%            |              |               |              |               |               |               |               |               |
| <i>Betula pubescens</i>      |               |               |               |               |               |               | r            | 1%            | 1%           | 1%            | 1%           | 1%            |               |               |               |               |
| <i>Fagus sylvatica</i>       | 10%           | 10%           | 10%           | 5%            | 2%            | 1%            | 1%           | 1%            | 1%           | 1%            | 1%           | 1%            | 1%            | 5%            | 5%            | 5%            |
| <i>Picea abies</i>           | 45%           | 45%           | 40%           | 40%           | 36%           | 37%           | 48%          | 48%           | 48%          | 55%           | 60%          | 65%           | 79%           | 85%           | 85%           | 90%           |
| <i>Sorbus aucuparia</i>      | 45%           | 45%           | 50%           | 50%           | 60%           | 60%           | 50%          | 49%           | 50%          | 43%           | 38%          | 33%           | 20%           | 10%           | 10%           | 5%            |
| E <sub>1</sub> :             |               |               |               |               |               |               |              |               |              |               |              |               |               |               |               |               |
| <i>Avenella flexuosa</i>     | + -1          | +             | +             | +             |               |               |              |               |              |               |              |               |               |               |               |               |
| <i>Betula pubescens</i>      |               |               |               |               | r             | r             |              | r             | r            | r             | r            | r             |               |               |               |               |
| <i>Calamagrostis villosa</i> | + -1          | 1             | 1             | 1             | 1             | 1             | 1            | 1             | 1            | +             |              |               |               |               |               |               |
| <i>Dryopteris dilatata</i>   | 1-2           | 1             | 1             | 1             | 1-2           | 1             | +            | +             | +            | +             | +            | +             | +             | + -1          | + -1          | +             |
| <i>Fagus sylvatica</i> L.    |               |               | 1             |               |               | r             | r            | r             | r            | +             | +            | +             | +             | +             | +             | +             |
| <i>Maianthemum bifolium</i>  | +             | +             | +             |               | r             | r             | r            | r             |              | r             | (r)          | (r)           | (+)           | (r)           |               |               |
| <i>Mycelis muralis</i>       | +             |               |               |               |               |               |              |               |              |               |              |               |               |               |               |               |
| <i>Oxalis acetosella</i>     | 2-3           | 2             | 2             | 1             | 1             | 1             | 1            | + -1          | +            | +             | +            | +             | r             | r             | r             | r             |
| <i>Picea abies</i>           | 2             | 2             | 2             | 2-3           | 2             | 2             | 2            | 2             | 3            | 3             | 2            | 2             | 2             | 2             | 2             | 1             |
| <i>Prenanthes purpurea</i>   | +             | +             | +             |               | r             | +             | +            | +             | +            | +             | (r)          | (r)           | r             | (r)           | (r)           | (r)           |
| <i>Rubus idaeus</i>          | 1             | 1-2           | 1-2           | 1             | 1-2           | 1-2           | 1-2          | 1             |              |               |              |               |               | r             |               |               |
| <i>Solidago virgaurea</i>    |               | r             | r             |               |               |               |              |               |              |               |              |               |               |               |               |               |
| <i>Sorbus aucuparia</i>      | 2             | 2             | 1-2           | 1-2           | 2             | 1             | 1            | 1             | 1            | 1             | 1            | + -1          | +             | + -1          | + -1          | +             |
| <i>Vaccinium myrtillus</i>   | 2             | 2             | 1-2           | 1-2           | 1-2           | 1-2           | 2            | 2             | 2            | 2             | 2            | 2             | 1-2           | 1             | 1             | 1             |

Comments:

2007 - E<sub>3</sub> is dead

2009 - sanitary management of woods (cutting)

2014 - individuals of E<sub>2</sub> grow into E<sub>3</sub>

2021 - wood is intensively decaying, probably as result of high wetness during last two years

2022: *Abies alba* is yellowing

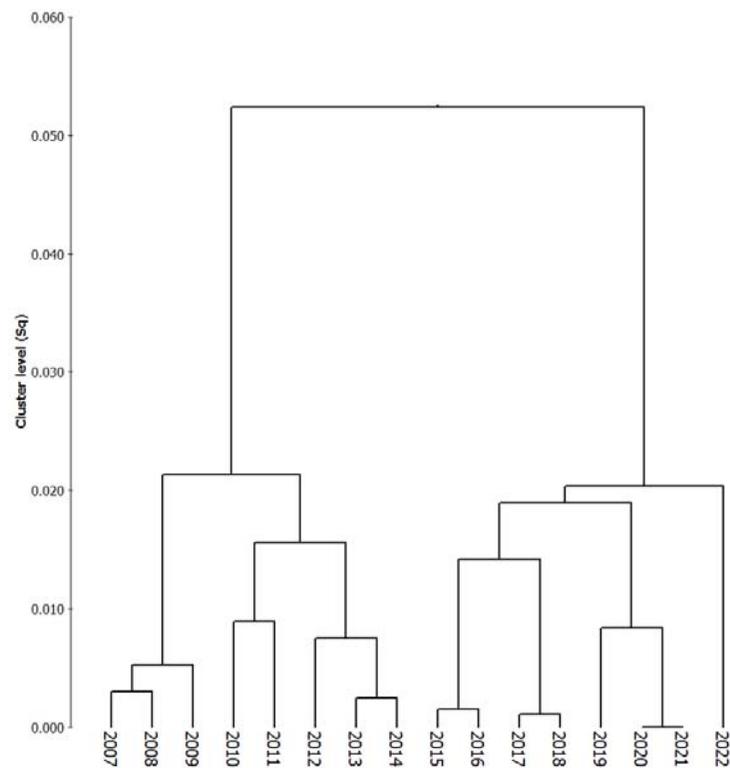


Fig. 3. Constrained clustering of relevés of the plot PJ1 by the procedure HSCA/Sq

Table 3. Plant community in the plot PJ2

| Column                         | 1             | 2             | 3             | 4             | 5             | 6             | 7            | 8             | 9            | 10            | 11           | 12            | 13            | 14            | 15            | 16            |
|--------------------------------|---------------|---------------|---------------|---------------|---------------|---------------|--------------|---------------|--------------|---------------|--------------|---------------|---------------|---------------|---------------|---------------|
| Relevé                         | 107/07        | 108/08        | 112/09        | 53/10         | 23/11         | 23/12         | 2/13         | 13/14         | 79/15        | 2/16          | 9/17         | 54/18         | 10/19         | 29/20         | 6/21          | 18/22         |
| Date                           | 15.8.<br>2007 | 30.7.<br>2008 | 10.8.<br>2009 | 16.8.<br>2010 | 10.8.<br>2011 | 15.8.<br>2012 | 1.8.<br>2013 | 17.7.<br>2014 | 6.8.<br>2015 | 26.7.<br>2016 | 7.8.<br>2017 | 25.7.<br>2018 | 23.7.<br>2019 | 28.7.<br>2020 | 21.7.<br>2021 | 25.7.<br>2022 |
| Area (m <sup>2</sup> )         | 400           | 400           | 400           | 400           | 400           | 400           | 400          | 400           | 400          | 400           | 400          | 400           | 400           | 400           | 400           | 400           |
| Cover of E <sub>3</sub> (%)    | 0             | 0             | 0             | 0             | 0             | 0             | 0            | 0             | 3            | 5             | 5            | 5             | 10            | 10            | 10            | 10            |
| Cover of E <sub>2</sub> (%)    | 40            | 50            | 55            | 60            | 70            | 75            | 75           | 75            | 80           | 85            | 85           | 85            | 90            | 90            | 95            | 95            |
| Cover of E <sub>1</sub> (%)    | 60            | 65            | 70            | 65            | 55            | 60            | 60           | 65            | 50           | 50            | 45           | 50            | 40            | 25            | 20            | 15            |
| Cover of E <sub>0</sub> (%)    | 30            | 25            | 20            | 20            | 20            | 25            | 25           | 25            | 25           | 25            | 25           | 25            | 25            | 25            | 25            | 25            |
| E <sub>3</sub> :               |               |               |               |               |               |               |              |               |              |               |              |               |               |               |               |               |
| <i>Betula pendula</i>          |               |               |               |               |               |               |              |               | 5%           | 5%            | 5%           | 2%            | 2%            | 2%            | 1%            | 1%            |
| <i>Picea abies</i>             | D             | D             |               |               |               |               |              |               | 80%          | 80%           | 80%          | 90%           | 90%           | 90%           | 95%           | 95%           |
| <i>Sorbus aucuparia</i>        |               |               |               |               |               |               |              |               | 15%          | 15%           | 15%          | 8%            | 8%            | 8%            | 4%            | 4%            |
| E <sub>2</sub> :               |               |               |               |               |               |               |              |               |              |               |              |               |               |               |               |               |
| <i>Betula pendula</i>          | 2%            | 2%            | 2%            | 2%            | 2%            | 2%            | 2%           | 2%            |              |               |              |               |               |               |               |               |
| <i>Picea abies</i>             | 65%           | 68%           | 68%           | 68%           | 70%           | 72%           | 73%          | 75%           | 77%          | 77%           | 85%          | 85%           | 85%           | 90%           | 95%           | 95%           |
| <i>Sorbus aucuparia</i>        | 33%           | 30%           | 30%           | 30%           | 28%           | 26%           | 25%          | 23%           | 23%          | 23%           | 15%          | 15%           | 15%           | 10%           | 5%            | 5%            |
| E <sub>1</sub> :               |               |               |               |               |               |               |              |               |              |               |              |               |               |               |               |               |
| <i>Calamagrostis villosa</i>   | 1-2           | 2             | 1-2           | 1             | 1             | +             | r            | +             | +            | + -1          |              |               | +             |               |               |               |
| <i>Dryopteris dilatata</i>     | 2             | 2             | 2             | 2             | 2             | 2             | 2            | 1-2           | 1            | 1             | +            | 1             | 1             | 1             | 1             | r             |
| <i>Epilobium angustifolium</i> | 2-3           | 2             | 2             | 2             | 1-2           | 1             | +            | +             | r            | +             | r            | r             | r             | r             | r             |               |
| <i>Luzula sylvatica</i>        |               |               |               |               |               | (r)           |              |               |              |               |              |               |               |               |               |               |
| <i>Oxalis acetosella</i>       | 1             | +             | +             | +             | +             | r             | r            | r             |              |               |              |               | r             |               |               |               |
| <i>Picea abies</i>             | 2-3           | 2-3           | 2             | 2             | 2             | 2             | 1            | 1-2           | 1-2          | 1-2           | 1-2          | 1-2           | 1-2           | 1-2           | 1-2           | 1             |
| <i>Prenanthes purpurea</i>     | +             |               |               |               | +             | +             | +            | r             | r            | r             | r            | r             |               |               |               |               |
| <i>Rubus idaeus</i>            | 1-2           | 2             | 2             | 2             | 1-2           | 1             | + -1         | 1             | +            | r             |              |               |               |               |               |               |
| <i>Sorbus aucuparia</i>        | 1             | 1             | + -1          | +             | +             | +             | +            | +             | +            | +             | +            | +             | +             | +             | +             | 1             |
| <i>Vaccinium myrtillus</i>     | 2-3           | 2-3           | 2-3           | 2-3           | 2-3           | 3             | 3            | 3-4           | 4            | 3             | 3            | 3-4           | 3             | 2             | 2             | 1-2           |

