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***Management and Conservation of Semi-natural
grasslands: from theory to practice***

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BOOK OF ABSTRACTS

(Oral and poster presentations, in alphabetical order of
first author)

Cover picture: xerophilous/xero-mesophilous grasslands on slumping mounds (Rom: *movile*) near Apold, Romania

Owen Mountford 2008

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Keynote Wednesday, 21 September

Integration by Place, Case and Process: Transdisciplinary Sustainability Science in Transylvania

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Sustainability science is an emerging arena of scientific enquiry. Unlike traditional disciplinary research, sustainability science seeks to transcend boundaries between disciplines, and between researchers and other societal stakeholders. Here, I summarize five years of team research that investigated trajectories for sustainable development in Southern Transylvania, Romania. This region boasts some of Europe's most notable natural and cultural heritage, including traditional land use systems and their associated biodiversity (from wildflower meadows to the European Brown Bear). However, rapid socioeconomic changes, and associated changes in land use, are now threatening these traditional heritage values. The aim of our research was to better understand the changes taking place in order to obtain insights for how they may be navigated. To this end, we integrated insights from the social sciences and ecological sciences with local expert knowledge via an approach centered around the notions of "place", "case" and "process". This integration approach focuses all research participants on a shared problem (here, landscape change in Transylvania) and common units of analysis (here, selected villages), and emphasizes informal methods of knowledge integration. In the past five years, among others, we surveyed plants, butterflies, birds and mammals at over 120 sites; we interviewed hundreds of people about rural development, living with carnivores, and their aspirations for the future; we involved 18 stakeholder groups in developing scenarios exploring the future; and we prepared a traveling exhibition, an outreach tour, and a bilingual book to share our research findings with local communities. This presentation summarizes key highlights of this research project and considers avenues in which similar approaches could also be useful in other settings.

About the speaker

Joern Fischer is a professor at the Faculty of Sustainability at Leuphana University Lüneburg. He was born in Germany but spent nearly 14 years studying, working, and living in Australia. He completed his PhD in landscape ecology in 2004 at The Australian National University. In 2010, he won a Sofja Kovalevskaja Award by the Alexander von Humboldt Foundation, which funded the research presented here. Professor Fischer has published over 130 scientific works, mostly focusing on the intersection of biodiversity conservation and sustainable development.

Keynote Friday, 23 September

Origins, evolution, management and conservation of semi-natural grasslands in Transylvania

Cristina Craioveanu & László Rákosy

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In explaining the origins and birth of semi-natural grasslands from Transylvania, the authors refer to natural edaphic aspects; emphasize the role of great herds of large herbivores and then anthropogenic influence in its various forms. The present semi-natural grasslands in Transylvania are the result of natural and anthropogenic processes manifested in the last 6000 years. The anthropogenic footprint is stronger in the last 2000 years and plays a decisive role in the last 800-1000 years, since it has become multicultural. In the last 20 years biodiversity in semi-natural grasslands from Transylvania became better known both on national and international levels. On small areas of approximately 20-30 ha impressive numbers have been reported, which culminate with approximately 1000 species of vascular plants, 1400 Lepidoptera species etc. Recent studies (Wilson et al 2012) found even that semi-natural, mesophilous grasslands in the area of Cluj have the highest diversity of flowering plants globally. If, next to the large number of species, we also consider the number of endemic and rare taxa, or world-wide unique plant and animal communities, we would still not have reached the full value of these grasslands. The cultural, aesthetic, recreational values are still very little known and even less harnessed. The uniqueness of these grasslands must be researched and popularized through new biology and ecology studies, including cultural ecology. In order to preserve them as close as possible to the present form, management conservation programs must be developed, based on accurate and in-depth, in-situ studies and not only on “recipes” acquired from literature, from recent studies conducted elsewhere in Europe. The solutions to our problems should come from the local reality, by involving local communities, which are aware of the values they are (or should be) managing in an appropriate way.

About the speakers

Dr. Cristina Craioveanu is lecturer at the Department of Taxonomy and Ecology, Faculty of Biology and Geology, Babeș-Bolyai University Cluj-Napoca. started working with butterfly communities from Transylvanian grasslands in 2001, as part of a research project funded by the Swiss Science Foundation. In 2005 she acquired the PhD title in zoology at Basel University with the thesis: “Effects of grassland management on plants and invertebrates in Transylvania, Romania: A threat to local biodiversity hotspots”. In the following years her research interest was oriented towards rare, endemic and endangered butterfly species (The Transylvanian Blue and Violet Copper and 3 of the Maculinea species).

Dr. László Rákosy is professor at the Department of Taxonomy and Ecology, Faculty of Biology and Geology, Babeș-Bolyai University Cluj-Napoca. His fields of expertise are Ecology, Zoology and Taxonomy. He is an expert in the group of Lepidoptera, and especially in their Taxonomy and population ecology. During the last years he dealt with the effect of grassland management on butterfly diversity and on endangered species.

Assessment of affecting factors on rangelands health in Iran's central Alborz (Case study: Lar rangelands in Tehran province)

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Keywords: Rangeland Health, Sustainable Site, Hydrologic Function, Biotic Integrity, Lar Rangelands

In order to investigate the function in any natural ecosystem, identification and use of health indicators (capacity and capabilities) are important. Rangeland ecosystems are changed like other unsustainable land with occurrence of turbulence. So that, with knowledge of the process of change can be managed properly exercised and took action to improve the situation. Therefore, the objective of this study was achieving to the most important ecological indicators in order to achieve appropriate indicators to assess by rangeland health models. For this purpose, the partly of Lar rangelands in Tehran province under three sites, including key area, exclosure and critical area were selected. The three characteristics of soil and site stability, hydrological function and biotic integrity, 17 factors of rangeland health were evaluated. The results showed that factors of production, composition and distribution of vegetation, structural-functional groups, soil stable and surface soil degradation was as the factors influence in key area. So that the effect of structural-functional groups factor have been more other factors. Also, results showed that factors plant mortality, functional structural groups, invasive plant, bare soil, soil stability, wind erosion and erosion columns were most important affecting factors on changes of health in critical area that index of plant mortality was the most important factor.

