

The area of western Ukrainian Carpathians is rich in semi-natural grasslands. In the study area most grasslands are used as meadows or pastures. In some regions (Voloveckiy and Mezghorskiy rayion), the prevailing grassland type is represented by meadows established on the former cooperative fields. Nowadays the mosaic of small fields with potatoes and fallows of various age form a typical landscape scene. The original permanent (never ploughed) meadows are less frequent distributed mainly in the region of Skoiyevskiy and Dolinskiy rayion (villages Golovetsko, Psonec, Senetsev). Manuring was generally used for all meadow types and during 1986-1988 some grasslands were also fertilized by phosphates (applied by aerial spraying). Recently, most meadows are mown once to three times a year, at higher altitudes only once a year. In wetter years with surplus of standing crops, the meadows remained unmown are burned in autumn. In few locations, larger areas of abandoned grasslands occur. They are irregularly burned or used as pastures for horses. Burning supports occurrence of certain species, especially *Galium verum*.

Aims:
High value grasslands were studied in the Ukrainian Carpathians aimed at:
 > identification of grassland types and evaluation of their species diversity;
 > comparison of recent phytosociological relevés (2010) with the older published relevés (1973-1988).

Study regions:
Zakarpatskaya oblast:
 > Mezghorskiy rayion (Pilipets, Siput, Verhniy Studeniy, Tornu, Borzhava Mts.)
 > Voloveckiy rayion (Verhniye Vorota, Lzy, Gukliviyy, Volovets - pereval Mencil, Verbiash - pereval Sredneverekkiy)
Ivano-Frankovskaya oblast
 > Dolynskiy rayion (Senetsev)
L'vovskaya oblast
 > Skoiyevskiy rayion (Verhniyatska, Zhupany, Klimets, Golovetsko, Psonec)

The individual cadastres differ in grazing management of pasture land. In most settlements, common pastures are used for cattle grazing in small herds (15-30 animals). More remote areas at higher altitudes are usually used for this purpose. The cattle is watched by several local people (shepherds) during the day and return to the stables for the night. Fenced pastures in close vicinity of houses are common in the regions with dispersed settlements. Here, the animals (cattle or horses) are kept for longer periods, thus the effect of trampling and ruderalisation is more pronounced.

During the collectivisation period, fields of *Heracleum mantegazzianum* were established due to high standing crop and high food value of this alien species. Recently, growing of this dangerous plant is not performed any more, however, *Heracleum* has spread spontaneously and large areas are infested. They are usually not managed and call for urgent restoration activities. Surroundings of Zhupany, Klimets, Latirka and Ivashkivsi belong to the most infested areas.

Material and Methods:
 Phytosociological relevés were recorded in July 2010 according to Zurich-Montpellier school. All types of mesophilous vegetation were sampled in plots of 16 m² using Braun-Blanquet scale (9 degrees) and 1 m² in the lower left corner was investigated in more details using the species percentage cover. Thus, species number was indicated at two scales, 1 m² and 16 m². Altogether, 30 relevés were recorded. Another 30 relevés were obtained from literature, the Ukrainian synthesis of the *Molinio-Arrhenatheretea* class (Kuzemko 2009). The published relevés were made by Kris during 1973-1988. All relevés, the new ones recorded in 2010 and the older published data were analysed together by cluster analysis (Ward method with Euclidean distance as a similarity measure) and detrended correspondence analysis (DCA, pseudospecies cut levels 0, 5, 25; downweighting of rare species). Only vascular plant records were used for analyses. Woody species were omitted from the analyses. Differences among vegetation types in species number of 1 m² and 16 m² plots were tested by ANOVA with a post-hoc comparisons of means of all pairs of groups (StatSoft Inc. 2006).



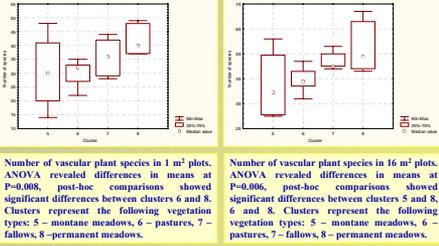
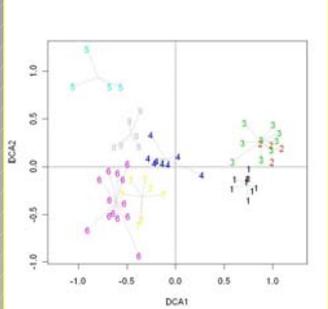
Results and discussion

> According to the published literature (Kuzemko 2009) the western part of the Ukrainian Carpathians was studied by Kris (1973-1988). He distinguished four associations (groups 1-4 in the DCA ordination plot):