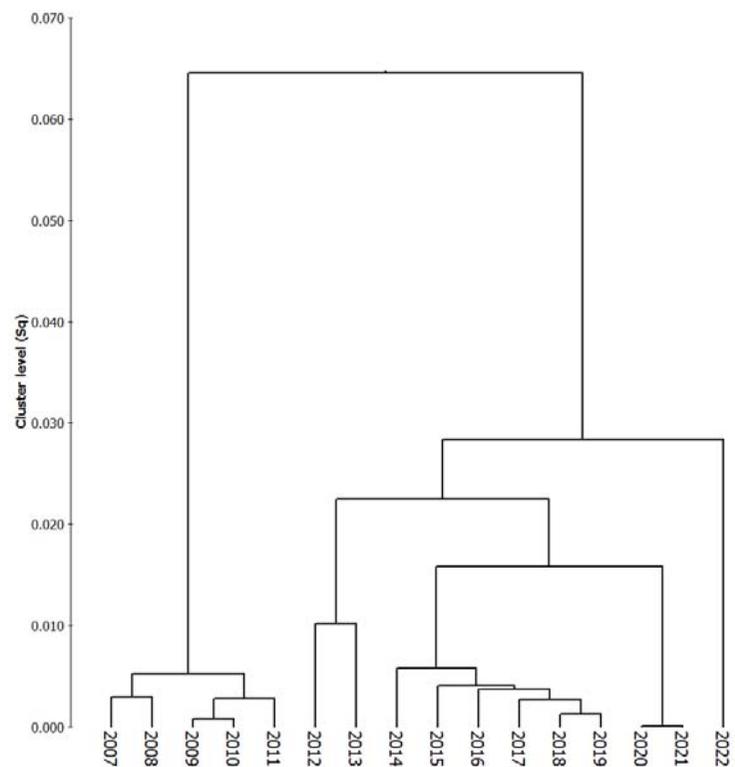


Fig. 4. Constrained clustering of relevés of the plot PJ2 by the procedure HSCA/Sq

Table 4. Plant community in the plot PJ3

| Column                         | 1             | 2             | 3             | 4             | 5             | 6             | 7            | 8             | 9            | 10            | 11           | 12            | 13            | 14            | 15            | 16            |
|--------------------------------|---------------|---------------|---------------|---------------|---------------|---------------|--------------|---------------|--------------|---------------|--------------|---------------|---------------|---------------|---------------|---------------|
| Relevé                         | 108/07        | 109/08        | 113/09        | 54/10         | 24/11         | 24/12         | 3/13         | 14/14         | 80/15        | 3/16          | 10/17        | 55/18         | 11/19         | 30/20         | 7/21          | 19/22         |
| Date                           | 15.8.<br>2007 | 30.7.<br>2008 | 10.8.<br>2009 | 16.8.<br>2010 | 10.8.<br>2011 | 15.8.<br>2012 | 1.8.<br>2013 | 17.7.<br>2014 | 6.8.<br>2015 | 26.7.<br>2016 | 7.8.<br>2017 | 25.7.<br>2018 | 23.7.<br>2019 | 28.7.<br>2020 | 21.7.<br>2021 | 25.7.<br>2022 |
| Area (m <sup>2</sup> )         | 400           | 400           | 400           | 400           | 400           | 400           | 400          | 400           | 400          | 400           | 400          | 400           | 400           | 400           | 400           | 400           |
| Cover of E <sub>3</sub> (%)    | 2             | 0             | 0             | 0             | 0             | 0             | 0            | 0             | 0            | 0             | 0            | 0             | 0             | 0             | 0             | 0             |
| Cover of E <sub>2</sub> (%)    | 0.5           | 0.5           | 1             | 5             | 5             | 8             | 9            | 10            | 15           | 20            | 20           | 20            | 25            | 25            | 25            | 25            |
| Cover of E <sub>1</sub> (%)    | 80            | 80            | 80            | 80            | 90            | 90            | 90           | 90            | 95           | 95            | 95           | 95            | 85            | 80            | 85            | 85            |
| Cover of E <sub>0</sub> (%)    | 15            | 18            | 20            | 20            | 20            | 20            | 20           | 20            | 20           | 20            | 20           | 20            | 20            | 20            | 20            | 20            |
| E <sub>3</sub> :               |               |               |               |               |               |               |              |               |              |               |              |               |               |               |               |               |
| <i>Picea abies</i>             | +             | D             | D             | D             | D             | D             | D            | D             |              |               |              |               |               |               |               |               |
| E <sub>2</sub> :               |               |               |               |               |               |               |              |               |              |               |              |               |               |               |               |               |
| <i>Betula pubescens</i>        |               |               |               |               |               |               | r            |               |              |               | r            | +             | +             | +             | +             | +             |
| <i>Picea abies</i>             | 50%           | 50%           | 60%           | 55%           | 55%           | 55%           | 60%          | 70%           | 75%          | 80%           | 75%          | 75%           | 80%           | 80%           | 75%           | 75%           |
| <i>Populus tremula</i>         |               |               |               |               | r             |               |              |               |              |               | r            | +             | r             | r             |               |               |
| <i>Sorbus aucuparia</i>        | 50%           | 50%           | 40%           | 45%           | 45%           | 45%           | 40%          | 30%           | 25%          | 20%           | 25%          | 25%           | 20%           | 20%           | 25%           | 25%           |
| E <sub>1</sub> :               |               |               |               |               |               |               |              |               |              |               |              |               |               |               |               |               |
| <i>Athyrium distentifolium</i> |               |               |               |               |               | +             | +            | 1             | 1            | +             | +            | +             | +1            | 1             | 1             | 1             |
| <i>Avenella flexuosa</i>       | 2-3           | 2-3           | 2-3           | 3             | 3             | 3             | 3            | 3             | 3-4          | 3-4           | 3-4          | 3             | 3             | 2             | 2             | 2             |
| <i>Betula pubescens</i>        | r             | r             |               |               | r             | r             |              |               |              |               | r            |               |               |               | r             |               |
| <i>Blechnum spicant</i>        |               |               |               |               |               |               |              |               |              |               |              | r             |               |               | r             | r             |
| <i>Calamagrostis villosa</i>   | 2             | 2             | 2-3           | 2-3           | 2             | 1-2           | 1-2          | 2             | 2            | 2             | 2            | 2             | 2             | 2             | 2             | 2             |
| <i>Carex canescens</i>         |               |               |               |               | r             | r             |              |               |              |               |              |               | r             |               |               |               |
| <i>Dryopteris dilatata</i>     | 1-2           | 1-2           | 1-2           | 1-2           | 1             | 1             | 1            | 1             | +1           | +1            | +            | +1            | +             | +             | +             | +             |
| <i>Epilobium angustifolium</i> | +             | +             | +             | r             | r             | +             | r            | r             | +            | r             | r            | +             |               | r             | r             | +             |
| <i>Fagus sylvatica</i>         |               |               |               |               |               |               |              |               |              | r             |              |               |               |               |               |               |
| <i>Galium saxatile</i>         |               |               |               |               |               |               |              |               |              |               |              |               |               |               |               | r             |
| <i>Homogyne alpina</i>         | +1            | +1            | +1            | 1             | +             | +             | +            | +             | r            | +             | +            | +             | +             | r             | r             | +             |
| <i>Luzula sylvatica</i>        | 2             | 1-2           | 1             | 1             | +1            | +1            | +1           | 1             | 1            | 1             | 1            | +             | +             | +             | r             | r             |
| <i>Oxalis acetosella</i>       | +             | +             | +             | r             | +             | +             | r            | r             | r            | r             | r            | r             | +             |               |               |               |
| <i>Picea abies</i>             | +1            | +             | +1            | 1-2           | 1-2           | 1-2           | 1-2          | 1-2           | 1-2          | 1-2           | 1-2          | 1-2           | 1             | 1-2           | 1-2           | +1            |
| <i>Populus tremula</i>         |               |               |               |               |               |               |              |               | r            | r             |              |               | r             | r             | r             | r             |
| <i>Rubus idaeus</i>            |               | +             | +             | +             | +             | +             | +1           | +1            | +1           | +1            | +            | +1            | r             | r             | r             | r             |
| <i>Sorbus aucuparia</i>        | 1-2           | 1-2           | 1-2           | 1             | 1             | 1             | 1            | +1            | 1            | +1            | 1            | 1             | 1             | 1             | 1             | +1            |
| <i>Trientalis europaea</i>     | +1            | +1            | +1            | +1            | +             | +             | +            | +             | +            | +             | +            | +             | +1            | +1            | +1            | +             |

| Column                       | 1 | 2 | 3   | 4   | 5 | 6 | 7 | 8   | 9 | 10 | 11 | 12  | 13  | 14  | 15  | 16 |
|------------------------------|---|---|-----|-----|---|---|---|-----|---|----|----|-----|-----|-----|-----|----|
| <i>Vaccinium myrtillus</i>   | 2 | 2 | 1-2 | 1-2 | 2 | 2 | 2 | 1-2 | 1 | 1  | 2  | 2-3 | 2-3 | 2-3 | 2-3 | 4  |
| <i>Vaccinium vitis-idaea</i> |   |   |     |     |   |   |   |     |   |    | r  |     |     |     |     | r  |

Comments:

2011 - broken and falling dead trees are lying on the soil surface

2019 - surface temperatures at 13:00 are from 23 °C (shadow plots) and 31 °C (sunned vegetation) to 48 °C (sunned woods) and 60 °C (bare plots)

2020 - bare spots (dry and elevated) emerged, *Luzula sylvatica* and *Trientalis europaea* are drying

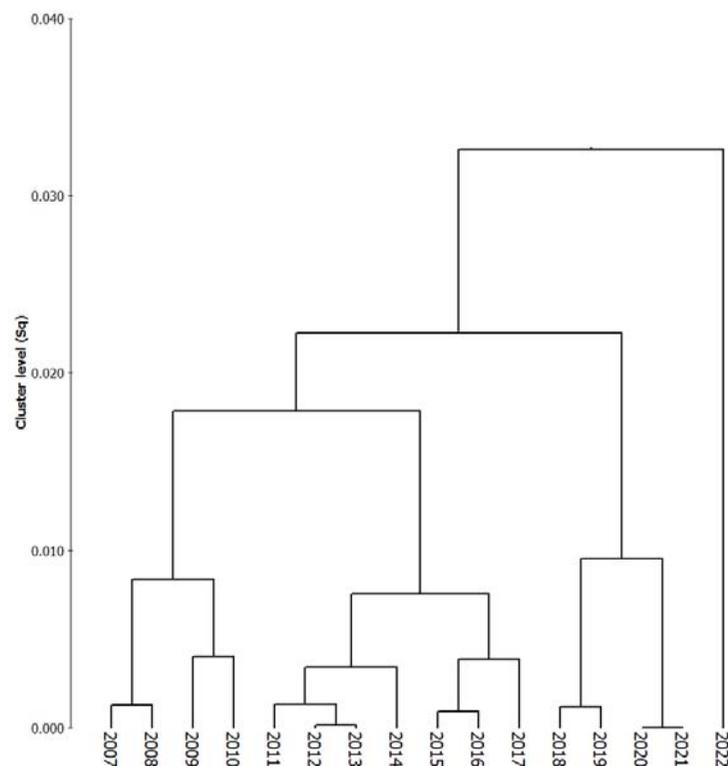


Fig. 5. Constrained clustering of relevés of the plot PJ3 by the procedure HSCA/Sq