Spatial and temporal trends in threats to biodiversity of Anatolian steppes (Turkey)

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Anatolian steppe is a good example of temperate grasslands in terms of high species richness on three biodiversity hotspots and low protection level. Composed of central Anatolian plateau, the eastern Anatolian highlands and the south-eastern Anatolian lower plateau; the land witnessed various social changes especially in the last 100 years, affecting the land use. Here I aimed to assess persistent and novel threats at the regional level, their causes and priority conservation actions based on a systematic review of the regional and national level conservation priorities and expert knowledge obtained through semi-structured questionnaires (n=29 out of 85 invitations, 16 questions). Only 27% of the steppes has “healthy” vegetation and 12% is in good condition in terms of rangeland quality. Both methods revealed that there is an increasing pressure from all 20 types of threats in the last 20 years especially from uncontrolled urban growth, mining, sun and wind energy power stations, road constructions and hydropower schemes. Eastern and south-eastern Anatolia is threatened mainly by persistent threats of unsustainable grazing and agricultural intensification whereas in central Anatolia, other “novel” threats act especially urbanisation, unsustainable underground water use, afforestation, road construction and climate change. The underlying causes of those threats are lack of knowledge and awareness on steppe ecosystem (23% of responses), steppes not perceived as conservation targets (19%), problems in legislation (14%) and lack of policy (14%). In parallel with the causes, the most urgent conservation actions were indicated as education and awareness raising (30%), more research on steppe ecosystems (18%), improving legislation and policies (15%) and effective implementation of legislation (15%). It is assumed to be the economical developmentalist approach and climate change that will cause steppe biodiversity loss in the near future (in five years) and far future (15 years later), respectively, whereas land abandonment and increasing conservation efforts will promote biodiversity. Division of government units responsible for the biodiversity conservation and rangeland use in two different ministries poses a difficulty. Initiation of conservation projects by the Ministry of Forest and Water Affairs targeting steppic species and pilot projects to accommodate with European Union standards is promising but developed methods and measures fail to be integrated into national legislation and programmes.

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The role of traditional ecological knowledge in nature conservation

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Species-rich, semi-natural grasslands are great components of European cultural landscapes. In a few, marginalised corner of our continent these grasslands are still managed by extensive land use systems that are maintained through still surviving traditional ecological knowledge. Our aim is to reveal the characteristics of this knowledge related to high nature value grasslands.

We carried out our research in the Gyimes region of the Eastern Carpathians (Romania), in a heterogeneous cultural landscape. The investigated (Csángó) community has about 1700 members. We studied traditional ecological knowledge and grassland management system from cultural anthropological and ecological aspects, using participatory observations and semi-structured interviews.

Traditional land use system is based on deep ecological knowledge related to the species composition and vegetation of semi-natural grasslands. We found 85 wild plant species that were strongly associated with meadows or pastures by the local farmers. The majority of key (constant and sub-constant) species on semi-natural grasslands are well known by the locals. This knowledge is a basic tool for local farmers to influence vegetation dynamics of grasslands by elements of traditional (extensive) grassland management, like mowing, mowing-date rotation of tracts, oversowing with hayseed etc. Their goal is to keep grasslands in good condition for a long run, and thus ascertain the availability of hay in the needed quantity and quality.

We argue that local farmers have wide-ranging knowledge on ecological processes (species, habitats, vegetation changes); they are aware of the effects of their daily farming activities on vegetation. Understanding existing traditional, low-input grassland management could greatly help to improve our ability to preserve biodiversity in traditionally managed farmlands.

Do public institutions on nature conservation and agriculture contribute to the conservation of species-rich hay meadows? Comparative case study on implementing EU nature conservation policy in Germany and Romania

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In recent decades, to the conservation of species-rich hay meadows throughout Europe has been given major attention. Yet, those habitats are at risk mainly due to intensification or abandonment, even in the countries where extensive traditional farming still exists. The member states still face difficulties on different levels when implementing EU policies. In this paper we (i) compare the implementation of EU conservation policies and (ii) follow the collaboration between institutions for nature conservation and for agriculture in the German federal state of Baden-Württemberg and Romania. We applied a comparative case study design and methods, analysing the following aspects for each case: (1) public administration structure, (2) management of protected areas, (3) reward systems and (4) stakeholders awareness. The results demonstrate that even though the structure of public administration in Germany enables multi-level governance, a functional system itself seems insufficient to assure the favourable conservation status of species-rich hay meadows. In Romania, organisational changes may be needed in the ministerial structures that are responsible for nature conservation and agriculture in order to increase institutional stability and capacity. In both cases, a conservation or agricultural approach to species-rich hay meadows in terms of formal institutional understanding (legislation) cannot cover the complexity of those semi-natural systems; thus it is suggested that there needs to be some mechanism for connecting social-ecological and cultural dimensions.

Herb vegetation diversity and meadow flora under protection regime (based on the study of Central Forest and Polistovsky nature reserves, Russia)

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Keywords: used and abandoned meadows, overgrowth of grasslands, biodiversity, herb vegetation, anthropogenic factor, meadows

The object of our research is herb vegetation and structure of meadow flora under and without the protection regime. It is well known that mainland meadows of the forest zone are formed and maintained by human activities. However after the exclusion of agricultural use grasslands deteriorate and become overgrown with forest. Based on the study of Central Forest and Polistovsky nature reserves we compare the structure of mainland meadow partial floras. We try to check the hypothesis that a significant reduction in species richness, in species saturation, and the disappearance of rare species takes place in the meadows under protection regime.

