Short-term restoration effect of mulching and mowing on semidry *Bromion* grassland

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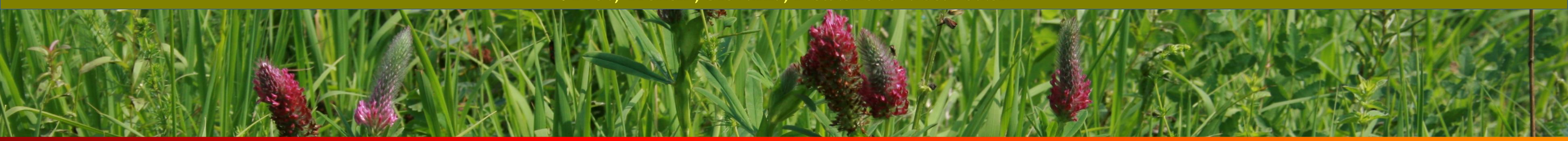
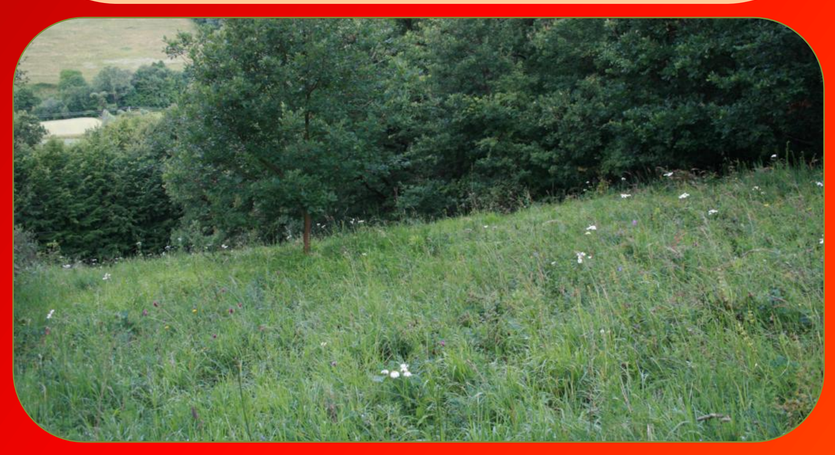
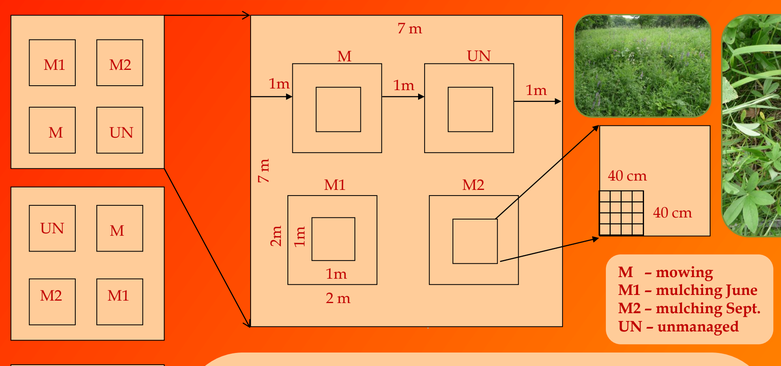


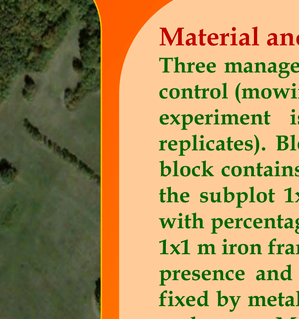
Introduction

The Biele Karpaty Mts are a part of a Protected Landscape Area located at the border between the Slovak Republic and the Czech Republic. The main reasons for their protection is the high biological diversity and harmonic land use. In this area a mosaic of little settlements, small fields, meadows orchards, and deciduous forests has developed. During the 20th century many people left their land. A lot of grasslands especially on the remote sites were abandoned. Collectivisation of the agricultural land also had a negative impact on the grasslands due to the increasing fertilisation and land reclamation. Some grasslands were preserved by being designated nature reserves, while some others remained intact in inaccessible areas. The field experiment to investigate the restoration effect of mulching and mowing on semidry *Bromion* grassland was founded in 2009 in the Bošácka dolina Valley, Biele Karpaty Mts, Slovakia. Permanent plots were established in grassland community of the association *Brachypodio pinnati-Molinietum arundinaceae*, which was unmanaged for several years. Due to successional changes, the species composition was changed. The effect of the four management treatments was tested: mowing, mulching in summer (June), mulching in autumn (September), no management. The plots were sampled during three vegetation seasons (2009–2011).