Table 5. Plant community in the plot PJ4

| Column                         | 1             | 2             | 3             | 4             | 5             | 6             | 7            | 8            | 9             | 10            | 11           | 12            | 13            | 14            | 15            | 16            |
|--------------------------------|---------------|---------------|---------------|---------------|---------------|---------------|--------------|--------------|---------------|---------------|--------------|---------------|---------------|---------------|---------------|---------------|
| Relevé                         | 109/07        | 110/08        | 114/09        | 55/10         | 25/11         | 25/12         | 4/13         | 20/14        | 83/15         | 6/16          | 14/17        | 56/18         | 15/19         | 31/20         | 12/21         | 22/22         |
| Date                           | 15.8.<br>2007 | 30.7.<br>2008 | 10.8.<br>2009 | 16.8.<br>2010 | 10.8.<br>2011 | 15.8.<br>2012 | 1.8.<br>2013 | 8.8.<br>2014 | 17.8.<br>2015 | 26.7.<br>2016 | 7.8.<br>2017 | 26.7.<br>2018 | 24.3.<br>2019 | 28.7.<br>2020 | 21.7.<br>2021 | 25.7.<br>2022 |
| Area (m <sup>2</sup> )         | 400           | 400           | 400           | 400           | 400           | 400           | 400          | 400          | 400           | 400           | 400          | 400           | 400           | 400           | 400           | 400           |
| Cover of E <sub>3</sub> (%)    | 10            | 3             | 0             | 0             | 0             | 0             | 0            | 0            | 0             | 0             | 0            | 0             | 0             | 0             | 0             | 0             |
| Cover of E <sub>2</sub> (%)    | 1             | 1             | 1             | 1             | 1             | 1             | 2            | 5            | 10            | 10            | 35           | 40            | 45            | 50            | 55            | 60            |
| Cover of E <sub>1</sub> (%)    | 25            | 30            | 35            | 40            | 45            | 50            | 60           | 70           | 65            | 70            | 60           | 70            | 75            | 75            | 80            | 85            |
| Cover of E <sub>0</sub> (%)    | 60            | 60            | 60            | 60            | 70            | 70            | 50           | 60           | 60            | 60            | 60           | 60            | 60            | 60            | 60            | 60            |
| E <sub>3</sub> :               |               |               |               |               |               |               |              |              |               |               |              |               |               |               |               |               |
| <i>Picea abies</i>             | 100%          | D             | D             | D             | D             | D             | D            | D            | D             |               |              |               |               |               |               |               |
| E <sub>2</sub> :               |               |               |               |               |               |               |              |              |               |               |              |               |               |               |               |               |
| <i>Betula pubescens</i>        |               |               |               |               |               | r             | r            | 40%          | 45%           | 45%           | 40%          | 40%           | 45%           | 50%           | 60%           | 55%           |
| <i>Picea abies</i>             |               | +             | +             | +             | +             | +             | +            | 30%          | 25%           | 25%           | 30%          | 35%           | 40%           | 40%           | 35%           | 40%           |
| <i>Sorbus aucuparia</i>        | r             | r             | r             | +             | +             | +             | +            | 30%          | 30%           | 30%           | 30%          | 25%           | 15%           | 10%           | 5%            | 5%            |
| E <sub>1</sub> :               |               |               |               |               |               |               |              |              |               |               |              |               |               |               |               |               |
| <i>Avenella flexuosa</i>       | 1             | + -1          | +             | +             | +             | +             | +            | +            | + -1          | + -1          | r            | r +           | +             | +             | +             | +             |
| <i>Betula pubescens</i>        |               | r             | r             | +             | + -1          | 1             | 1            | 1            | 1             | 1             | + -1         | +             | +             | +             | +             | +             |
| <i>Calamagrostis villosa</i>   |               |               |               |               |               |               |              |              | r             | r             | r            | r             | r             | r             | r             | r             |
| <i>Carex canescens</i>         |               |               |               |               |               |               |              | r            | r             |               |              |               |               |               |               |               |
| <i>Dryopteris dilatata</i>     | +             | +             | +             | + -1          | +             | +             | +            | + -1         | + -1          | 1             | +            | +             | +             | +             | +             | +             |
| <i>Epilobium angustifolium</i> |               | +             | +             | 1-2           | 1-2           | 2             | 2            | 1            | 1-2           | 1             | +            | 1             | (+)           | (+)           | r             | r             |
| <i>Fagus sylvatica</i>         |               | r             |               |               |               |               |              |              |               |               |              |               |               |               |               |               |
| <i>Larix decidua</i>           |               |               |               |               |               |               |              |              | r             | r             | r            | r             |               |               |               |               |
| <i>Picea abies</i>             | +             | 1             | 1             | 1-2           | 1-2           | 1-2           | 2            | 2            | 2             | 2             | 2            | 2             | 2             | 2             | 2             | 2             |
| <i>Populus tremula</i>         |               |               |               |               |               |               |              | r            |               |               |              |               |               |               |               |               |
| <i>Rubus idaeus</i>            |               |               | r             | +             | +             | +             | +            | +            | +             | + -1          | + -1         | +             | (+)           | (+)           | (+)           | (r)           |
| <i>Senecio ovatus</i>          |               |               |               | r             | r             |               |              |              |               |               |              |               |               |               |               |               |
| <i>Sorbus aucuparia</i>        |               | +             | +             | +             | +             | +             | +            | +            | +             | +             | + -1         | +             | +             | +             | +             | +             |
| <i>Vaccinium myrtillus</i>     | 2             | 3             | 3             | 3-4           | 3-4           | 3-4           | 3            | 3-4          | 3-4           | 3-4           | 3-4          | 3-4           | 4             | 4             | 4-5           | 5             |
| <i>Vaccinium vitis-idaea</i>   | +             | +             | + -1          | + -1          | + -1          | +             | +            | + -1         | +             | +             | +            | +             | +             | +             | +             | +             |

Comments:

2010 - fine branches of the dead trees are falling

2011 - dead trees have broken tops, wood volume on the soil surface is growing

2013 - extra high volume of broken wood on the soil surface  
2016 - prevailing part of the dead trees is broken

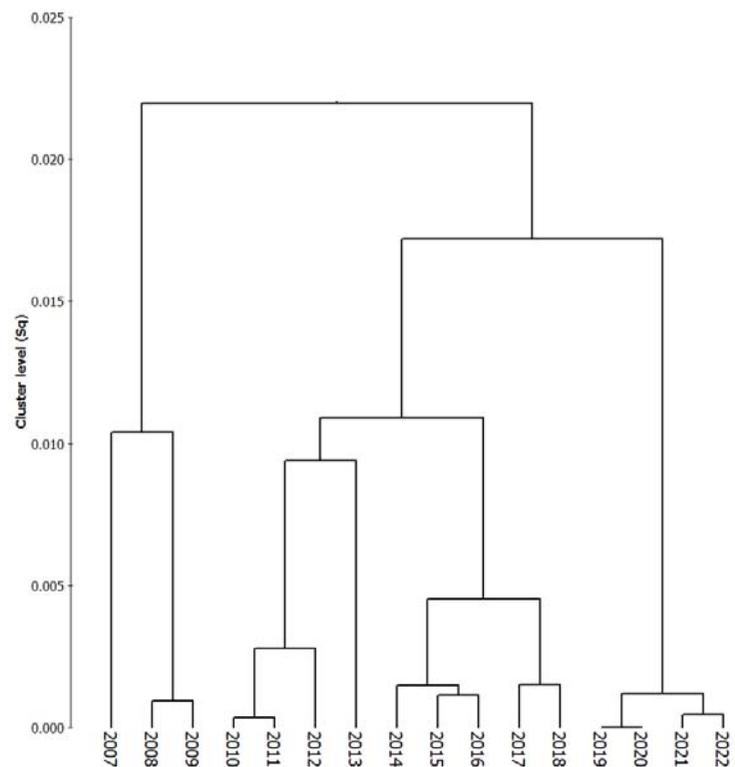


Fig. 6. Constrained clustering of relevés of the plot PJ4 by the procedure HSCA/Sq

Table 6. Plant community in the plot P19

| Column                         | 1       | 2       | 3       | 4       | 5       | 6       | 7    | 8     | 9     | 10            | 11           | 12           | 13           | 14            | 15           | 16            | 17            | 18            | 19            | 20            |       |     |
|--------------------------------|---------|---------|---------|---------|---------|---------|------|-------|-------|---------------|--------------|--------------|--------------|---------------|--------------|---------------|---------------|---------------|---------------|---------------|-------|-----|
| Relevé                         |         |         |         |         |         |         |      | 51/10 | 30/11 | 27/12         | 7/13         | 21/14        | 81/15        | 5/16          | 13/17        | 48/18         | 12/19         | 32/20         | 11/21         | 21/22         |       |     |
| Date                           | 1997    | 1998    | 2002    | 2004    | 2005    | 2007    | 2009 | 2010  | 2011  | 15.8.<br>2012 | 1.8.<br>2013 | 8.8.<br>2014 | 6.8.<br>2015 | 26.7.<br>2016 | 7.8.<br>2017 | 24.7.<br>2018 | 23.7.<br>2019 | 28.7.<br>2020 | 21.7.<br>2021 | 25.7.<br>2022 |       |     |
| Cover grade                    | ZI      | ZI      | ZI      | ZI      | ZI      | ZI      | ZI   | Br-BI | Br-BI | Br-BI         | Br-BI        | Br-BI        | Br-BI        | Br-BI         | Br-BI        | Br-BI         | Br-BI         | Br-BI         | Br-BI         | Br-BI         | Br-BI |     |
| Cover of E <sub>3</sub> (%)    | 65      | 65      | 45      | 45      | 45      | 40      | 1    | 1     | 1     | 1             | 1            | 1            | 1            | 1             | 1            | 1             | 1             | 1             | 1             | 1             | 1     |     |
| Cover of E <sub>2</sub> (%)    |         |         |         |         |         |         | 1    | 2     | 2     | 2             | 2            | 2            | 3            | 3             | 3            | 3             | 5             | 5             | 8             | 10            |       |     |
| Cover of E <sub>1</sub> (%)    |         |         |         |         |         |         | 75   | 85    | 85    | 90            | 90           | 80           | 85           | 85            | 85           | 85            | 85            | 85            | 85            | 90            |       |     |
| Cover of E <sub>0</sub> (%)    |         |         |         |         |         |         |      | 60    | 60    | 60            | 40           | 40           | 40           | 40            | 40           | 40            | 40            | 40            | 40            | 35            |       |     |
| E <sub>3</sub> :               |         |         |         |         |         |         |      |       |       |               |              |              |              |               |              |               |               |               |               |               |       |     |
| <i>Picea abies</i>             | 60%/10% | 60%/10% | 40%/10% | 40%/10% | 40%/10% | (40)/5% | +    | +     | +     | +             | +            | +            | +            | +             | +            | +             | 90%           | 95%           | 100%          | 100%          | 100%  |     |
| <i>Sorbus aucuparia</i>        | +       | +       |         |         |         |         |      |       |       |               |              |              |              |               |              |               | 10%           | 5%            |               |               |       |     |
| E <sub>2</sub> :               |         |         |         |         |         |         |      |       |       |               |              |              |              |               |              |               |               |               |               |               |       |     |
| <i>Picea abies</i>             | 10%     | 10%     | 10%     | 10%     | 10%     | 5%      | -    | 70%   | 65%   | 65%           | 65%          | 65%          | 65%          | 65%           | 65%          | 65%           | 65%           | 65%           | 70%           | 70%           | 70%   | 70% |
| <i>Sorbus aucuparia</i>        | 5%      | 5%      | 5%      | 5%      | 5%      | 10%     | -    | 30%   | 35%   | 35%           | 35%          | 35%          | 35%          | 35%           | 35%          | 35%           | 35%           | 35%           | 30%           | 30%           | 30%   | 30% |
| <i>Betula pubescens</i>        |         |         |         |         |         |         |      |       |       |               |              |              |              |               |              |               |               |               |               |               |       | r   |
| E <sub>1</sub> :               |         |         |         |         |         |         |      |       |       |               |              |              |              |               |              |               |               |               |               |               |       |     |
| <i>Athyrium distentifolium</i> | 1       | 1       | +2      | 1       | 1       | +2      | -/+  | +1    | +     | +             | +            | 1            | 1            | 1             | +            | +             | 1             | +             | 1             | 1             | 1     |     |
| <i>Avenella flexuosa</i>       |         |         |         |         |         |         |      |       |       |               |              | r            | r            | r             | +            | r             | r             | r             | r             | r             | r     |     |
| <i>Betula pubescens</i>        |         |         |         |         |         |         |      |       |       | r             |              | r            | r            | r             |              |               |               |               |               | r             | r     |     |
| <i>Calamagrostis villosa</i>   |         |         |         |         |         |         |      | r     | r     |               |              | r            | r            | r             |              |               | r             | r             | r             | r             |       |     |
| <i>Dryopteris dilatata</i>     | 1       |         | +       | +       | -       | +       | -    | 1     | 1-2   | 1-2           | 1-2          | +            | +            | +             | +            | +             | +             | +             | +             |               |       |     |
| <i>Epilobium angustifolium</i> |         |         |         |         |         |         |      | -     | +     | +1            | 1            | +1           | 1            | 1-2           | +1           | +1            | 1             | +1            | +             | +             | +     |     |
| <i>Epilobium montanum</i>      |         |         |         |         |         |         |      |       |       | r             |              |              |              |               |              |               |               |               |               |               |       |     |
| <i>Galium saxatile</i>         |         |         |         |         |         |         |      | -     |       |               |              |              |              |               |              |               |               |               |               |               |       |     |
| <i>Picea abies</i>             | +/+     | 1/+     | +/+     | -       | +       | +       | +    | +     | +     | +             | +1           | +            | 1            | 1             | 1            | 1             | 1             | 1             | 1             | 1-2           | 1     |     |
| <i>Pinus mugo</i>              |         | +       |         | 1       | 1       | +       |      |       |       |               |              |              |              |               |              |               |               |               |               |               |       |     |
| <i>Rubus idaeus</i>            |         |         |         |         |         |         |      |       |       |               |              | +            | r            | r             | +            | +1            | +             | +1            | +1            | +1            | +1    |     |
| <i>Sorbus aucuparia</i>        |         | +       |         | -       |         |         | +1   | r     | +     | +             | +            | +            | +            | +             | +1           | +1            | +             | +             | +             | +             | +     |     |
| <i>Vaccinium myrtillus</i>     | -5      | +5      | +5      | -5      | +5      | +5      | -4   | 4-5   | 4-5   | 4-5           | 4-5          | 4-5          | 4-5          | 4-5           | 4-5          | 4-5           | 5             | 5             | 5             | 5             | 5     |     |
| <i>Vaccinium vitis-idaea</i>   | 1       | +2      | 1       | 1       | -2      | 1       | -2   | 2     | 2     | 2             | 2            | 2            | 1-2          | 1-2           | 1-2          | 2             | 1-2           | 1-2           | 1-2           | 1-2           | 1-2   |     |