In the course of our research we have made taxonomic, geographic, coenotic, ecological and biomorphological analyses of meadow flora. Tests were made for a general meadow flora as well as for each meadow flora of the reserves and dedicated meadow coenofloras. The results allowed us to analyse species richness and saturation of their types.

We have allocated 10 types of herbal communities and have revealed particular features of composition and structure of coenofloras for each of these types. We have found significant decrease in species diversity, richness and saturation of many abandoned herbal communities. We discovered that rare and adventive species are more likely to be found in abandoned meadows. As an upshot of our research we have established that the similarity of the species composition in coenofloras is primarily determined by the presence of the anthropogenic factor while local features of the examined territories play only a minor role.

Classification of grassland and wetland vegetation of the Upper Prut River and Upper Siret River within Ukraine

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Keywords: grassland, wetland, syntaxonomy, Prut river, Siret river, Ukrainian Carpathians

The Carpathian Mountains are known biodiversity hotspot in Europe. They have high level of coenotic diversity including in grassland and wetland vegetation. Vegetation of the Ukrainian Carpathians attracted the attention of many researchers, but with phytosociological point of view they are still insufficiently studied. Basins of the Upper Prut River and Upper Siret River within Ukraine is a region where phytosociological study of grassland and wetland vegetation is not actually performed. In this context, the aim of our study was carry out phytosociological analysis of grassland and wetland vegetation of the basins of the Upper Prut River and Upper Siret River within Ukraine and draw up preliminary Synopsis of studied vegetation. Materials for the study were 2,408 relevés made by the authors during 1996-2015, as well as literary and archival sources. All relevés were entered in the TURBOVEG database and included in the Ukrainian Grassland Database (EU-UA-0001 in GIVD). The data analysis was carried out using the PC-Ord provided by the JUICE software with Relative Sorensen index as distance measure and the Flexible beta at -0.25 as Group Linkage method.

Proposed Synopsis includes 8 vegetation classes: *Molinio-Arrhenatheretea* class (*Arrhenatheretalia* order: *Arrhenatherion* and *Cynosurion* alliances; *Poo alpinae-Trisetetalia* order: *Polygono bistortae-Trisetion flavescens* alliance; *Molinietalia caeruleae* order: *Molinion caeruleae* and *Calthion palustris* alliances), *Festuco-Brometea* class (*Brometalia erecti* order: *Cirsio-Brachypodion* and *Bromion erecti* alliances; *Festucetalia valesiaca* order: *Festucion valesiaca* alliance), *Calluno-Ulicetea* class (*Nardetalia strictae* order: *Nardo-Agrostion tenuis* alliance), *Mulgedio-Aconitetea* class (*Adenostyletalia* order: *Adenostylin alliariae* alliance; *Calamagrostietalia villosae* order: *Calamagrostion villosae* alliance; *Rumicetalia alpinae* order: *Rumicion alpinae* alliance), *Elyno-Seslerietea* class (*Seslerietalia albicantis* order: *Festuco saxatilis-Seslerion* alliance), *Phragmito-Magno-Caricetea* class (*Magnocaricetalia* order: *Magnocaricion elatae* alliance), *Oxycocco-Sphagnetetea* class (*Sphagnetalia medii* order: *Sphagnion magellanicum* alliance), *Polygono arenastris-Poëtea annuae* class (*Plantaginietalia majoris* order: *Polygonion avicularis* alliance). The geographical distribution of the syntaxa within the study area, their ecological characteristics, trends of succession and participation of rare species in their composition have been analysed.

Simulating the species occurrence in Serbian grasslands of protected areas

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Keywords: Serbian grasslands, climate changes, plant community simulation

This study took place at three different protected areas, at different parts of Serbia (South-eastern Europe), and its aim was to simulate changes in floristic structure of grasslands due to climate changes. Site 1- Peštersko polje Ramsar site (in procedure to becoming Special Nature reserve)-grassland/ flooded rarely/ grazed frequently; Site 2: Labudovo okno Ramsar site (southern part of Special Nature Reserve Deliblato sands) - grassland/ not flooded/ grazed periodically, mowed frequently; Site 3: Special Nature Reserve Zasavica- grassland/ not flooded/ grazed frequently. Plant communities were analysed at all three sites, one representative was selected per site to simulate the changes in floristic structure. Climate changes were simulated for mean temperatures and precipitations using EBU-POM climate model, for A1B IPCC SRES scenario, period 1951-2100, also sunshine duration and soil moisture for period 1979-2100. Soil properties were determined at exact locations where phytocoenological relevés were taken. Canonical Correspondence Analysis of plant communities was performed, with humidity and temperature as indicator value gradients. Simulation of plant's response to climate and environmental changes was undertaken using VSDpStudio (Version 5.5, 2001, 2015 Alterra, CCE) for period 1980-2100. Overall conclusions are: at all tree sites, relative abundance of many species drops down around 2040-2060. Cosmopolites and thermophilic species will be more accustomed to new conditions. Grasses: *Dactylis glomerata*, *Lolium perenne* and *Agrostis capillaris* will be the most stable species in future years. Grazing, mowing and flooding are important factors for development of semi-natural grasslands, and will be added to future research.

The *Helianthemo-Thymetea* class communities within the Central Russian Upland (Ukrainian part)

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Keywords: chalk vegetation, *Helianthemo-Thymetea*, syntaxonomy, Central Russian Upland

The south-western shoots of the Central Russian Upland are characterised by the unique plant communities that formed on the chalk outcrops. Litvinov, Taliev, and others paid attention to chalk vegetation in the 19th century. The syntaxonomic classification of these communities is currently being subject to debate. Some authors consider them at the level of class *Helianthemo-Thymetea* Romashchenko, Didukh et V. Solomakha 1996 and the others as *Hyssopetalia cretacei* Didukh 1989 within the class *Festuco-Brometea* Br.-Br. et Tx. ex Soo 1947. Apparently, in a broader analysis this group is revealed to be closer to *Drypidetea spinosae* Quezel 1964. We have analysed the chalk outcrops vegetation on the territory of Ukraine. For the analysis there were taken 236 geobotanical descriptions of the chalk vegetation and at about 300 descriptions of steppe vegetation (1988 - 2016).

