Changes in species composition in grasslands caused by management changes during the last 15-19 years in the Biele Karpaty Mts (Slovakia)

Iveta Škodová, **Katarína Hegedüšová**

Institute of Botany SAS, Dúbravská cesta 9, 845 23 Bratislava, Slovak Republic, iveta.skodova@savba.sk, katarina.hegedusova@savba.sk

Introduction

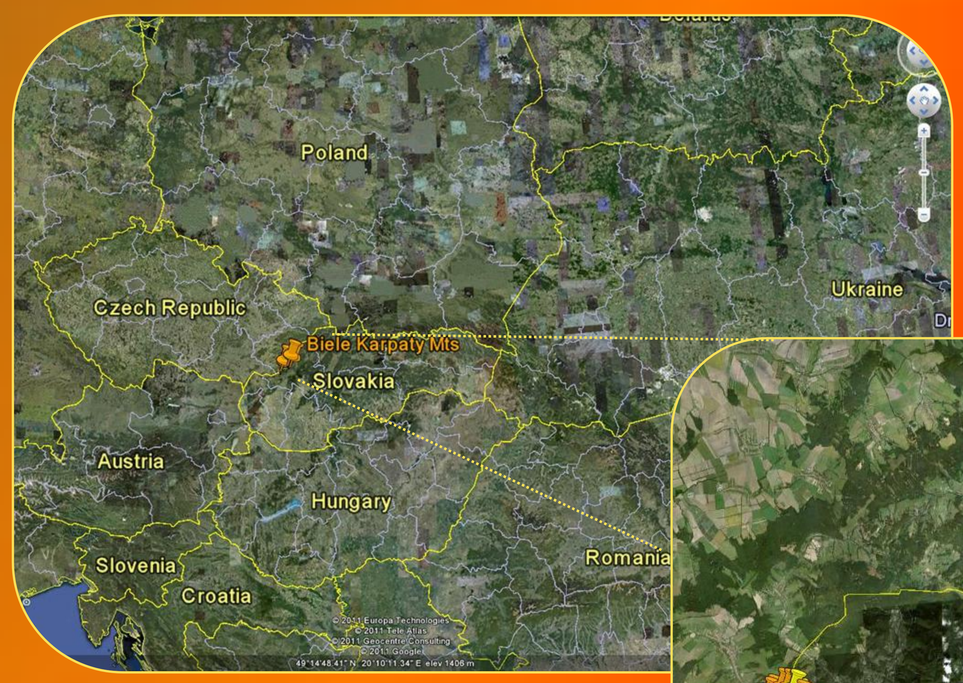
The Biele Karpaty Mts are a part of a Protected Landscape Area located at the border between the Slovak Republic and the Czech Republic. The main reasons for their protection is the high biological diversity and harmonic land use. The territory is a good example of a form of land use that preserves a high level of alpha phytodiversity. 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 and found work in towns. 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. Thanks to the nature protection and activities of people still living in the secluded places and farming their land, the unique land structure has been preserved. The vegetation of the meso- and subxerophilous grasslands of the Biele Karpaty Mts. is famous for its high species richness. This vast species diversity is a result of the long-term maintenance of grasslands (regular mowing and grazing), diverse microrelief conditions, and a land use history spanning to the prehistoric times. Grassland vegetation in the Biele Karpaty Mts was sampled in the years 1991-1995. In 2010 the repeated phytosociology research was made on sites of former relevés with the aim to study changes in species composition.