Comments:

2013 - *Vaccinium myrtillus* partly with dead leaves, mainly at affected spots, probably as a result of last spring frost  
2014 - *V. myrtillus* heavily damaged by insect rot, with dry tops  
2017 - *V. myrtillus* and *V. vitis-idaea* are highly fertile  
2018 - most of dead trees is broken  
Cover grade ZI - according to Zlatník (relevés were recorded by J. Viewegh), Br-BI - according to Braun-Blanquet

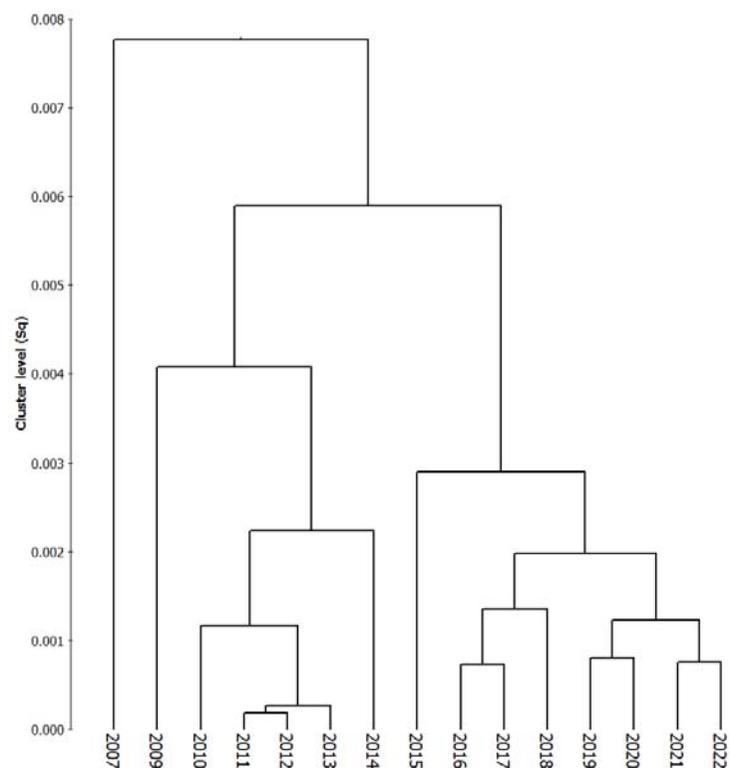


Fig. 7. Constrained clustering of relevés of the plot P19 by the procedure HSCA/Sq

Table 7. Plant community in the plot P20

| Column                         | 1          | 2          | 3          | 4          | 5          | 6          | 7             | 8    | 9             | 10            | 11           | 12           | 13            | 14            | 15           | 16            | 17            | 18            | 19            | 20            |
|--------------------------------|------------|------------|------------|------------|------------|------------|---------------|------|---------------|---------------|--------------|--------------|---------------|---------------|--------------|---------------|---------------|---------------|---------------|---------------|
| Relevé                         |            |            |            |            |            |            | 106/08        |      | 30/11         | 26/12         | 8/13         | 22/14        | 71/15         | 4/16          | 11/17        | 50/18         | 13/19         | 34/20         | 8/21          | 20/22         |
| Date                           | 1997       | 1998       | 2002       | 2004       | 2005       | 2007       | 30.7.<br>2008 | 2009 | 10.8.<br>2011 | 15.8.<br>2012 | 1.8.<br>2013 | 8.8.<br>2014 | 24.7.<br>2015 | 26.7.<br>2016 | 7.8.<br>2017 | 25.7.<br>2018 | 23.7.<br>2019 | 28.7.<br>2020 | 21.7.<br>2021 | 25.7.<br>2022 |
| Cover grade                    | Z1         | Z1         | Z1         | Z1         | Z1         | Z1         | Br-B1         | Z1   | Br-B1         | Br-B1         | Br-B1        | Br-B1        | Br-B1         | Br-B1         | Br-B1        | Br-B1         | Br-B1         | Br-B1         | Br-B1         | Br-B1         |
| Cover of E <sub>3</sub> (%)    | 30         | 30         | 40         | 40         | 40         | 40         | 20            | 1    | 1             | 1             | 1            | 1            | 1             | 1             | 0            | 0             | 0             | 0             | 0             | 0             |
| Cover of E <sub>2</sub> (%)    |            |            |            |            |            |            | 5             | 8    | 10            | 15            | 15           | 15           | 15            | 15            | 15           | 15            | 15            | 15            | 20            | 20            |
| Cover of E <sub>1</sub> (%)    | 1          | 1          | 1          | 1          | 1          | 1          | 80            | 80   | 85            | 90            | 95           | 95           | 95            | 95            | 95           | 95            | 95            | 95            | 95            | 95            |
| Cover of E <sub>0</sub> (%)    |            |            |            |            |            |            |               |      |               | 20            | 15           | 15           | 15            | 15            | 20           | 20            | 15            | 15            | 20            | 20            |
| E <sub>3</sub> :               |            |            |            |            |            |            |               |      |               |               |              |              |               |               |              |               |               |               |               |               |
| <i>Picea abies</i>             | 30%/<br>5% | 30%/<br>5% | 40%/<br>5% | 40%/<br>5% | 40%/<br>5% | 40%/<br>5% | 100%          | +    | +             | +             | +            | +            | +             | +             |              |               |               |               |               |               |
| E <sub>2</sub> :               |            |            |            |            |            |            |               |      |               |               |              |              |               |               |              |               |               |               |               |               |
| <i>Picea abies</i>             | 5%         | 5%         | 30%        | 30%        | 30%        | 20%        | 40%           | +    | 35%           | 35%           | 35%          | 35%          | 30%           | 35%           | 40%          | 40%           | 40%           | 45%           | 50%           | 55%           |
| <i>Sorbus aucuparia</i>        | 5%         | 5%         | 5%         | 5%         | 5%         | +          | 60%           | 5%   | 65%           | 65%           | 65%          | 65%          | 70%           | 65%           | 60%          | 60%           | 60%           | 55%           | 50%           | 45%           |
| E <sub>1</sub> :               |            |            |            |            |            |            |               |      |               |               |              |              |               |               |              |               |               |               |               |               |
| <i>Athyrium distentifolium</i> | -2/<br>+3  | 1/<br>+4   | +3         | +3         | -4         | +/-<br>-2  | 1             | +    | +             | 1             | 1            | 1-2          | 1             | 1             | 1            | 1             | 2             | 2-3           | 2-3           | 2-3           |
| <i>Avenella flexuosa</i>       | +4/<br>-5  | +5         | +4         | -4         | -4         | +3         | 3             | +2   | 1             | 2             | 2-3          | 2            | 2-3           | 2-3           | 2-3          | 2             | 1-2           | 2             | 2             | 2             |
| <i>Betula pubescens</i>        |            |            |            |            |            |            |               | r    |               |               |              |              |               |               |              |               |               |               |               |               |
| <i>Calamagrostis villosa</i>   | -2         | 1          | 1          | -2         | -2         | +2         | 1             | +1   | 1-2           | 1             | 2            | 2            | 2             | 2             | 2-3          | 2-3           | 3             | 2-3           | 2-3           | 2-3           |
| <i>Dryopteris dilatata</i>     | 1/-2       | +2         | 1          | +2         | +2         | -2         | 2             | 1    | 2             | 2             | 2            | 2            | 2             | 2             | 1-2          | 1-2           | +             |               |               |               |
| <i>Epilobium angustifolium</i> |            |            |            |            |            |            |               |      | +1            | 1-2           | 2            | 1-2          | 2             | 1             | +1           | 1-2           | +1            | 1             | +             | +1            |
| <i>Epilobium ciliatum</i>      |            |            |            |            |            |            |               |      |               | r             |              |              |               |               |              |               |               |               |               |               |
| <i>Epilobium montanum</i>      |            |            |            |            |            |            |               |      | r             | r             |              |              | r             | r             |              |               |               |               |               |               |
| <i>Fagus sylvatica</i>         |            |            |            |            |            |            |               |      |               |               |              |              |               |               | r            |               |               |               |               |               |
| <i>Galium saxatile.</i>        |            |            |            |            |            |            |               |      |               |               |              |              |               | r             |              |               | r             |               | +             |               |
| <i>Homogyne alpina</i>         | 1          | -2         | 1          | 1          | -2         | +1         | +1            | -    | 1             | 1             | 1            | 1            | 1             | +1            | +            | +             |               | r             | r             | r             |
| <i>Luzula sylvatica</i>        |            | 1          | +          | -2         | -2         | -2         | 1             | +    | +             | +             | +            | +            | +             | +             | +            | +             | +             | +             | r             | r             |
| <i>Oxalis acetosella</i>       | 1          | -2         | -3         | +3         | +3         | -2         | +             | -3   | 2             | 2             | 1            | +            | +             | +             | +            | +             | +             | r             | +             | +             |
| <i>Picea abies</i>             | -2/1       | +2         | +3/1       | +/-        | 1/-2       | 1/1        | +1            | +    | +1            | +1            | +            | +            | +             | +             | +1           | 1             | +1            | 1-2           | 1             | 1             |
| <i>Rubus idaeus</i>            |            |            |            |            |            |            |               | -/+  | +             | +1            | +            | +1           | +             | +1            | +1           | 1-2           | 1             | 1             | 1-2           | 2             |
| <i>Salix caprea</i>            |            |            |            |            |            |            |               |      | r             |               |              |              |               |               |              |               |               |               |               |               |
| <i>Senecio ovatus</i>          |            |            |            |            |            |            |               |      | +             | +             |              | r            |               |               |              | +1            |               |               | r             |               |

| Column                     | 1  | 2  | 3   | 4   | 5    | 6   | 7  | 8  | 9 | 10 | 11 | 12 | 13 | 14 | 15  | 16  | 17  | 18  | 19 | 20 |
|----------------------------|----|----|-----|-----|------|-----|----|----|---|----|----|----|----|----|-----|-----|-----|-----|----|----|
| <i>Soldanella montana</i>  |    |    |     |     |      |     |    | -  |   |    |    |    |    |    |     |     |     |     |    |    |
| <i>Solidago virgaurea</i>  | -  |    |     |     |      |     |    |    |   |    |    |    |    |    |     |     |     |     |    |    |
| <i>Sorbus aucuparia</i>    |    | +  | +/+ | +/+ | +/+1 | 1/- | +1 | +  | 1 | +1 | +  | +  | +1 | +  | +1  | 1   | 1   | 1   | 1  | 1  |
| <i>Trientalis europaea</i> |    |    | -   |     |      | 1   |    | -  | r | +  | +  | +  | +  | +  | +   | +   | 1-2 | 1   | 1  | +  |
| <i>Vaccinium myrtillus</i> | -2 | +3 | +3  | +3  | +3   | +3  | 2  | +2 | 2 | 2  | 2  | 2  | 3  | 3  | 2-3 | 2-3 | 2   | 2-3 | 3  | 4  |