The analysis of chalk vegetation showed a clear separation from steppe communities *Festuco-Brometea*. The *Helianthemo-Thymetea* communities divided into two alliances: *Artemisio hololeucae-Hyssopion cretacei* and *Centaureo carbonatae-Koelerion talievii*. The first union includes typical chalk outcrops communities and the second one covers petrophytic steppes. Due to the presence and dominance of the hyper-carbonatophiles (*Helianthemum canum*, *Thymus calcareus*, *Erucastrum cretaceum*, *Euphorbia cretophila*), carbonatophiles (*Koeleria talievii*, *Linum hirsutum*, *Astragalus austriacus*, *Hedysarum grandiflorum*, *Asperula tephrocarpa*) and absence of steppe species (*Medicago falcata*, *Agrimonia eupatoria*, *Veronica incana*, *Ranunculus polyanthemos*, *Achillea millefolium*, *Potentilla argentea*, *Falcaria vulgaris*, *Plantago media*, *Elytrigia intermedia*, *Carex praecox*, *Tragopogon major*) we can refer the communities of *Centaureo carbonatae-Koelerion talievii* to the *Helianthemo-Thymetea*.

The classification scheme of chalk vegetation appears as follows:

Cl. *Helianthemo-Thymetea* Romashchenko, Didukh et V. Solomakha 1996

Ord. *Thymo cretacei-Hyssopetalia cretacei* Didukh 1989

All. *Artemisio hololeucae-Hyssopion cretacei* Romashchenko, Didukh et V. Solomakha 1996

Ass. *Artemisio nutantis-Plantaginetum salsae* Didukh 1989

Ass. *Onosmo tanaiticae-Androsacietum kozo-poljanskii* Didukh, Romaschenko et V. Solomakha, 1996

Ass. *Thymo-cretacei-Hyssopetum cretacei* Didukh 1989

Ass. *Artemisio hololeucae-Polygaletum cretaceae* Didukh 1989

All. *Centaureo carbonatae-Koelerion talievii* Romashchenko, Didukh et V. Solomakha 1996

Ass. *Euphorbio cretophilae-Jurinetum brachycephalae* Didukh 1989

Ass. *Jurineo brachycephalae-Koelerietum talievii* Romashchenko, Didukh et V. Solomakha 1996

Ass. *Bupleuro falcatae-Stipetum capillatae* Romashchenko, Didukh et V. Solomakha 1996

Ass. *Scrophulario cretacei-Helianthemetum cretacei* Didukh, Romaschenko et V. Solomakha, 1996

Ass. *Gypsophilo oligospermae-Campanuletum sibiricae* Romashchenko, Didukh et V. Solomakha 1996

Ass. *Pimpinello titanophillae-Artemisietum salsoloides* Didukh 1989

Ass. *Carici pediformis-Salvietum nutantis* ass. nov. prov.

Ass. *Androsacio koso-poljanskii-Caricetum humilis* Didukh, Korotchenko, 1998.

What is the effect of a perennial invasive species (*Asclepias syriaca*) on the regeneration of sandy grassland?

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Keywords: secondary succession, invasive species, sand, old-field

The invasion of alien species can cause long-lasting and widely impact on plant communities, especially regarding their diversity, functioning and regeneration ability. There is a discussion on how to measure and evaluate the effect of invasive species on original community. Often effect of invasion process is estimated based on snapshots or space-for-time substitutions, however it can have be misleading.

Our aim was to study the spontaneous regeneration of abandoned arable lands and to determine the role of a perennial neophyte species in this process. We asked whether the neophyte species, especially the invasive perennial species, *Asclepias syriaca* have any effect on this process: Can it really outpace the native species or is it just an additional perennial species among others?

We conducted our study in the Hungarian lowland, in the sandy area between the Danube and Tisza rivers. We studied the vegetation of old-fields of 4 different age-groups (abandoned 35-26, 25-13, 12-7, 6-2 years before 2000) from 2000 to 2010. In 2015 a management (cutting and herbicide application) was carried out against invasive species in the study area by the Nature Conservation Service. We checked also for first effects of this management.

We found that the total abundance of neophyte species decreased with time, but the abundance of *Asclepias syriaca* increased in every age-group. In the meantime the abundance of native perennial species increased only on recently abandoned fields. There was a negative correlation between the changes of *Asclepias syriaca* abundance from 2000 to 2010 and the changes of perennial or sandy specialist species from 2000 to 2010. It clearly indicates a negative impact of *Asclepias syriaca* on the regeneration of old-fields: the presence of this perennial neophyte species hampers the increasing of abundance of the perennial specialist species of this potential vegetation: sandy grassland. The mechanism underlying this phenomena is not clear, it needs further study.

Grassland vegetation on the national park Galičica (SW Macedonia)

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Keywords: new grassland association, *Saturejo-Thymion* (*Festuco-Brometea*)

This study deals with the syntaxonomic position and the ecological characteristics of the dry grasslands on the territory of the national park Galičica. Dry grasslands have an important role in sustaining the biodiversity of national park Galičica by harbouring many rare and endangered plant species. As secondary communities in the territory of the examined area they are developing in the belt of these forest communities: *Fraxino orni-Quercetum petraeae*, *Ostryo carpinifoliae-Quercetum cerris* and *Fraxino orni-Quercetum cerris*, and some in the lower belt of beech forest, at an altitude of 700-1200m.