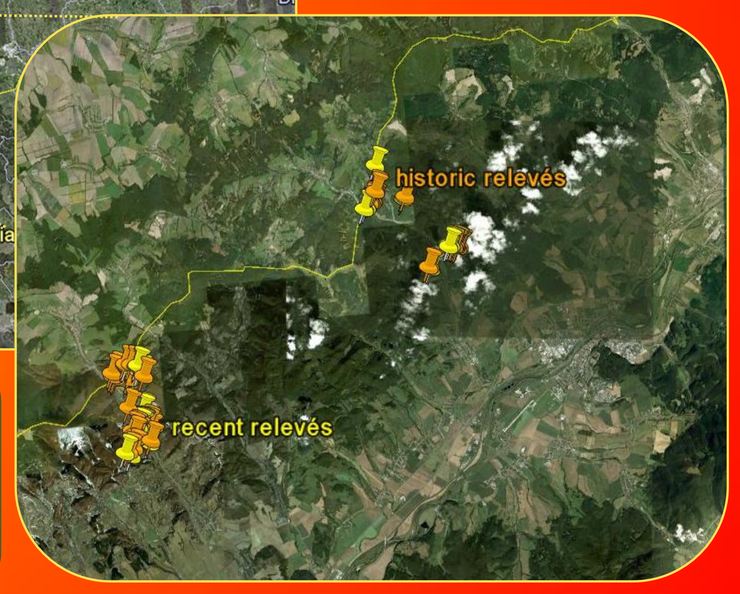
Aims

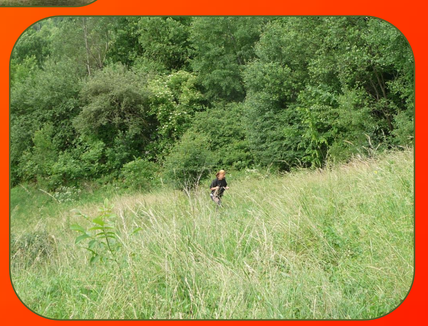
- to study changes in species composition of grasslands caused by management changes during the last 15-19 years
- to analyze the main gradients in species composition through the comparison of historical and recent relevés
- to compare the presence of species with different plant traits in historical and recent relevés

Material and methods

As the core data source for the evaluation of the vegetation we used 83 relevés (44 historical, 39 recent), which were sampled in the years 1991-1995 and 2010 repeatedly. No permanent plots had been marked during the first sampling period. The relevé plot size was 25 m^2 in most relevés. The data were exported to the JUICE 7.0.61 software (Tichý 2002). Nonparametric statistic followed by Kruskal-Wallis ANOVA and Mann-Whitney U Test (Statica 8; http://www.statsoft.com/) were used to investigate whether the changes of species richness (number of species, number of Red list species, number of trees and number of herbs) in each pair of historical and recent relevés, respectively were significant. Occurrence of plants with different life forms and functional groups was compared between the old and new relevés. Data on plant traits (leaf distribution) were extracted from the database CloPla3 (Klimešová & de Bello 2009, http://clopla.butbn.cas.cz). Detrended correspondence analysis (DCA) by the CANOCO 4.5 for Windows package (ter Braak & Šmilauer 2002) was applied for the evaluation of changes in the studied vegetation. For the ecological interpretation of ordination axes, the average non-weighted Ellenberg indicator values (Ellenberg et al. 1992) calculated for relevés and information about management were plotted onto the DCA ordination diagram as supplementary environmental data.





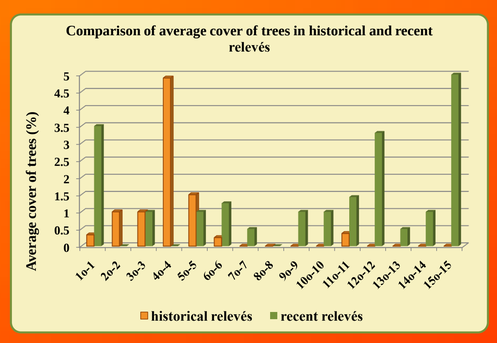


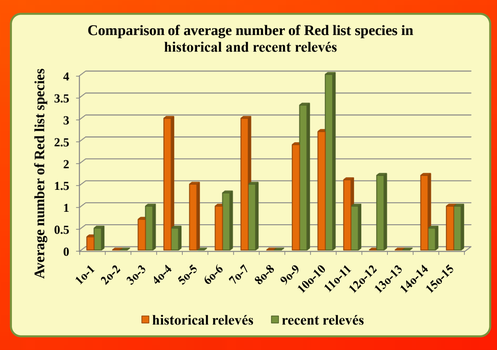
Results

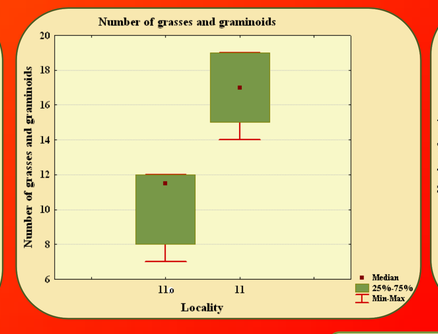
The studied communities belong to the associations *Brachypodio pinnati-Molinietum arundinaceae* (*Bromion erecti*), *Pastinaco-Arrhenatheretum elatioris*, *Ranunculo bulbosi-Arrhenatheretum elatioris* and *Anthoxantho odorati-Agrostietum tenuis* (*Arrhenatherion elatioris*). In the analysed data set 227 vascular plant species were recorded in historical relevés and 279 species in recent relevés.