Comments:

2022 - *Luzula sylvatica* and *Trientalis europaea* are damaged by dry

Cover grade ZI - according to Zlatník (relevés were recorded by J. Viewegh), Br-BI - according to Braun-Blanquet

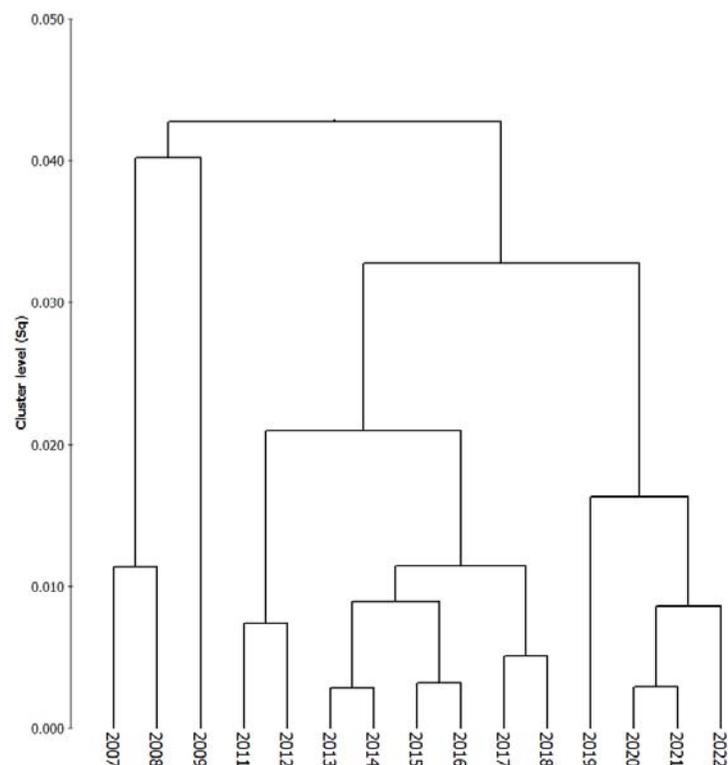


Fig. 8. Constrained clustering of relevés of the plot P20 by the procedure HSCA/Sq



Table 8. Plant community in the plot CU

| Column                         | 1             | 2            | 3             | 4             | 5             | 6            | 7            | 8             | 9             | 10           | 11            | 12            | 13           | 14           | 15            | 16           |
|--------------------------------|---------------|--------------|---------------|---------------|---------------|--------------|--------------|---------------|---------------|--------------|---------------|---------------|--------------|--------------|---------------|--------------|
| Relevé                         | 110/07        | 112/08       | 115/09        | 58/10         | 31/11         | 18/12        | 10/13        | 15/14         | 73/15         | 7/16         | 18/17         | 57/18         | 16/19        | 36/20        | 13/21         | 29/22        |
| Date                           | 29.8.<br>2007 | 5.8.<br>2008 | 17.8.<br>2009 | 23.8.<br>2010 | 17.8.<br>2011 | 8.8.<br>2012 | 6.8.<br>2013 | 25.7.<br>2014 | 30.7.<br>2015 | 8.8.<br>2016 | 15.8.<br>2017 | 31.7.<br>2018 | 6.8.<br>2019 | 6.8.<br>2020 | 27.7.<br>2021 | 3.8.<br>2022 |
| Area (m <sup>2</sup> )         | 400           | 400          | 400           | 400           | 400           | 400          | 400          | 400           | 400           | 400          | 400           | 400           | 400          | 400          | 400           | 400          |
| Cover of E <sub>3</sub> (%)    | 30            | 25           | 20            | 20            | 20            | 20           | 20           | 20            | 20            | 15           | 15            | 0             | 0            | 0            | 0             | 0            |
| Cover of E <sub>2</sub> (%)    | 0             | 0            | 0.1           | 0.1           | 0.1           | 0.1          | 0.1          | 0.1           | 0.1           | 0.1          | 0.1           | 3             | 0.5          | 0.5          | 1             | 1            |
| Cover of E <sub>1</sub> (%)    | 85            | 85           | 85            | 85            | 85            | 90           | 90           | 90            | 85            | 80           | 85            | 65            | 75           | 80           | 80            | 90           |
| Cover of E <sub>0</sub> (%)    | 20            | 30           | 35            | 35            | 40            | 40           | 40           | 40            | 40            | 30           | 35            | 5             | 10           | 10           | 10            | 5            |
| E <sub>3</sub> :               |               |              |               |               |               |              |              |               |               |              |               |               |              |              |               |              |
| <i>Picea abies</i>             | 100%          | 100%         | 100%          | 100%          | 100%          | 100%         | 100%         | 100%          | 100%          | 100%         | 100%          |               |              |              |               |              |
| E <sub>2</sub> :               |               |              |               |               |               |              |              |               |               |              |               |               |              |              |               |              |
| <i>Betula pubescens</i>        |               |              |               |               |               |              |              |               |               |              |               |               |              | r            | r             | r            |
| <i>Picea abies</i>             |               |              |               |               |               |              |              | r             | r             | r            | r             | 80%           | 80%          | 50%          | 60%           | 80%          |
| <i>Sorbus aucuparia</i>        |               |              | r             | r             | r             | r            | r            | r             | r             | r            | r             | 20%           | 20%          | 50%          | 40%           | 20%          |
| E <sub>1</sub> :               |               |              |               |               |               |              |              |               |               |              |               |               |              |              |               |              |
| <i>Avenella flexuosa</i>       | 3             | 3-4          | 3-4           | 4             | 4             | 4            | 4            | 4             | 4             | 3-4          | 4             | 2             | 4            | 4            | 4             | 4            |
| <i>Betula pubescens</i>        |               |              |               |               |               |              |              | r             | r             |              | r             | (r)           | r            |              |               | r            |
| <i>Calamagrostis villosa</i>   | 2-3           | 2-3          | 2-3           | 2             | 2             | 2            | 2-3          | 2             | 2-3           | 2            | 2             | 3             | 2            | 2            | 2             | 3            |
| <i>Dryopteris dilatata</i>     | 1             | 1-2          | 1             | +1            | +1            | 1            | 1            | 1             | 1             | 1            | 1             | 1             | 1            | +            | 1             | 1            |
| <i>Epilobium angustifolium</i> |               |              |               |               |               |              |              |               |               | r            | +             | +             | r            | r            | 1             | 1            |
| <i>Luzula sylvatica</i>        | +             | +            | +             | +             | +             | +1           | +1           | +1            | +             | r+           | r             | +1            | +            | +            | +             | +1           |
| <i>Lycopodium annotinum</i>    | +             | +            | +             | r+            | r+            | +            | +            | r             | r+            | r+           | r             | (r)           |              |              |               | r            |
| <i>Oxalis acetosella</i>       |               |              | r             |               |               |              |              |               |               |              |               |               |              |              |               |              |
| <i>Picea abies</i>             |               |              | r             | r             | r             | +            | +            | +             | r+            | r+           | +             | 1             | +1           | +            | 1             | +            |
| <i>Pinus sylvestris</i>        |               |              |               |               |               |              |              |               |               |              |               |               |              |              |               | r            |
| <i>Rubus idaeus</i>            |               |              |               | r             | r             | r            | r            | r             | r             | r            | +             |               | r            | r            | +             | +            |
| <i>Sorbus aucuparia</i>        | r             | r            | r             | r             | r             | r            | r            | r             | r             | r            | r             | r             | r            | r            | r             | r            |
| <i>Vaccinium myrtillus</i>     |               |              |               | r             | r             | r            | r            | +             | r             | r            | +             | +             | +            | +            | r             | r            |

## Comments:

2008 - Stand is damaged with uprooting, completely destroyed stands in the vicinity.

2009 - Remediation of dead tree wood was carried out.

2012 - Norway spruce shows slowly increase of regeneration; *Lycopodium annotinum* regenerate after preceeding deaing.

2014 - Number of tree uprootings and breaks is increasing. *Lycopodium annotinum* is heavily damaged again (the same situation is visible in the catchment)

2015 - Carried out remediation of dead trees (debarking, cutting for removal); *Lycopodium annotinum* is heavily dying.

2016 - Severe damage by the spruce bark beetle starting from the opening of the stand - a strip of damage passes through the center of the plot, a number of trees are cut down and stripped of bark.

2017 - Number of uprootings on part of the plot.

2018 - The stand of the plot is completely destroyed by wind. Relevé was recorded on fully-comparable substitute plot of cca 60 m distant.

2019 - Relevé on the original plot. *Avenella flexuosa* is remarkably fertile.

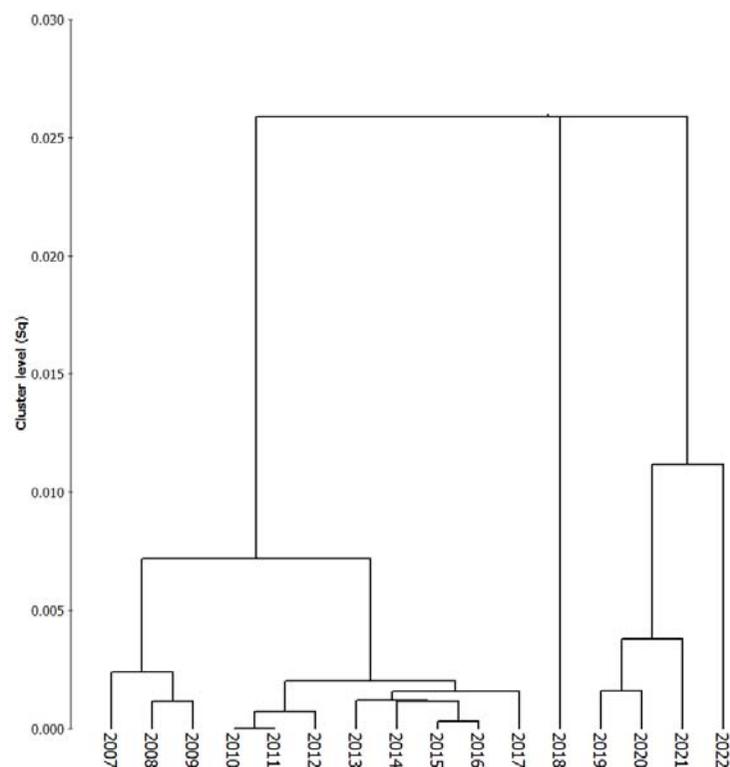


Fig. 9. Constrained clustering of relevés of the plot CU by the procedure HSCA/Sq