Field researches were realised during the year 2009 and 2010, on many locations in the zone of dry grasslands, in the region of the national park Galičica (SW part of Republic of Macedonia).

Vegetation investigations were realised by the classical European method (Braun-Blanquet 1964; Westhoff & van der Maarel, 1973).

Vegetation relevés (taken by our team and other authors) were added in the Turboveg data base. Various multivariate analyses were used for this purpose, involving computer program as JUICE 6.4, using methods of hierarchical classification and ordinance. Differential species were determined by using statistical measures (Fidelity measure, phi coefficient, u-value) and others.

To determine the syntaxonomic position of the investigated vegetation type, a database was composed which includes 278 vegetation relevés (50 from the investigated area and 230 from literary sources) which were subjected to cluster analysis by the computer program Juice (classification method Twinspan). After a comprehensive analysis and comparison with the previously studied associations on the territory of the Republic of Macedonia and the surrounding area, it was concluded that the studied area is clearly differentiated as vegetation unity. By preparing a synoptic table with the Juice program, we got diagnostic taxa, which differentiate this community from the other associations: *Alyssum strigosum*, *Anthemis arvensis*, *Bupleurum gussonei*, *Cerastium brachypetalum* subsp. *roeseri*, *Clinopodium acinos*, *Elytrigia intermedia*, *Sideritis montana* subsp. *remota* and *Trifolium dalmaticum*. Named as ass. *Siderito montanae-Trifolietum dalmaticae* ass. nova belong to the *Saturejo-Thymion* (*Astragalo-Potentilletalia*, *Festuco-Brometea*). Its geographical distribution, climatic and ecological characteristics are provided. The presence and percentage of life forms and the areal-types at the plant communities were analysed.

Effects of local environmental factors on the species composition of loess grassland fragments - A case study on isolated kurgans

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Keywords: isolation, fragmented landscape, cultural monument, steppe, agri-environmental scheme

Land use changes resulted in a considerable loss and isolation of semi-natural grasslands in Eurasia. In intensively used agricultural landscapes the remnants of semi-natural vegetation and grassland species could persist only in small habitat islands embedded in a hostile matrix. In the steppe and forest steppe zone burial mounds, so-called kurgans, have the potential to preserve grassland biodiversity. Understanding the underlying mechanisms driving biodiversity in these isolated habitat fragments is crucial for understanding ecological processes shaping their vegetation and for designing effective strategies for their protection. We sampled the vegetation of 44 kurgans in the Carpathian Basin and studied the effects of habitat area, slope, recent disturbance, historical destruction and level of woody encroachment on the species number and cover of grassland plant species typical to loess steppes and on problem species (competitor weedy species). We used model selection techniques and linear models for selecting relevant factors affecting species composition of grassland fragments. We found that kurgans have a considerable biodiversity conservation potential, which is especially supported by their steep slopes providing adequate habitat conditions and micro-climate for steppic grassland plant species. However, grassland species are threatened both by recent disturbances and encroachment of alien woody species, especially *Robinia pseudoacacia*. Factors supporting grassland species suppressed problem species via providing unfavourable environmental conditions and putting them in a competitive disadvantage. We found that woody encroachment and current disturbances affect the vast majority of kurgans, posing a great threat for grassland species, thus there is an urgent need to integrate active conservation actions into the current passive protection of kurgans.

Can we restore dry grasslands without grazing? – Impact of restorative shrub removal and mowing on dry grasslands plant community structure

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Keywords: grassland specialist; management; plants; Poland; restoration

Nowadays, after cessation of traditional pastoral use, dry grasslands in nemoral zone of Europe are threatened with secondary succession. Their maintenance and restoration is possible only with the use of active conservation measures. Reestablishment of grazing is well-known and approved method of dry grassland restoration and conservation. However, it requires a lot of labour and can be costly especially in areas where animal husbandry has been totally abandoned. Additionally, in a landscape where dry grasslands are preserved as small scattered patches applying grazing is difficult due to organisational and logistical issues. Due to the abovementioned issues many dry grassland patches are maintained by nature conservation authorities only with the use of infrequent (every few years) tree and shrub removal. More and more often also mowing is applied to dry grasslands, which do not have chance to be grazed. Such management is even supported by Polish agri-environmental schemes.

To test how tree and shrub removal and mowing influence dry grassland plant community structure we established a split-block fully-factorial experimental design within three dry grassland patches located at the edge of Bug and Vistula valleys (south-eastern Poland). In 2013 seven blocks (including control, mown and raked, shrub removed, and both treatments plots) have been established and original state of vegetation has been sampled. Just after the management have been applied. Subsequently in following years the monitoring of vegetation and management practices were repeated. Noted species have been divided into target (dry grassland specialists), neutral and undesirable (trees, shrubs, ruderal and expansive species) ones. Treatments were compared using means and confidence intervals of cumulative cover of the abovementioned species groups.

Results showed that tree and shrub removal was positively influencing dry grassland specialists. Mowing had a positive influence on that group only when it was applied together with the shrub removal. At the same time non-target species increased their cover in all treatments except from the only shrub removed one. This phenomenon could be explained by successional changes in control plots and too severe disturbance in mown plots.

Our results confirm the positive effects of shrub removal which could be observed just after this practice. The effects of mowing were more disruptive. However, we think that the response of community to this kind of practice can take more time.

The battle over grassland habitats: are agri-environment and Natura 2000 payments in conflict in Romania?