- 1. *Poa-Trisetetum flavescens* Knapp ex Oberdorfer 1957 (*Arrhenatherion elatioris* Luquet 1926), 9 relevés**
 Diagnostic species: *Cyanus mollis*, *Dactylorhiza sambucina*, *Agrirotia eupatori*, *Trisetum flavescens*, *Geranium sylvaticum*, *Luzula luculoides*, *Agrostis repens*, *Poa pratensis*
 Dominant species: *Trisetum flavescens*, *Festuca rubra*
- 2. *Festuco-Cynosuretum cristati* R. Tx. 1942 (*Cynosurion cristati* Tx. 1947), 4 relevés**
 Diagnostic species: *Crepis paludosa*, *Pteris hieracifolia*, *Betonica officinalis*
 Dominant species: *Anthoxanthum odoratum*, *Deschampsia caespitosa*
- 3. *Brizeto-Anthoxanthetum Kmoníček 1936* (*Cynosurion cristati* Tx. 1947), 9 relevés**
 Diagnostic species: *Succisa pratensis*, *Lycopodium europaeum*, *Trifolium rubens*, *Carex leporina*, *Silene latifolia* subsp. *alba*
 Dominant species: *Briza media*, *Festuca rubra*, *F. pratense*, *Deschampsia caespitosa*, *Anthoxanthum odoratum*
- 4. *Anthoxantho-Agrostietum tenuis* Sillinger 1933 (*Cynosurion cristati* Tx. 1947), 8 relevés**
 Diagnostic species: *Hypochaeris radicata*, *Carlina acaulis*
 Dominant species: *Agrostis capillaris*, *Festuca rubra*

> Four main grassland types were distinguished in 2010 data set (groups 5-8 in the DCA ordination plot):

- 5. *Montane meadows* (*Nardo strictae-Agrostion tenuis* Sillinger 1933), average number of vascular plant species 43 in 16 m² plots and 31 in 1 m² plots, 4 relevés**
 Diagnostic species: *Scorzonera vicia*, *Tromodesia oviflora*, *Vaccinium myrtillus*, *Arnica montana*
 Dominant species: *Nardus stricta*
- 6. *Intensive pastures, grazed mostly by cattle* (*Cynosurion cristati* Tx. 1947, *Violin caninae* Schweickerath 1944), some abandoned irregularly burned pastures are included, average number of vascular plant species 45 in 16 m² plots and 28 in 1 m² plots, 13 relevés**
 Diagnostic species: *Lolium comiculatum*, *Pilosella officinarum*, *Viola canina*, *Dianthonia decumbens*, *Achillea millefolium*, *Trifolium repens*, *T. medium*, *Veronica officinalis*
 Dominant species: *Nardus stricta*, *Thymus polygoides*, *Leontodon hispidus*, *Festuca rubra*, *Jacea pratensis*
- 7. *Fallow of cooperative fields, transformed to meadows 15-20 years ago* (*Arrhenatherion elatioris* Luquet 1926), average number of vascular plant species 52 in 16 m² plots and 36 in 1 m² plot, 7 relevés**
 Diagnostic species: *Galium mollugo*, *Phleum pratense*, *Trisetum flavescens*, *Crepis biennis*, *Vicia sepium*, *Cardaminopsis halleri*
- 8. *Permanent meadows at lower altitudes* (*Arrhenatherion elatioris* Luquet 1926, *Polygonum bistorta-Trisetum flavescens* Br.-Bl. et Tx. ex Marshall 1947), average number of vascular plant species 58 in 16 m² plots and 42 in 1 m² plot, 6 relevés**
 Diagnostic species: *Equisetum arvense*, *Vicia cracca*
 Dominant species: *Festuca rubra*, *Ononis arvensis*, *Jacea pratensis*



The vegetation types recorded by Kris and those recorded recently differ in their floristic composition as well as in the dominant species. It is well reflected in the ordination plot where all clusters are separated by the authors. These differences may be caused either by different sampling approach (different plot size, different rules in plot selection or different abundance/cover scale) or by certain shifts in environmental conditions. In general, the relevés of Kris contain more species of moist and nutrient-rich habitats and our relevés are richer in acidophilous species.

According to our results, species richness in 1 and 16 m² plots differs among the vegetation types. The highest species richness was indicated in permanent meadows while the lowest species richness was found in montane meadows. Even if we do not consider the montane meadows (as they may differ in climatic conditions), it is obvious, that the long-lasting management affects the species richness of the semi-natural grasslands.



Detrended correspondence analysis of a joined data set. Eight clusters of relevés are indicated by numbers: 1 – *Poa-Trisetetum flavescens*, 2 – *Festuco-Cynosuretum cristati*, 3 – *Brizeto-Anthoxanthetum*, 4 – *Anthoxantho-Agrostietum tenuis*, 5 – montane meadows, 6 – pastures, 7 – fallows, 8 – permanent meadows. Clusters 1-4 represent historical relevés made by Kris (1973-1988) and clusters 5-8 represent recent relevés recorded in 2010.

Number of vascular plant species in 1 m² plots. ANOVA revealed differences in means at P=0.008, post-hoc comparisons showed significant differences between clusters 6 and 8. Clusters represent the following vegetation types: 5 – montane meadows, 6 – pastures, 7 – fallows, 8 – permanent meadows.

Mean number of species in 16 m² plots (blue columns) and 1 m² plots (orange columns) in four vegetation types indicated in 2010. 5 – montane meadows, 6 – pastures, 7 – fallows, 8 – permanent meadows.



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