Table 9. Plant community in the plot CL

| Column                         | 1             | 2            | 3             | 4             | 5             | 6            | 7            | 8             | 9             | 10           | 11            | 12            | 13           | 14           | 15            | 16           |     |
|--------------------------------|---------------|--------------|---------------|---------------|---------------|--------------|--------------|---------------|---------------|--------------|---------------|---------------|--------------|--------------|---------------|--------------|-----|
| Relevé                         | 112/07        | 114/08       | 116/09        | 59/10         | 32/11         | 19/12        | 11/13        | 16/14         | 74/15         | 8/16         | 19/17         | 58/18         | 17/19        | 37/20        | 14/21         | 31/22        |     |
| Date                           | 29.8.<br>2007 | 5.8.<br>2008 | 17.8.<br>2009 | 23.8.<br>2010 | 17.8.<br>2011 | 8.8.<br>2012 | 6.8.<br>2013 | 25.7.<br>2014 | 30.7.<br>2015 | 8.8.<br>2016 | 15.8.<br>2017 | 31.7.<br>2018 | 6.8.<br>2019 | 6.8.<br>2020 | 27.7.<br>2021 | 3.8.<br>2022 |     |
| Area (m <sup>2</sup> )         | 400           | 400          | 400           | 400           | 400           | 400          | 400          | 400           | 400           | 400          | 400           | 400           | 400          | 400          | 400           | 400          |     |
| Cover of E <sub>3</sub> (%)    | 30            | 30           | 30            | 35            | 35            | 35           | 35           | 35            | 35            | 35           | 35            | 35            | 35           | 30           | 30            | 25           | 30  |
| Cover of E <sub>2</sub> (%)    | 0             | 0            | 0             | 0.1           | 0.2           | 0.2          | 0.2          | 0.2           | 0.2           | 0.2          | 0.2           | 0.2           | 0.2          | 0.2          | 0.2           | 0.5          | 0.5 |
| Cover of E <sub>1</sub> (%)    | 50            | 55           | 55            | 55            | 55            | 50           | 50           | 50            | 50            | 55           | 65            | 70            | 70           | 70           | 70            | 70           |     |
| Cover of E <sub>0</sub> (%)    | 35            | 30           | 30            | 30            | 30            | 35           | 40           | 40            | 40            | 40           | 40            | 40            | 40           | 40           | 40            | 40           |     |
| E <sub>3</sub> :               |               |              |               |               |               |              |              |               |               |              |               |               |              |              |               |              |     |
| <i>Abies alba</i>              | 5%            | 5%           | 5%            | 5%            | 5%            | 5%           | 5%           | 5%            | 5%            | 5%           | 5%            | 5%            | 5%           | 5%           | 5%            | 5%           |     |
| <i>Fagus sylvatica</i>         | 5%            | 5%           | 5%            | 5%            | 5%            | 9%           | 9%           | 9%            | 9%            | 9%           | 9%            | 9%            | 9%           | 9%           | 5%            | 10%          |     |
| <i>Picea abies</i>             | 89%           | 89%          | 89%           | 89%           | 89%           | 85%          | 85%          | 85%           | 85%           | 85%          | 85%           | 85%           | 85%          | 85%          | 90%           | 85%          |     |
| <i>Sorbus aucuparia</i>        | 1%            | 1%           | 1%            | 1%            | 1%            | 1%           | 1%           | 1%            | 1%            | 1%           | 1%            | 1%            | 1%           | 1%           | r             | r            |     |
| E <sub>2</sub> :               |               |              |               |               |               |              |              |               |               |              |               |               |              |              |               |              |     |
| <i>Abies alba</i>              |               |              |               |               |               |              |              |               |               |              | +             | + -1          | + -1         | + -1         | + -1          | + -1         |     |
| <i>Fagus sylvatica</i>         |               |              |               |               |               |              |              |               |               |              | r             | r             | r            | r            |               |              |     |
| <i>Picea abies</i>             |               |              |               |               |               |              |              |               |               |              |               | +             | +            | + -1         | + -1          | l            |     |
| <i>Sorbus aucuparia</i>        |               |              |               | r             | +             | +            | +            | +             | +             | +            | +             | + -1          | +            | +            | r             | r            |     |
| E <sub>1</sub> :               |               |              |               |               |               |              |              |               |               |              |               |               |              |              |               |              |     |
| <i>Abies alba</i>              | +             | +            | +             | +             | +             | r - +        | +            | +             | +             | +            | +             | +             | +            | +            | r             | +            |     |
| <i>Avenella flexuosa</i>       | 1 - 2         | 1            | 1             | +             | +             | +            | +            | +             | +             | +            | r - +         | r             | r            | +            | +             |              |     |
| <i>Calamagrostis villosa</i>   |               |              |               |               |               | r            |              |               |               |              |               |               |              |              |               |              |     |
| <i>Dryopteris dilatata</i>     | + - 1         | + - 1        | + - 1         | +             | +             | +            | +            | +             | +             | +            | +             | +             |              |              | r             |              |     |
| <i>Epilobium angustifolium</i> |               |              | r             |               |               |              |              |               |               |              |               |               |              |              |               |              |     |
| <i>Fagus sylvatica</i>         | +             |              | r             |               |               |              |              |               |               | r            | r             |               | r            |              |               |              |     |
| <i>Lycopodium annotinum</i>    |               |              | (+)           | (+)           | (+)           | (+)          | (+)          |               |               |              | r             | r             | r            |              |               |              |     |
| <i>Picea abies</i>             | +             | +            | +             | +             | +             | + - 1        | + - 1        | + - 1         | + - 1         | + - 1        | + - 1         | + - 1         | + - 1        | + - 1        | +             | 1 - 2        |     |
| <i>Rubus idaeus</i>            | r             |              |               | r             | r             |              |              |               |               |              |               |               |              |              |               |              |     |
| <i>Sorbus aucuparia</i>        | +             | +            | +             | + - 1         | +             | +            | +            | +             | + - 1         | + - 1        | +             | +             | +            | +            | +             | +            |     |
| <i>Vaccinium myrtillus</i>     | 4             | 4            | 4             | 4             | 4             | 4            | 4            | 4             | 4             | 4            | 4 - 5         | 4 - 5         | 4 - 5        | 4 - 5        | 4 - 5         | 4 - 5        |     |
| <i>Vaccinium vitis-idaea</i>   |               | r            |               |               |               |              |              |               |               |              |               |               |              |              |               |              |     |

Comments:

- 2011 - *Lycopodium annotinum* is dying.
- 2012 - *Vaccinium myrtillus* with expressible defoliation, probably as result of the last frost
- 2013 - *Vaccinium myrtillus* is not fertile.
- 2014 - Fertility of *V. myrtillus* is still low.
- 2017 - *V. myrtillus* shows regeneration.
- 2019 - Tree uprooting is frequent, bark beetle infestation is evident
- 2021 - Stand is lighted, clearcut in the vicinity, *V. myrtillus* is damaged (defoliation, not fertile)
- 2022 - spruce is heavy attacked by bark beetle, *Vaccinium myrtillus* has high defoliation

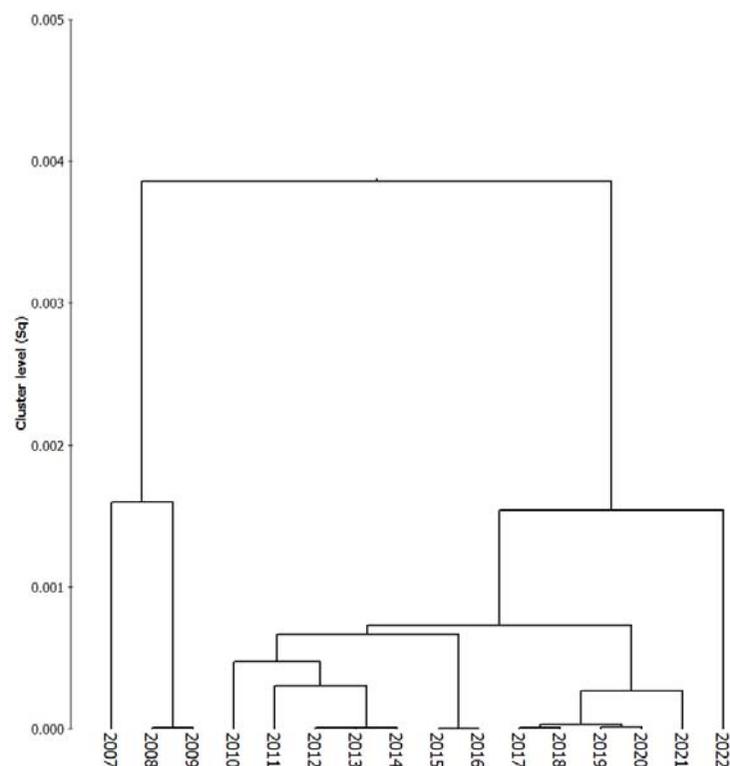


Fig. 10. Constrained clustering of relevés of the plot CL by the procedure HSCA/Sq

