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The impact of different types of management on biodiversity and botanical composition of upland meadows

The goals of the thesis:
- To describe the impact of cutting, liming and fertilising on botanical composition and biodiversity of chosen types of Šumava mountains meadows
- To describe the impact of these treatments on total growth biomass and on individual species biomass
- To evaluate differences in content of extractable soil components in surveyed phytocoenoses

The study area:
The Czech Republic, frontier region of Šumava mountains, 920 m a.s.l., catchment of Horský Brook This region was abandoned after second world war, thus the cessation of farming caused the start of succession of upland meadows.
Chosen types of meadows:

1) association *Molinion (Molinia caerulea)*

2) Degraded vegetation with dominating *Carex brizoides*

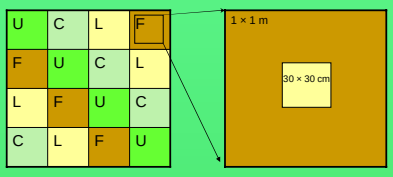
3) vegetation with dominating *Calamagrostis villosa*

Methods:
- In spring 2006 three permanent plots in latin square design were constituted
- Each of them is situated in one type of meadow community
- They are located in homogeneous growths
- The size of each latin square 520 × 520 cm, devided into 16 plots (130 × 130 cm).

The areal organisation of treatments:

- U - uncutted control (no MNG)
- C - cutting
- L - liming (250 g of grinded lime stone/m^2)
- F - fertilising (1 kg of cattle slurry mixed with water/m^2)

- L and F is provided always at the beginning of vegetation season - April
- In the half of July fytocenological inventory of all squares (in total 48)
- Afterwards all squares are cutted (except of U treatment)



- Within each plot (1 m^2) one subplot of 30 × 30 cm was established
- The complete list of all plant species and estimate of coverage (Braun - Blanquet scale) was provided. Their coverage was estimated as the percentage of area in central squares 30 × 30 cm (in total 48 little squares)
- Cutting of above-ground biomass at the soil level and removal in plastic bags to laboratory for establisment of weight of dry matter of all species found
- Annual removal of soil samples from all treatments for assesment N, P, K, C, Mg, Ca, dry matter (%) and pH ($CaCl_2$)

Results generally:
The evaluation of different treatments effect on composition and structure of upland meadow vegetation. This year is the second one of 3-year experiments.
Data were calculated in programs STATISTICA (Analysis of variance) and CANOCO for windows (PCA and RDA analyses).

STATISTICA was used for testing the difference between limed, fertilised and control squares - differences in biomass and plant coverage.
All meadows differs in biomass amount ($p = 0{,}018$) and plant coverage ($p < 0{,}001$) as Fig. 1 and Fig. 2 show.

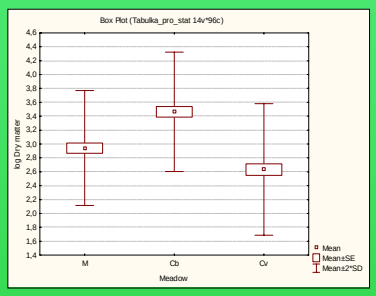


Fig. 1: Biomass amount in *Molinia caerulea* (M), *Carex brizoides* (Cb) and *Calamagrostis villosa* (Cv) meadows.

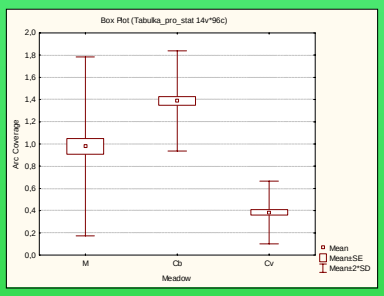


Fig. 2: Plant coverage in *Molinia caerulea* (M), *Carex brizoides* (Cb) and *Calamagrostis villosa* (Cv) meadows.

STATISTICA did not prove the impact of treatments on biomass. In case of plant coverage there is also not statistically significant impact, but treatment effects are very close ($p = 0{,}065$) to significance, so maybe next season the impact will be prooved. STATISTICA also revealed, that cutting, liming and fertilising effects did not differ between meadow types In case of biomass amount (all treatments fuction equally on each type of meadow). But in case of plant coverage there is signifficant difference ($p = 0{,}025$) between meadow types under the same management conditions (treatments function differently on meadow types). Comparison of different teatments effect on plant coverage shows Fig. 3.