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Romania joined the EU in 2007, and since then more than 500 Natura 2000 sites have been designated that cover more than 20% of the country's territory. Because Natura 2000 status may bring restrictions or extra costs to land-owners, Natura 2000 payments are ready as a measure to compensate or encourage owners/users of land to adopt certain management decisions over others. Romania chose to link Natura 2000 payments to management measures to be developed as part of the management plans. However, the elaboration of these instruments proved to be a long process, and by 2016 only a handful of Natura 2000 sites have an official management plan in place. On the other hand, already since the first year of joining EU, agri-environment payments have been introduced and they have been developed ever since. Agri-environment payments are available now for HNV grasslands, certain bird habitats and *Maculinea* sites as distinct packages. Regarding their purpose, the agri-environment payments are similar to Natura 2000 payments - they both serve the goal to maintain or encourage land use practices that are favourable for wildlife. In practice, agri-environment schemes are voluntary, while Natura 2000 schemes compulsory (or at least most people imagine them like that). In this paper, I review a number of Romanian Natura 2000 management plans to identify and classify management measures that are relevant for grasslands, and compare them to existing agri-environment measures. At the same time I provide an analysis of agri-environment measures regarding their structure, scientific background and efficiency, as far as official data allow. It turns out that there is a large overlap between management measures and the requirements of agri-environment schemes, which creates a very difficult situation in the cases where the two measures have a spatial overlap. Some proposals and scenarios for managing these situations are discussed too.

Mapping dry grasslands in North-Western part of the Caspian lowland

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Keywords: Dry Grasslands, Caspian lowland, Kalmykia, Satellite images

We have studied the distribution of open dry grasslands in North-Western part of the Caspian lowland (Republic of Kalmykia) in 2011-2016. The study is carried out under the EU / CoE Joint Programme "Emerald Network of Nature Protection Sites, Phase II", as well as in the framework of the Steppe Project of UNDP, GEF and Ministry of Natural Resources and Environment of the Russian Federation. The "Chiornye Zemli" State Natural Biosphere Reserve have kindly hosted the research team.

Methods include field observations and descriptions of the vegetation cover in model fixed points (list of species, their abundance and predominating life forms); comparison of field data with satellite images; analysis of the satellite images.

We have fixed about 300 model points in different parts of the project area and compared the field data with the LandSat-7 and the LandSat-8 satellite images (30 metres per pixel resolution). Variability of the identified vegetation shows a mosaic with patches usually smaller than the resolution of the satellite image. This interferes with implementing the automatic classification of satellite imagery. Using the Sentinel satellite images (20 metres per pixel resolution) decreased the problems but not completely. Therefore we had to implement the expert analysis based on some additional characteristics of considered features as their configuration, inner structure, land use history (if known) and some other.

There are sites with predominating turf grasses in the Northern part of Kalmykia. Grasslands with a significant participation of *Artemisia* are widespread on the Yergeny Hills. Fine mosaic of grass, sagebrush, and halophytic plants patches covers the Caspian lowland depending on soils and their salinisation, overgrazing, and fires. We can conclude that in the Caspian lowland we observe a very flat gradient of global climatic factors actually being in changes. Therefore local factors become often decisive in defining vegetation state and trends.

In general, various types of the habitat types of European importance **E1.2** Perennial calcareous grassland and basic steppes and **E6.2** Continental inland salt steppes (EUNIS classification) jointly cover the high proportion of the analysed territories of the "Chiornye Zemli" State Natural Biosphere Reserve, subordinate Federal Preserves, Protected Areas of Republican importance and many territories under extensive livestock. This is an indicator of the high conservation value of the Kalmyk grasslands both protected and traditionally used. At the same time areas around sheepfolds are overgrazed. Some grasslands along roads are destroyed by forest plantations being unhappy in many cases.

The meadow vegetation management of delta of Kiliya mouth of Danube river (Ukraine)

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Keywords: management, meadow vegetation, delta of Danube river, Ukraine

The meadow vegetation of delta of Kiliya mouth of Danube river is represented by 27 associations from classes *Phragmito-Magno-Caricetea*, *Festuco-Puccinellietea*, *Molinio-Arrhenatheretea* and *Juncetea maritimi*. The historical aspect of meadow vegetation is suffered mainly grazing and mowing, which in the second half of the twentieth century has become catastrophic. With the creation of the Danube Biosphere Reserve in 2009 and the expansion of its area to 50,252.9 ha, due to significant changes in the environmental management of the region on territory have developed demutation processes. They were occurring through a stage of domination of weed species, in the direction of forming communities of dominated K-strategists species. There are *Glyceria maxima*, *Phalaroides arundinacea* (*Glycerio-Sparganion* and *Phalaridion arundinaceae*) for marshy meadows; *Juncus maritimus*, *Elytrigia elongata*, *Carex distans* (*Juncion maritimi*, *Plantagini salsae-Artemision santonicae*, *Scorzonero-Juncion gerardii*, *Puccinellion giganteae*) for saline meadows; *Festuca orientalis*, *Deschampsia cespitosa*, *Alopecurus pratensis* for true meadows; and *Elytrigia repens*, *Cynodon dactylon*, *Festuca valesiaca* (*Festuco valesiaca-Limonion gmelinii*) for steppe meadows. Under these conditions, within the part of northern intrusion, species that are rare in the steppe region have declined sharply. Overgrowing by shrubs *Amorpha fruticosa*, *Elaeagnus angustifolia* and *Tamarix ramosissima* is occurring. In areas where human influence has been removed, there has been a negative impact of excessive accumulation of non-utilised plant mass. It was proved that the regime of absolute protected areas leads to a significant depletion of the abundance and diversity of meadow vegetation.

We mowed the grass on experimental plots of 100 m² three times per year for 3 years, with normalised grazing cattle and burning in the winter in areas outside the absolutely protected area to preserve phytodiversity of meadow vegetation on the territory of the Danube Biosphere Reserve during 2000-2015.

It was established that for communities of marshy meadows single summer mowing or burning in the winter is optimal, for salt meadows – once summer mowing, for real meadows – grazing cattle at the rate of 1-2 head per hectare, or one-time summer mowing, for steppe meadows – also grazing cattle at the rate of 2-3 head per hectare, or sheep and goats at the rate of 15-20 head per hectare.