Table 10. Plant community in the plot C1

| Column                       | 1             | 2            | 3             | 4             | 5             | 6            | 7            | 8             | 9             | 10           | 11            | 12            | 13           | 14           | 15            | 16           |    |
|------------------------------|---------------|--------------|---------------|---------------|---------------|--------------|--------------|---------------|---------------|--------------|---------------|---------------|--------------|--------------|---------------|--------------|----|
| Relevé                       | 111/07        | 113/08       | 117/09        | 60/10         | 33/11         | 20/12        | 12/13        | 17/14         | 75/15         | 9/16         | 20/17         | 59/18         | 18/19        | 38/20        | 15/21         | 30/22        |    |
| Date                         | 29.8.<br>2007 | 5.8.<br>2008 | 17.8.<br>2009 | 23.8.<br>2010 | 17.8.<br>2011 | 8.8.<br>2012 | 6.8.<br>2013 | 25.7.<br>2014 | 30.7.<br>2015 | 8.8.<br>2016 | 15.8.<br>2017 | 31.7.<br>2018 | 6.8.<br>2019 | 6.8.<br>2020 | 27.7.<br>2021 | 3.8.<br>2022 |    |
| Area (m <sup>2</sup> )       | 400           | 400          | 400           | 400           | 400           | 400          | 400          | 400           | 400           | 400          | 400           | 400           | 400          | 400          | 400           | 400          |    |
| Cover of E <sub>3</sub> (%)  | 55            | 45           | 45            | 45            | 45            | 45           | 45           | 45            | 45            | 45           | 45            | 45            | 45           | 40           | 35            | 1            |    |
| Cover of E <sub>2</sub> (%)  | 0             | 0            | 0.1           | 0.5           | 0.5           | 0.5          | 0.5          | 0.5           | 1             | 1            | 3             | 5             | 7            | 10           | 10            | 5            |    |
| Cover of E <sub>1</sub> (%)  | 50            | 40           | 45            | 45            | 45            | 45           | 45           | 45            | 45            | 45           | 45            | 50            | 50           | 50           | 50            | 35           |    |
| Cover of E <sub>0</sub> (%)  | 20            | 15           | 15            | 15            | 15            | 20           | 20           | 20            | 20            | 20           | 20            | 15            | 15           | 15           | 15            | 5            |    |
| E <sub>3</sub> :             |               |              |               |               |               |              |              |               |               |              |               |               |              |              |               |              |    |
| <i>Abies alba</i>            | 10%           | 5%           | 5%            | 5%            | 5%            | 5%           | 5%           | 5%            | 5%            | 5%           | 5%            | 5%            | 5%           | 5%           | 5%            |              |    |
| <i>Fagus sylvatica</i>       | 30%           | 30%          | 30%           | 30%           | 30%           | 30%          | 30%          | 30%           | 30%           | 30%          | 30%           | 30%           | 35%          | 30%          | 30%           | 50%          |    |
| <i>Picea abies</i>           | 60%           | 65%          | 65%           | 65%           | 65%           | 65%          | 65%          | 65%           | 65%           | 65%          | 65%           | 65%           | 60%          | 65%          | 65%           | 50%          |    |
| E <sub>2</sub> :             |               |              |               |               |               |              |              |               |               |              |               |               |              |              |               |              |    |
| <i>Abies alba</i>            |               |              |               |               | r             | +            | +            | +             | +             | +            | +             | +             | +            | +1           | 1             | +1           | +1 |
| <i>Fagus sylvatica</i>       |               |              | r             | r             | r             | r            | r            | r             | r             |              |               |               |              |              |               |              |    |
| <i>Picea abies</i>           |               |              |               | r             | r             | r            | r            | r             | +             | +            | +1            | 1             | 1            | 1            | 1-2           | 1            |    |
| <i>Sorbus aucuparia</i>      |               |              |               | r             | r             | r            | r            | r             | +             | +            | +             | +             | +            | +            | r             | r            |    |
| E <sub>1</sub> :             |               |              |               |               |               |              |              |               |               |              |               |               |              |              |               |              |    |
| <i>Abies alba</i> *          | 1             | 1            | 1             | 1             | 1             | 1            | 1            | 1             | 1             | 1            | 1             | 1             | +1           | +1           | +             | +            |    |
| <i>Avenella flexuosa</i>     | 2-3           | 2            | 2             | 2             | 2             | 2            | 2            | 2             | 2             | 2            | 2             | 1-2           | 1-2          | 2            | 2             | 1            |    |
| <i>Blechnum spicant</i>      | r             |              |               | r             | r             | r            | r            | r             | r             | r            | r             | r             | r            | +            | r             |              |    |
| <i>Calamagrostis villosa</i> | 1             | 1-2          | 1             | 1             | 1-2           | 1-2          | 1-2          | 1-2           | 1-2           | 1-2          | 1-2           | 1-2           | 2            | 2            | 1-2           | 1            |    |
| <i>Carex canescens</i>       |               |              |               |               |               | r            |              |               |               |              |               |               |              |              |               |              |    |
| <i>Carex echinata</i>        |               |              |               |               |               | r            | r            |               |               |              |               |               |              |              |               |              |    |
| <i>Carex pilulifera</i>      |               |              |               |               |               | r            |              | r             |               |              |               |               |              |              |               |              |    |
| <i>Dryopteris dilatata</i>   | 1             | 1            | 1             | 1             | 1             | 1            | 1            | 1             | 1             | 1            | 1             | +1            | 1            | +            | +             | r            |    |
| <i>Fagus sylvatica</i>       | +             | +            | +             | r             |               | r            | +            | (r)           | r+            | r            | +             | r             | +            |              |               |              |    |
| <i>Homogyne alpina</i>       |               |              |               | r             | r             |              |              |               |               |              | r             |               |              |              |               |              |    |
| <i>Luzula sylvatica</i>      |               |              |               |               |               | r            |              |               |               |              |               |               |              |              |               |              |    |
| <i>Lycopodium annotinum</i>  | 1-2           | 1            | 1             | 1-2           | 1-2           | 1-2          | 1-2          | 1-2           | 2             | 2            | 2             | 2             | 2-3          | 2-3          | 2             |              |    |
| <i>Maianthemum bifolium</i>  |               |              |               | r             |               |              |              | r             | r             |              |               |               | r            |              |               |              |    |
| <i>Oxalis acetosella</i>     |               |              |               |               |               | r            |              |               |               |              |               |               |              |              |               |              |    |
| <i>Picea abies</i>           | +             | +            | +             | +             | +             | +            | +            | +             | +             | +1           | 1             | 1             | 1            | +1           | +             | +            |    |
| <i>Rubus idaeus</i>          |               | r            | +             |               | r             | r            |              | r             |               |              |               |               |              |              |               |              |    |

| Column                     | 1 | 2   | 3    | 4   | 5    | 6   | 7   | 8   | 9 | 10  | 11 | 12 | 13 | 14 | 15 | 16 |
|----------------------------|---|-----|------|-----|------|-----|-----|-----|---|-----|----|----|----|----|----|----|
| <i>Sorbus aucuparia</i>    | + | +   | + -1 | 1   | + -1 | +   | +   | +   | + | +   | +  | +  | +  | +  | +  | +  |
| <i>Vaccinium myrtillus</i> | 1 | 1-2 | 1-2  | 1-2 | 1-2  | 1-2 | 1-2 | 1-2 | 2 | 1-2 | 2  | 2  | 2  | 2  | 2  | 3  |

Comments:

\* Fir can be partly planted.

2008 - Timber was being brought across the area, thinnings were being harvested in the vicinity.

2010 - Underground vegetation is regenerating.

2021 - *Lycopodium annotinum* is damaged by cutting in near surrounding.

2022 - Intensive (sanitary?) cutting of prevailing part of trees with removal of wood, soil surface damage.

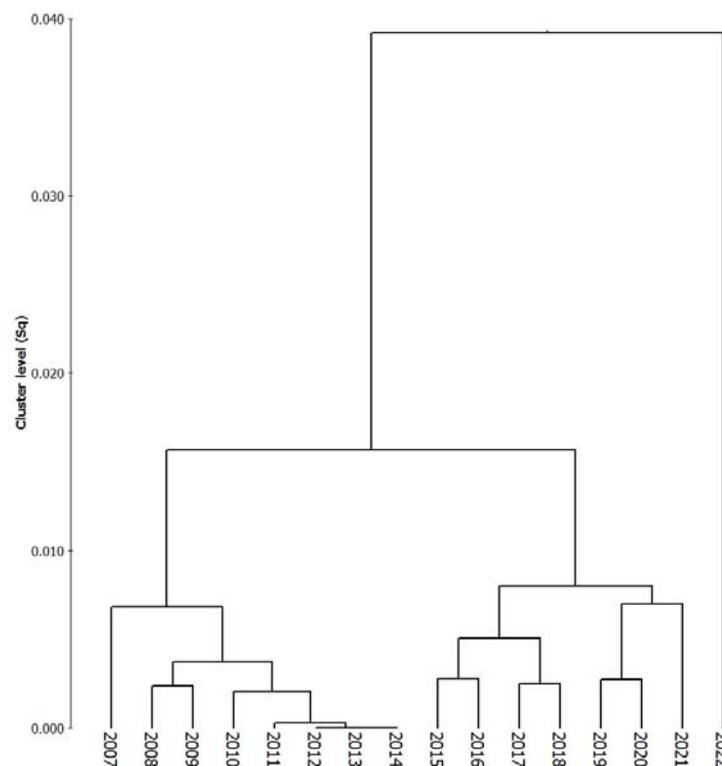


Fig. 11. Constrained clustering of relevés of the plot C1 by the procedure HSCA/Sq

Table 11. Plant community in the plot C2

| Column                        | 1             | 2            | 3             | 4             | 5            | 6             | 7             | 8            | 9             | 10            | 11           | 12           | 13            | 14           |
|-------------------------------|---------------|--------------|---------------|---------------|--------------|---------------|---------------|--------------|---------------|---------------|--------------|--------------|---------------|--------------|
| Relevé                        | 113/07        | 115/08       | 56/10         | 34/11         | 21/12        | 18/14         | 76/15         | 10/16        | 21/17         | 60/18         | 19/19        | 39/20        | 16/21         | 32/22        |
| Date                          | 29.8.<br>2007 | 5.8.<br>2008 | 23.8.<br>2010 | 17.8.<br>2011 | 8.8.<br>2012 | 25.7.<br>2014 | 30.7.<br>2015 | 8.8.<br>2016 | 15.8.<br>2017 | 31.7.<br>2018 | 6.8.<br>2019 | 6.8.<br>2020 | 27.7.<br>2021 | 3.8.<br>2022 |
| Area (m <sup>2</sup> )        | 400           | 400          | 400           | 400           | 400          | 400           | 400           | 400          | 400           | 400           | 400          | 400          | 400           | 400          |
| Cover of E <sub>3</sub> (%)   | 40            | 30           | 25            | 25            | 25           | 25            | 25            | 25           | 25            | 20            | 20           | 15           | 15            | 15           |
| Cover of E <sub>2</sub> (%)   | 25            | 25           | 30            | 30            | 30           | 30            | 30            | 30           | 30            | 30            | 30           | 30           | 30            | 40           |
| Cover of E <sub>1</sub> (%)   | 60            | 60           | 25            | 30            | 35           | 45            | 50            | 55           | 55            | 55            | 55           | 60           | 60            | 65           |
| Cover of E <sub>0</sub> (%)   | 30            | 30           | 30            | 30            | 30           | 30            | 30            | 30           | 30            | 30            | 30           | 40           | 40            | 40           |
| E <sub>3</sub> :              |               |              |               |               |              |               |               |              |               |               |              |              |               |              |
| <i>Abies alba</i>             | 10%           | 10%          | 10%           | 10%           | 10%          | 10%           | 10%           | 10%          | 10%           | 15%           | 15%          | 35%          | 35%           | 35%          |
| <i>Fagus sylvatica</i>        | 25%           | 25%          | 60%           | 60%           | 60%          | 60%           | 60%           | 60%          | 60%           | 70%           | 75%          | 60%          | 60%           | 60%          |
| <i>Picea abies</i>            | 65%           | 65%          | 30%           | 30%           | 30%          | 30%           | 30%           | 30%          | 30%           | 15%           | 10%          | 5%           | 5%            | 5%           |
| E <sub>2</sub> :              |               |              |               |               |              |               |               |              |               |               |              |              |               |              |
| <i>Abies alba</i>             |               | 5%           | 5%            | 5%            | 5%           | 5%            | 5%            | 5%           | 5%            | 5%            | 5%           | 5%           | 5%            | +            |
| <i>Fagus sylvatica</i>        |               | 5%           | 5%            | 5%            | 5%           | 5%            | 5%            | 5%           | 5%            | 5%            | 5%           | 5%           | 5%            | 5%           |
| <i>Picea abies</i>            | 70%           | 65%          | 85%           | 85%           | 85%          | 80%           | 80%           | 80%          | 80%           | 80%           | 80%          | 80%          | 80%           | 85%          |
| <i>Sorbus aucuparia</i>       | 30%           | 25%          | 5%            | 5%            | 5%           | 10%           | 10%           | 10%          | 10%           | 10%           | 10%          | 10%          | 10%           | 10%          |
| E <sub>1</sub> :              |               |              |               |               |              |               |               |              |               |               |              |              |               |              |
| <i>Abies alba</i>             | 1             | +1           | +             | +             | +            | +             | +             | +            | +             | +             | +            | +            | +             | +            |
| <i>Avenella flexuosa</i>      | 2             | 2            | +             | 1             | 1            | 1             | 1-2           | 1            | 1             | 1             | 1            | 1            | 1             | 1            |
| <i>Blechnum spicant</i>       | +             | +            | r             | r             | +            | +             | +             |              | r             | r             | +            | +            | +             | +            |
| <i>Calamagrostis villosa</i>  | 2             | 2            | 1             | 1-2           | 1            | 1             | 1             | +1           | +1            | +1            | +1           | 1            | 1             | 1            |
| <i>Carex canescens</i>        |               |              |               |               |              |               |               |              |               |               |              | (r)          |               |              |
| <i>Dryopteris carthusiana</i> |               |              | +             | +             | r            | +             | +             | +            | +             | +             | +            | +            | +             | +            |
| <i>Dryopteris dilatata</i>    | +1            | +            | 1             | 1             | 1            | +             | +             | +            | +             | +             | +            | +            | +             | +            |
| <i>Fagus sylvatica</i>        |               | +            | +             | +             | +            | +             | +             | +            | +             | +             | +            | +            | r             | r            |
| <i>Homogyne alpina.</i>       |               |              |               | r             |              |               |               |              |               |               |              |              |               |              |
| <i>Luzula sylvatica</i>       | +             | +            | +             | +             | +            | +             | +             | r            | r             | r             | r            | +            | +             | +            |
| <i>Lycopodium annotinum</i>   | +             | +1           | 2             | 2             | 2            | 2             | 1             | 2            | 1-2           | 1             | 1            | 1            | 1             | +            |
| <i>Maianthemum bifolium</i>   |               | (r)          |               | r             | r            |               |               | r            |               | r             |              | r            |               |              |
| <i>Oxalis acetosella</i>      |               | (r)          | r             | +             | r            | r             | r             | r            | r             |               |              | (r)          |               |              |
| <i>Picea abies</i>            | 1             | 1            | 1             | 1             | 1            | 1-2           | 1             | 1            | 1             | 1             | 1            | +1           | +1            | 1            |
| <i>Prenanthes purpurea</i>    | r             | (r)          |               | r             |              | (r)           | (r)           | (r)          | (r)           | (r)           | (r)          | +            | (r)           | (r)          |
| <i>Rubus idaeus</i>           |               |              |               |               |              |               |               |              |               |               |              |              |               | r            |

| Column                     | 1   | 2   | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
|----------------------------|-----|-----|---|---|---|---|---|---|---|----|----|----|----|----|
| <i>Sorbus aucuparia</i>    |     | +   | + | + | + | + | + | + | + | +  | +  | +  | +  | +  |
| <i>Vaccinium myrtillus</i> | 3-4 | 3-4 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3  | 3  | 3  | 3  | 4  |