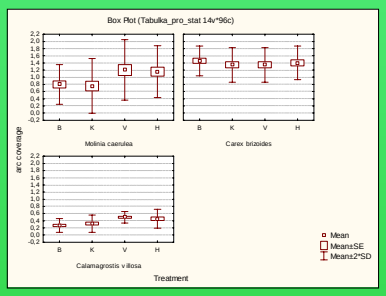


Fig. 3: Comparison of different teatments effect on plant coverage in three meadow types. B = unmanaged, K = cutted, V = limed, H = fertlised plots. Effect of all treatments differs especially in *Carex brizoides* plots compared with the other meadow types.

Results in CANOCO for windows: significance of individual axes and variables was count up with Monte Carlo permutation test
PCA analyses - represent relationships between species regardless of treatments
RDA analyses- represent interactions of treatments, years and individual species.

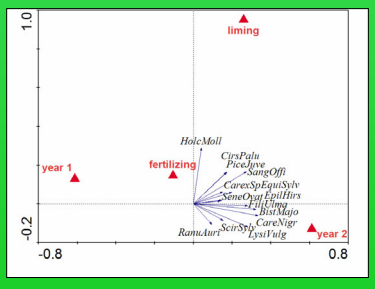


Fig. 4: RDA analysis of plant coverage in litte squares 30 × 30 cm. The model is significant ($p = 0{,}002$), but it explains only little percent (3,6 %) of variability of species coverage: Trace = 0,036. It could be caused by presence of many species with little abundance or with small coverage. The impact of liming and fertilising on botanical composition is not significant. The significance of whole model is caused by year-on-year changes. Most of species reacting on treatments occured rather in second year (they have greater coverage).

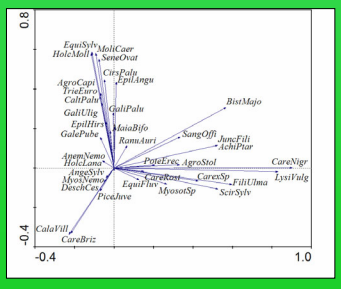


Fig. 5: PCA analysis of plant coverage in little squares. It also shows relationships between individual species regardless of years or treatments. For example *Bistorta major* does not grow on places with *Carex brizoides*, but with *Sanguisorba officinalis* together.

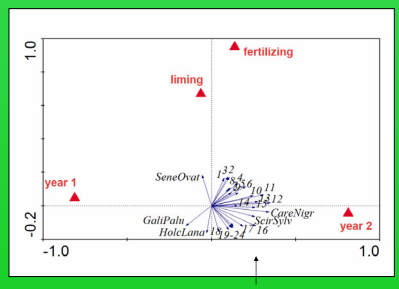


Fig. 6: RDA analysis of plant coverage in big squares 1 × 1 m. The model is significant ($p = 0{,}002$), but it explains only little percent (3,9 %) of variability of species coverage: Trace = 0,039. The influence of treatments is not significant. The presence of individual species differs between years, but it is not the direct reaction on liming or fertilising.

1 - *Holcus mollis*
2 - *Sorbus aucuparia juv.*
3 - *Galium uliginosum*
4 - *Picea abies juv.*
5 - *Anemone nemorosa*
6 - *Caltha palustris*
7 - *Juncus effusus*
8 - *Myosotis sp.*
9 - *Potentilla erecta*
10 - *Sanguisorba officinalis*
11 - *Lysimachia vulgaris*
12 - *Filipendula ulmaria*
13 - *Bistorta major*
14 - *Achillea ptarmica*
15 - *Ranunculus auricomus*
16 - *Equisetum sylvaticum*
17 - *Cirsium palustre*
18 - *Heracleum sphondylium*
19 - *Equisetum fluviatile*
20 - *Carex rostrata*
22 - *Potentila palustris*
23 - *Agrostis stolonifera*
24 - *Epilobium angustifolium*

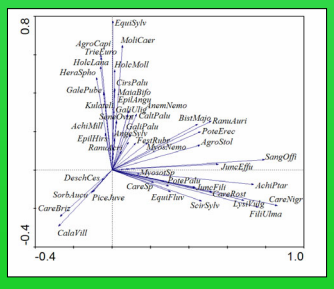


Fig. 7: PCA analysis of plant coverage in big squares. The influence of treatments and years on botanical composition is significant ($p = 0{,}006$), but it explains only little percent (3,1 %) of variability of species coverage: Trace = 0,031.

Summary:
All meadows differ significantly in biomass amount and plant coverage**.** STATISTICA did not prove the impact of treatments on biomass and plant coverage. It was proved, that cutting, liming and fertilising effects did not differ between meadow types in case of biomass amount, but it differs in case of plant coverage. CANOCO proved the common impact of treatments and years on botanical composition, but it explains only little percent of variability of species coverage. Changes in vegetation are caused mainly by time; treatments represent only the part of its influence.