Due to the commissioning of the ship channel "Danube-Black Sea", which too caused redistribution volumes of wastewater sleeves of delta, as due to the climatic changes, monitoring of the state is carried out, in particular of the meadow vegetation, and will be amended in the management.

Effects of spring- and summertime prescribed burning on spores and colonisation of mycorrhiza and five plant species in a dry grassland

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Keywords: prescribed fire, grassland restoration, soil ecology, plant community dynamics

Plant-mycorrhiza symbiosis significantly affects plant community dynamic and composition in dry grasslands. On the other hand, fire is a natural component of many dry grasslands worldwide. Prescribed fire, as a restoration technique, may alter the plant-mycorrhiza relationships. However, its effects may vary on different plant species, and depending on the time of burning. Two prescribed fires were applied on spring (20th April) and autumn (30th October) 2015, in a dry grassland, Dehbar, Torghabeh, Northeast Iran. Soil sampling and mycorrhiza studies were conducted three times; *i.e.* 15th May 2015 (T1) and 15th May 2016 (T2) for spring burning (SB) also 15th of May 2016 (T3) for autumn burning (AB). Spring time burning (SB) initially (T1) increased (55%) mycorrhiza spore density in the burnt plots, but its effects were diminished after one year (T2). Mycorrhiza colonisation rate was also increased after SB, but it was higher in T1 (50%) than T2 (26%). Autumn burning increased both mycorrhiza spore density (33.3%) and inoculations (11.3%). In terms of plant species comparisons, the prescribed fires (SB & AB) increased mycorrhiza symbiosis (spore density and colonisation rate) with perennial shrubs (*Astragalus gossypinus* and *Artemisia aucheri*) and a rhizomatous grass (*Agropyron trichophorum*), but decreased symbiosis with ephemeral geophyte grass *Poa bulbosa*. Prescribed burning increased the mycorrhiza symbiosis with the bunchgrass *Stipa arabica* in the short term (T1) but reduced it after the relatively longer times in T2 and T3. In conclusions, prescribed burning may be beneficial for plant-mycorrhiza relationships in dry grasslands. Prescribed spring fire is more preferred, as it causes more positive effects on mycorrhiza symbiosis with perennial shrubs and grasses but negatively reduces symbiosis with the invasive and ephemeral species such as *Poa bulbosa*.

Spiders as indicators of the dry grassland type and management

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Keywords: Spider assemblages, Araneae, indicators, dry grassland

Spiders (*Araneae*) are a numerous and diverse group of arthropods that inhabit all terrestrial biotopes. Being very sensitive to microclimatic conditions, they respond to site topography and humidity, changes in vegetation height and structure, and all natural or man-caused disturbances. Spiders are recommended to be included in monitoring and assessment of the conservation status of dry grass ecosystems.

In the East European Plain, the local spider fauna is the richest in the forb-bunchgrass steppes and the southern variant of meadow steppes (104–105 species). Northwards in the meadow steppes and southwards in the bunchgrass steppes species composition decreases to 88–92 species. In the north, it is less specific and includes meadow and forest-edge species. Azonal steppes, like sandy, chalky and stony ones, are rich in steppe specialists and serve as a corridor for their spreading to the north. However, their local fauna is the poorest, 60–70 species.

In each steppe type, spider assemblages depend on the site management. In general, spiders prefer undisturbed plots, being the richest in both species and numbers. The wetter conditions, the easier spiders survive hay mowing and/or grazing. Various ecological groups of spiders recover after disturbance in different ways. Herb dwellers are the least vulnerable. On the third year after steppe fire or mowing, they recover almost completely being similar to spider assemblages of the undisturbed plots. However the web-builders are more sensitive to intensive grazing, as the cattle destroys mechanically their nets.

Active ground-dwellers show different reactions. Depending on the site specificity and vegetation, they can be more abundant either at mowed and grazed or at the strictly preserved plots. Thus, thickets of *Caragana frutex* developed in the undisturbed forb-bunchgrass steppes are less inhabited by spiders than pastures and mowed steppes. After extent fires, the first-year spider assemblages are characterised by poor species composition and predominance of the generalist species. They recover on the second–third year and include many xerophilous species. Fires at small areas cause insignificant short-term changes in the ground-dwelling spider assemblages.

Litter-dependent spiders do not recover after fires at least three-five years, they also hardly tolerate annual hay making. In case of constant disturbance, rare species may disappear from regional faunas as it was described on the example of *Neottiura suaveolens* (Simon, 1879). In the grazed steppe, less active ground-dwellers find suitable microhabitats in the short turf and form a specific pasture assemblage.

Impact of shrub encroachment on species and functional diversity in dry basiphilous grasslands in Transylvania

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Keywords: Dry grassland, woody species invasion, litter accumulation, species diversity, functional diversity, fire, Transylvania

Questions: The semi-natural dry basiphilous grasslands in the Transylvanian Basin of Romania are among the most species-rich grasslands worldwide. Currently they are under threat due to land use changes and subsequent litter accumulation and invasion by native and non-native woody species. To halt secondary succession, shrub-encroached grasslands have progressively been set on fire by farmers in recent years. Since particularly the effects of shrub encroachment on plant species diversity and structure as well as the impact of fire on woody species establishment are not well documented for these grasslands, we ask: (i) In which ways does woody species encroachment affect plant species and functional diversity, (ii) do native and non-native woody species differ with respect to their impact on grassland species composition and structure, and (iii) can controlled burning be applied as a useful management tool to control shrub encroachment and to preserve species- and structural diversity of these grasslands?

Location: Up to 30 dry basiphilous grassland sites in the Transylvanian Basin will be sampled from June to August 2016.