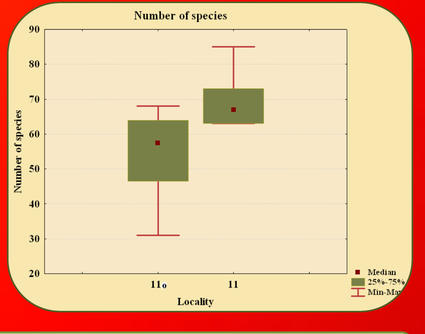
The significant differences in species richness (number of species, number of grasses and graminoids, and number of trees) between the recent and historical relevés were demonstrated with respect to each locality. Abandonment of grazing/regular mowing and its change to an irregular mowing scheme resulted in the significant changes in occurrence of trees and higher abundance of grasses in the locality No. 9. The results of the analysis indicated that there was a significant difference between the species richness and number of grasses and graminoids in the historical and recent relevés in the medians, $\chi 2$ (7, N = 83) = 45.24249; p = .0279. Following the Mann-Whitney U test species richness and number of grasses and graminoids increased significantly after abandonment in the recent relevés of the locality No. 11 from ca 54 species in 1993 to 70 species in 2010, which is especially due to higher occurrence and abundance of grasses. Differences in presence of rosette, semi-rosette and non-rosette species in historical and recent relevés were significant only in the case of no-rosette species in the localities No. 6 and No. 14 ($\chi 2$(28, N= 83) = 44.64978 ; p =.0239).

The comparison of historical and recent relevés in ordination diagram (DCA, length of gradient 3.2, total inertia 4.63) shows the shift of all grasslands along the nutrient and light gradients (along the axis 2, correlation coefficient between ax2/nutrients was 0.67, light/ax2 was -0.72). In the abandoned stands the accumulation of litter led to nutrient soil enrichment, to the dominance of competitively strong tall grasses (*Dactylis glomerata*, *Arrhenatherum elatius*, *Brachypodium pinnatum*) and to decrease of number of small dycotyledon herbs. The changes recorded in the managed plots might be caused by shifts of the mowing or grazing intensity or most probably by the spacial heterogenity of the vegetation, since the plots studied were not the permanent plots.









Mann-Whitney U Test (Number of grasses)
By variable Group
Marked tests are significant at p <.05000

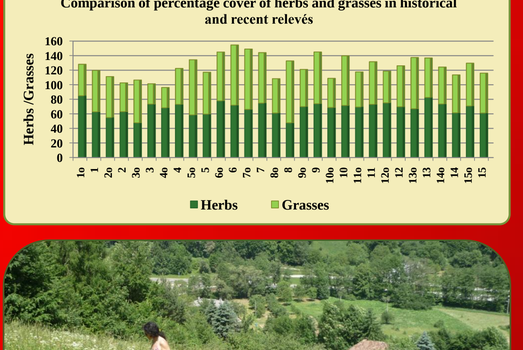
	Rank Sum Group 11o	Rank Sum Group 11	U	Z	p-level	Z adjusted	p-level	Valid N Group 11o	Valid N Group 11	2*1sided exact p
Total number of species	36.00000	84.00000	0.00	-3.24037	0.001194	-3.27865	0.001043	8	7	0.000311

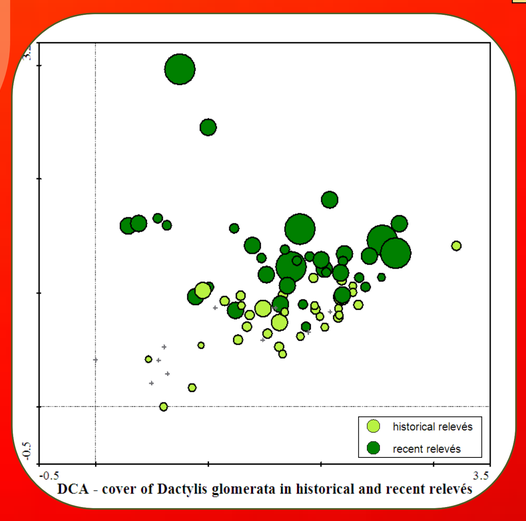
Mann-Whitney U Test (Number of trees)
By variable Group
Marked tests are significant at p <.05000