M – mowing
M1 – mulching June
M2 – mulching Sept.
UN – unmanaged



Average number of vascular species in permanent plots		
management, year	1x1 m	10x10 cm
mowing 2009	32.50	5.36
mowing 2010	35.75	6.53
mowing 2011	36.25	5.89
mulching in autumn 2009	30.25	4.96
mulching in autumn 2010	33.25	6.52
mulching in autumn 2011	35.50	6.03
mulching in spring 2009	34.75	5.16
mulching in spring 2010	38.00	6.13
mulching in spring 2011	35.25	5.83
unmanaged 2009	32.00	5.14
unmanaged 2010	28.75	5.08
unnmanaged 2011	28.50	4.83

The main questions of the study are:

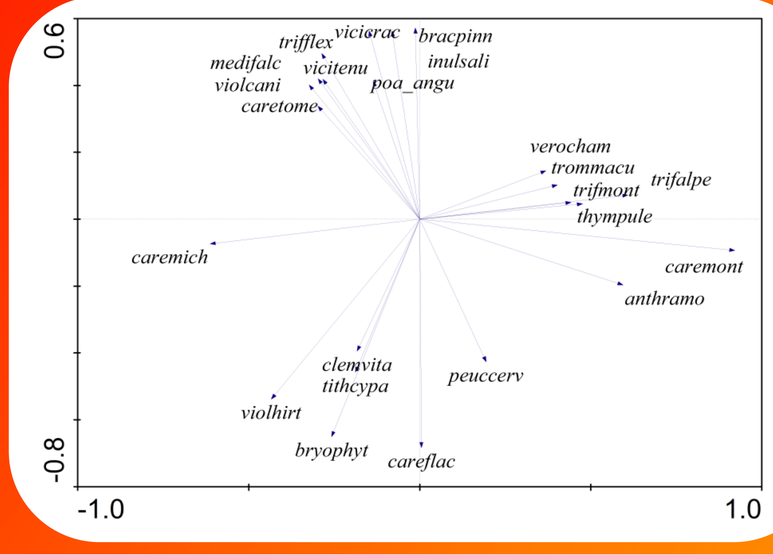
- Is mulching appropriate management for restoration of the abandoned grasslands?
- Are there any differences in the effect of mulching in different seasons – summer and autumn?
- What are the differences in effect of mulching and mowing on species composition and species richness?

Material and methods

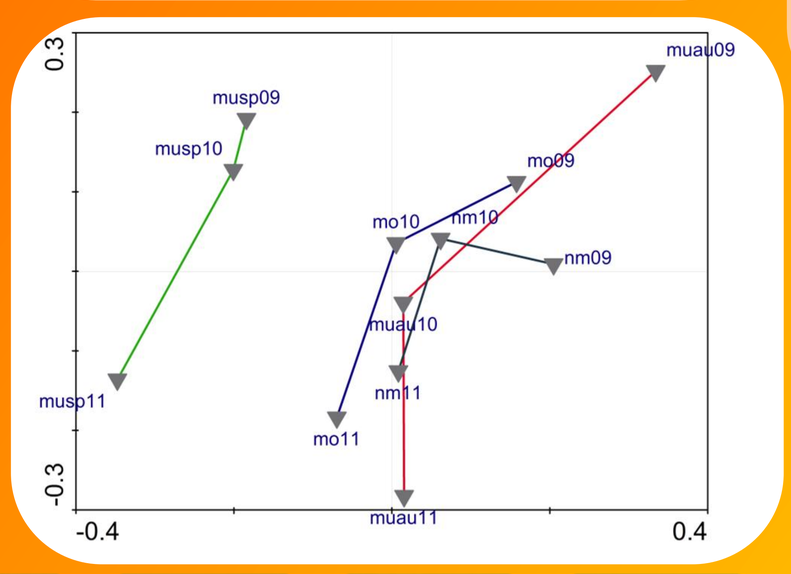
Three management regimes are tested in comparison to no management control (mowing in June, mulching in June, mulching in September). The experiment is organized in completely randomized blocks (four replicates). Blocks (7x7m) are situated on moderate slope (15-20°). Each block contains 4 plots (2x2 m) which were managed differently. There is the subplot 1x1m in the middle of each plot, where the list of species with percentage cover is recorded in vegetation season (June). Within the 1x1 m iron frame, which is divided by iron sticks to 10x10 cm squares, the presence and absence data in 16 squares were recorded. The frame is fixed by metal nails, thus the sampling can be repeated on the same plot each year. Mulching and mowing are performed by machine cutter. Special adapter is used for mulching imitating its effect (cutting of biomass into smaller pieces, which is then left on the ground). Multi-way ANOVA was performed on logarithmically transformed data on species richness of vascular plants in two scales (1x1 m and 10x10 cm). Three factors were tested: factor BLOCK (identification of experimental block – random factor), factor TREATMENT (identification of applied treatment – between-subject factor) and factor TIME (consecutive time from the beginning of experiment – within-subject factor). Frequency data on species composition were analysed by Principal Component Analysis (PCA).