Comments:

2018 - First visible attack of spruce bark beetle.

2019 - Half of tree count is damaged by bark beetle.

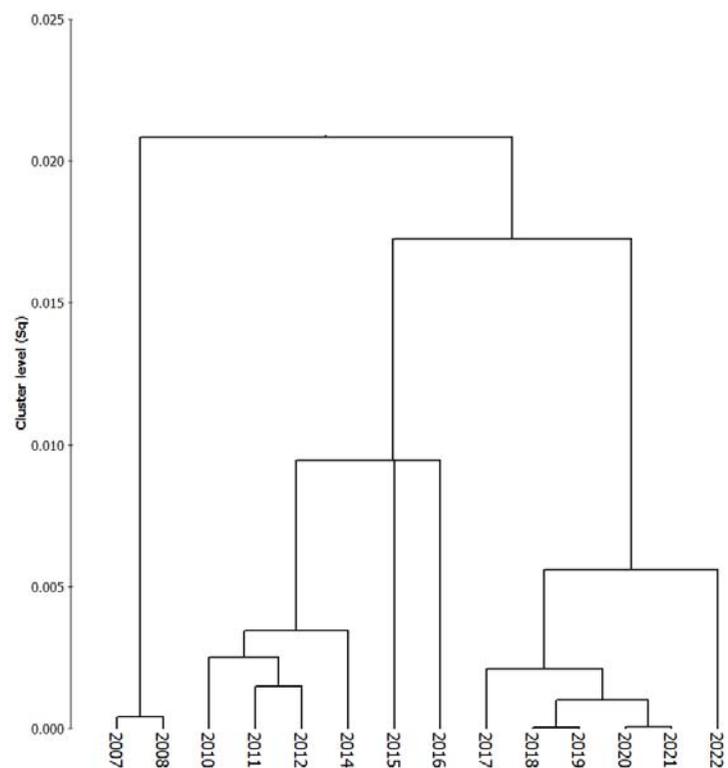


Fig. 12. Constrained clustering of relevés of the plot C2 by the procedure HSCA/Sq

Table 12. Plant community in the plot C4

| Column                       | 1            | 2             | 3             | 4             | 5            | 6             | 7             | 8            | 9             | 10            | 11           | 12           | 13            | 14           |
|------------------------------|--------------|---------------|---------------|---------------|--------------|---------------|---------------|--------------|---------------|---------------|--------------|--------------|---------------|--------------|
| Relevé                       | 111/08       | 118/09        | 61/10         | 36/11         | 13/13        | 19/14         | 77/15         | 11/16        | 22/17         | 61/18         | 20/19        | 40/20        | 17/21         | 33/22        |
| Date                         | 5.8.<br>2008 | 17.8.<br>2009 | 23.8.<br>2010 | 17.8.<br>2011 | 6.8.<br>2013 | 25.7.<br>2014 | 30.7.<br>2015 | 8.8.<br>2016 | 15.8.<br>2017 | 31.7.<br>2018 | 6.8.<br>2019 | 6.8.<br>2020 | 27.7.<br>2021 | 3.8.<br>2022 |
| Area (m <sup>2</sup> )       | 400          | 400           | 400           | 400           | 400          | 400           | 400           | 400          | 400           | 400           | 400          | 400          | 400           | 400          |
| Cover of E <sub>3</sub> (%)  | 50           | 50            | 50            | 50            | 50           | 50            | 50            | 50           | 50            | 50            | 50           | 50           | 45            | 1            |
| Cover of E <sub>2</sub> (%)  | 5            | 5             | 5             | 5             | 5            | 8             | 10            | 15           | 20            | 20            | 20           | 25           | 25            | 30           |
| Cover of E <sub>1</sub> (%)  | 55           | 55            | 55            | 60            | 60           | 65            | 65            | 65           | 65            | 65            | 70           | 75           | 75            | 75           |
| Cover of E <sub>0</sub> (%)  | 20           | 20            | 20            | 20            | 25           | 30            | 30            | 35           | 35            | 35            | 35           | 40           | 45            | 45           |
| E <sub>3</sub> :             |              |               |               |               |              |               |               |              |               |               |              |              |               |              |
| <i>Fagus sylvatica</i>       | 2%           | 2%            | 2%            | 2%            | 2%           | 2%            | 2%            | 2%           | 2%            | 2%            | 2%           | 2%           | 1%            | 1%           |
| <i>Picea abies</i>           | 98%          | 98%           | 98%           | 98%           | 98%          | 98%           | 98%           | 98%          | 98%           | 98%           | 98%          | 98%          | 99%           | 99%          |
| E <sub>2</sub> :             |              |               |               |               |              |               |               |              |               |               |              |              |               |              |
| <i>Abies alba</i>            |              |               |               | +             | +            | +             | +             | +            | +             | +             | +            | +            | +             | +            |
| <i>Fagus sylvatica</i>       |              |               |               | +             | +            | +             | +             | +            | +             | r             | r            | r            | r             | +            |
| <i>Picea abies</i>           |              |               | 2%            | 4%            | 5%           | 10%           | 15%           | 20%          | 20%           | 35%           | 50%          | 60%          | 70%           | 75%          |
| <i>Sorbus aucuparia</i>      | 100%         | 100%          | 98%           | 95%           | 94%          | 90%           | 85%           | 80%          | 80%           | 65%           | 50%          | 40%          | 30%           | 25%          |
| E <sub>1</sub> :             |              |               |               |               |              |               |               |              |               |               |              |              |               |              |
| <i>Abies alba</i>            | r            | +             | +             | +             | r            | +             | +             | +            | +             | r             | r            | r            | r             | +            |
| <i>Avenella flexuosa</i>     | +            | +             | +             | +             | +            | +             | +             | r            | +             | +             | +            | +            | +             | +            |
| <i>Blechnum spicant</i>      |              |               | r             | r             | r            | r             | r             |              |               |               |              |              |               | r            |
| <i>Calamagrostis villosa</i> | 2            | 2             | 2             | 2             | 2            | 2             | 2             | 2            | 2             | 2             | 2            | 2            | 2             | 2            |
| <i>Dryopteris dilatata</i>   | +            | + -1          | + -1          | +             | +            | +             | +             | +            | +             | +             | +            | +            | +             | +            |
| <i>Fagus sylvatica</i>       |              |               |               |               |              |               |               |              | r             | r             | r            | r            | r             | r            |
| <i>Luzula sylvatica</i>      | r            | r             | +             | +             | +            | +             | +             | +            | +             | +             | +            | +            | + -1          | + -1         |
| <i>Lycopodium annotinum</i>  | +            | +             | + -1          | 1             | +            | +             | +             | +            | +             | + -1          | + -1         | 1            | 1             | +            |
| <i>Maianthemum bifolium</i>  |              |               |               | r             |              |               |               |              |               |               |              |              |               | r            |
| <i>Melampyrum pratense</i>   | r            |               |               |               |              | r             |               |              |               |               |              |              |               |              |
| <i>Oxalis acetosella</i>     | +            | +             | +             | +             | +            | +             | +             | +            | +             | + -1          | 1            | + -1         | + -1          | + -1         |
| <i>Picea abies</i>           | +            | 1             | 1             | 1             | 1            | 1-2           | 1-2           | 1-2          | 1-2           | 1             | 1            | 1            | 1             | 1            |
| <i>Prenanthes purpurea</i>   |              | +             | +             | +             | +            | +             | +             | +            | +             | +             | r            | r            | +             |              |
| <i>Sorbus aucuparia</i>      | + -1         | 1             | 1             | 1             | 1            | + -1          | + -1          | 1            | 1             | 1             | +            | +            | +             | +            |
| <i>Vaccinium myrtillus</i>   | 2-3          | 2-3           | 2-3           | 2-3           | 2-3          | 2-3           | 2-3           | 2-3          | 2-3           | 2-3           | 2-3          | 2-3          | 2-3           | 2-3          |

Comments:

2016 - spruce seedlings on coarse wood are approximately 2 years old.

2021 - The first bark beetle trees of Norway spruce are occurred in the plot, sanitary cutting is provided near the plot.

2022 - Norway spruce is near to completely damaged by bark beetle, bark is accumulated on soil surface; spruce seedlings on coarse wood are still living; dry is manifested in the whole catchment, water level in the lake is low.

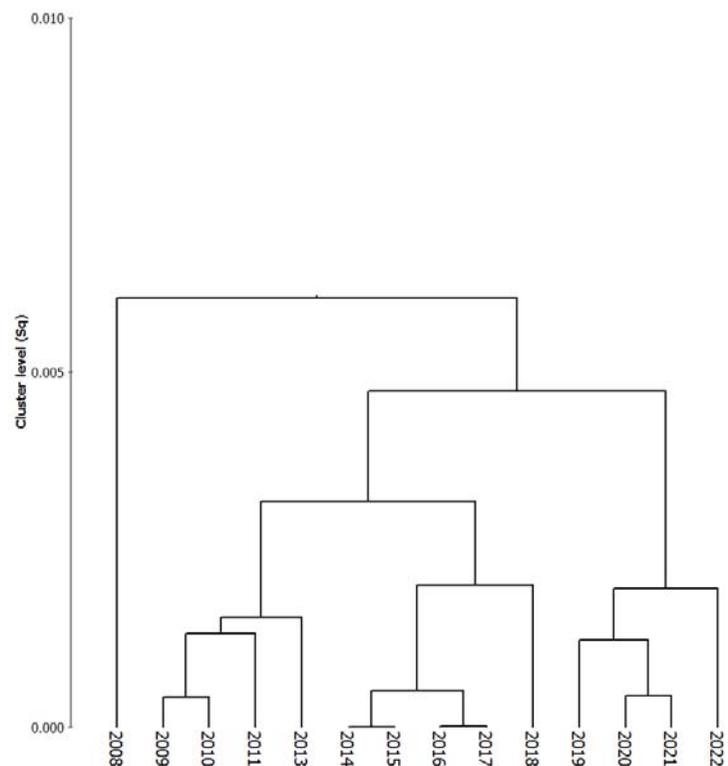


Fig. 13. Constrained clustering of relevés of the plot C4 by the procedure HSCA/Sq