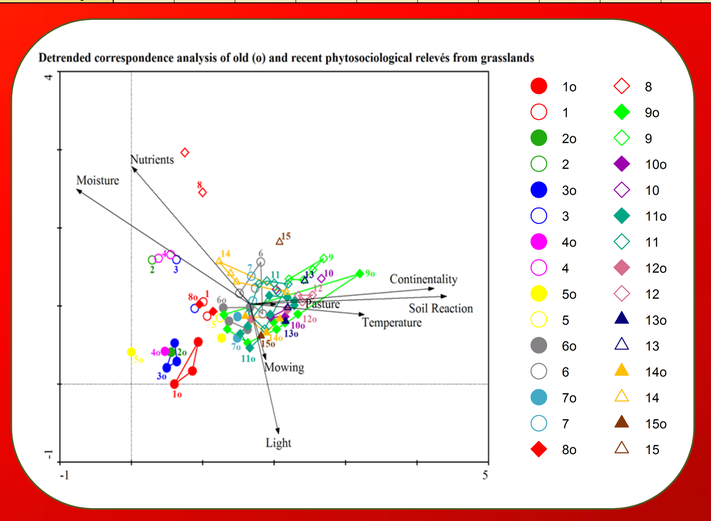
	Rank Sum Group 9o	Rank Sum Group 9	U	Z	p-level	Z adjusted	p-level	Valid N Group 9o	Valid N Group 9	2*1sided exact p
Total number of species	40.00000	38.00000	4.000000	-2.03810	0.041541	-2.70801	0.006769	8	4	0.048485

Mann-Whitney U Test (Number of species)
By variable Group
Marked tests are significant at p <.05000

	Rank Sum Group11o	Rank Sum Group 11	U	Z	p-level	Z adjusted	p-level	Valid N Group11o	Valid N Group 11	2*1sided exact p
Total number of species	44.00000	76.00000	8.000000	-2.31455	0.020638	-2.32286	0.020187	8	7	0.020513



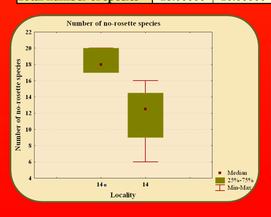


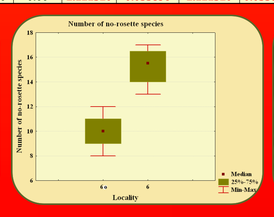


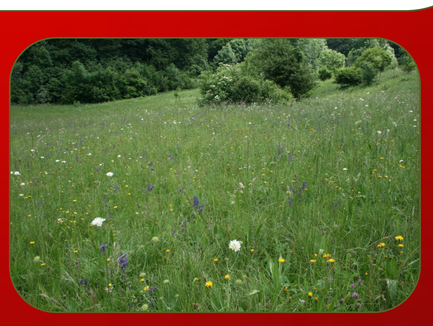
locality	historic management	recent management	community
1	unmanaged	unmanaged	Anthoxantho odorati-Agrostietum tenuis
2	irregular mowing	unmanaged	Anthoxantho odorati-Agrostietum tenuis
3	mowing	unmanaged	Anthoxantho odorati-Agrostietum tenuis
4	mowing	irregular mowing	Pastinaco sativae-Arrhenatheretum elatioris
5	mowing	irregular mowing	Anthoxantho odorati-Agrostietum tenuis
6	irregular mowing	irregular mowing	Ranunculo bulbosi-Arrhenatheretum elatioris Onobrychodo viciifoliae-Brometum erecti Brachypodio pinnati-Molinietum arundinaceae
7	irregular mowing	irregular mowing	Brachypodio pinnati-Molinietum arundinaceae
8	mowing	unmanaged	Pastinaco sativae-Arrhenatheretum elatioris
9	pasture, mowing	irregular mowing	Brachypodio pinnati-Molinietum arundinaceae
10	pasture, mowing	irregular mowing	Brachypodio pinnati-Molinietum arundinaceae Ranunculo bulbosi-Arrhenatheretum elatioris
11	mowing	pasture, irregular mowing	Brachypodio pinnati-Molinietum arundinaceae
12	mowing	irregular mowing	Brachypodio pinnati-Molinietum arundinaceae
13	mowing	irregular mowing	Brachypodio pinnati-Molinietum arundinaceae
14	mowing	pasture	Brachypodio pinnati-Molinietum arundinaceae
15	irregular mowing	pasture	Brachypodio pinnati-Molinietum arundinaceae

Mann-Whitney U Test (Number of no-rosette species)
By variable Group
Marked tests are significant at p <.05000

	Rank Sum Group 6o	Rank Sum Group 6	U	Z	p-level	Z adjusted	p-level	Valid N Group 6o	Valid N Group 6	2*1sided exact p
Total number of species	10.00000	26.00000	0.00	-2.30940	0.020922	-2.32327	0.020165	4	4	0.028571
	Rank Sum Group 14o	Rank Sum Group 41	U	Z	p-level	Z adjusted	p-level	Valid N Group 14o	Valid N Group 14	2*1sided exact p
Total number of species	18.00000	10.00000	0.00	2.121320	0.033896	2.121320	0.033896	3	4	0.057143







Acknowledgement: This research was supported by the grant VEGA 2/0181/09. The authors are grateful to Daniela Dúbravková for her correction of English language.