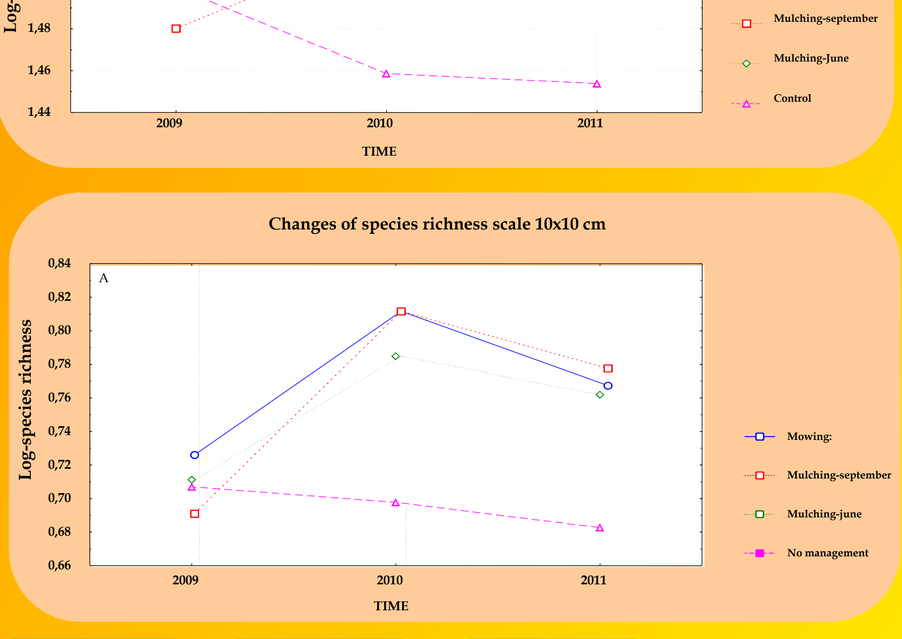
Results

However multi-way ANOVA did not show any significant interaction of Treatment and Time factors in relation to species richness, the results were close to significance level especially in the scale 1 x 1 m (P=0.058). It is evident, any type of applied management has positive effect on the species richness increasing both in plots 1x1 m and 10x10 cm comparing to no treatment control. The average number of vascular plant species in the mown plots 1x1 m was 33, in the plots mulched in June 35 species, in the plots mulched in September 30 species, and in unmanaged plots 32 species in 2009. In 2011 the average number of species in the mown plots was 36, in the plots mulched in June 35 species, in the plots mulched in September 36 species, and in unmanaged plots 29 species. The number of species in mown plots (1x1 m) has risen approximately by 4 species after 3 years of managing, in plots mulched in September by 6 species and in plots mulched in June by 1 species. Especially some dicotyledon forbs like *Salvia pratensis*, *Fragaria viridis*, *Galium mollugo*, *Leucanthemum vulgare*, *Knautia arvensis*, *Crepis praemorsa* and *Veronica chamaedrys* were more frequent in the managed plots. In unmanaged plots the number of species decreased approximately by 4 species during the 3 years of observation.



The changes in species richness in plots 10x10 cm were more considerable. In the mown plots the number of vascular plants in some cases increased by 5-7 species. The average number of species in the mown plots was 5.36 in 2009 and 5.89 in 2011, in the plots mulched in June 5.16 species in 2009 and 5.83 in 2011, in the plots mulched in September 4.96 species in 2009 and 6.03 in 2011, and in unmanaged plots 5.14 species in 2009 and 4.83 in 2011. Species like *Potentilla alba*, *Prunela vulgaris*, *Inula salicina*, *Betonica officinalis*, *Viola hirta* and *Trifolium alpestre* were more frequent in the managed plots. Removal of green biomass and litter by mowing allowed ecesis of smaller and competitively week species. Mulching caused reduction of the vegetation cover and supported growth of the stress-tolerant meadow species. The PCA analysis did not show differences in development trajectories of the plots with different treatments. It seems applied restoration management has not so pronounced short-term impact on species composition comparing to no management control. But, surprisingly there is some general floristic trend on all experimental plots, which is not clear so far. It might be a result of some weather fluctuations or an indirect impact of applied management.





Conclusions

It is evident from our results, that mulching is a restoration technique with comparable effect on species richness comparing to mowing and it can be applied for the restoration of dry *Bromion* grasslands.

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