Methods: We will compare vegetation composition and structure, soil conditions as well as temperature and light availability between densely encroached plots, original grasslands and a transitional zone between these two types. In addition to the assessment of species richness and diversity and measures directly derived from these (e.g. Shannon, evenness), measures of functional diversity will be employed.

Expected results and outlook: We will present preliminary results from our field study. We expect that increasing shrub encroachment in Transylvanian dry basiphilous grasslands will be accompanied by a decrease in grassland species diversity and functional diversity, a homogenisation of the functional trait space and an increase in number of shade- and competition-tolerating plant species. We expect non-native woody species to have more pronounced effects on grassland species composition and structure compared to native woody species, e.g. through their ability to more intensively modify soil conditions by N-fixation. Fire, a possible management tool to halt secondary succession in these grasslands, will likely decrease the cover of shrub and tree species but at the same time favour only a subset of the original grassland species. The outcomes of our study will extend the theoretical base for an improved management of dry basiphilous grasslands in Transylvania and the conservation of these highly diverse ecosystems.

Re-naturalisation of an industrial area: Restoring dry grassland – open oak forest steppe

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The move from theory to practice in the management and conservation of semi-natural communities demands the involvement of business actors. Practices helping scientifically based habitat restoration programs in the business sector should be made available to support further joint projects.

Hierarchical restoration prioritisation was applied to select best target for habitat reconstruction at a Hungarian industrial area in the Nyírség region, Hungary (47° 57' N, 21° 39' E). Multiple Potential Natural Vegetation Model, a novel approach supported restoration prioritisation satisfying both ecological (sustainability and nature conservation value) and other constrains (feasibility, rapid green surface, amenity and education value). Dry grasslands (*Pulsatillo hungaricae-Festucetum rupicola*, *Potentillo arenariae-Festucetum pseudovinae*, *Festuco vaginatae-Corynephorretum*) and steppe oak forest (*Festuco rupicola-Quercetum roboris*) endemic for the Pannonian region were selected as target. The steppe forest was a kind of vision with a goal to reconstruct the physiognomy (wooded and open ecological mosaics) rather than the total historic species pool.

Approximately 15 ha were restored in 4 parcels. At each parcels either *Festuca pseudovina* (seeding rate: 30 kg/ha) or *F. rupicola* (seeding rate: 60 kg/ha) were seeded or early summer hay originating from semi-natural grasslands was distributed to provide the matrix species. We used hay also as mulching to control erosion by wind and for weed suppression. 209 packages of hay of (200-250 kg each) were distributed either for seeds (early and late harvest) or as mulch. Further 59 grass and forb species were added in the form of seeds to diversify the grass matrix. 30 % of the grassland area was planted with trees and shrubs to create forest patches of varying size (300-3000 m²) and shape, using eleven tree and eleven shrub species.

The seeding of fescue species and haying was successful to develop a grassland matrix of 50-80 % coverage. Approximately 90 % of additional species established and spread, resulting in low diversity dry grasslands. There was a massive die off (more than 80%) of saplings in 2014 due to the severe drought throughout the year, but the survival rate of trees and shrubs is above 50 % after re-planting in 2015 November.

Restoration of *Stipa* spp. grasslands in Lounské Středohoří (southern part of České středohoří Mts, Czech Republic)

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Keywords: Ceske stredohori, steppe, restoration, *Stipa*, *Astragalus*, shrub removal

Lounské středohoří belongs to the extrazonal steppe region. Similarities to steppe formations of continental East Europe were distinguished by Martinovský (1967). The Raná and Oblík hills are at the western edge of the distribution of *Stipa zalesskii* and *Helictotrichon desertorum*. *Stipa* spp. grasslands gradually diminished due to rich soils arable land demands and overgrazing till 1950s and undergrazing or abandonment of the land in 1990s. This resulted in invasive trees, expansive shrubs and *Arrhenatherum elatius* growth spread. First restoration attempts started in 1984 - elimination of invasive *Robinia pseudoacacia* at Oblík hill, slow re-introduction of extensive sheep and goat grazing and trampling in 1995. The most intensive restoration of 250 ha started in 2011 (LIFE09 NAT/CZ/000363 project). Existing *Stipa* spp. grasslands rests, potential dry grasslands growth covered up to 95% by expansive *Crataegus* sp., *Prunus spinosa*, *Rosa canina* etc. were restored. Impacts of different management types and pressure (shrubs and trees removal, grazing) are observed at 30 fixed permanent plots (abundance, dominance). Visible abundance and distribution changes of 30 steppe species are monitored extensively, e.g. *Helictotrichon desertorum*, five *Stipa* spp., three *Astragalus* spp., *Oxytropis pilosa*, *Anthericum liliago*, *Viola ambigua* and *Pulsatilla pratensis*. *Stipa* spp. spreading was recorded already in the second year. However, multiple shrub elimination has been needed at most sites (branches growth exceeds 1 m/year). Experimental shrub removal showed even higher branches density than prior elimination after 2 years. Restored areas showed dynamical steppe species saturation already in the third year. *Stipa pennata* and *S. pulcherrima* appeared at some sites already in the second year in direct proportion to rich seed source distance or lasting soil seed source and germination capacity. Higher grazing and trampling pressure minimised the spreading of *Arrhenatherum* and shrubs, supported target species *Rosa elliptica*. Xerothermic species react at higher grazing and trampling pressure with ascending abundance and descending dominance. With higher pasture pressure the *Stipa* spp. gradually loses dominance and fertility (grazed seeds). Seed dispersal to other close restored sites was than limited. Rotating sheep herd transferred *Stipa tirsia* to new sites. *Astragalus danicus* reacted at grazing re-introduction to certain point positively. Mowing management was positive for *Spermophilus citellus* population spread. Repeatedly mowed sites demonstrated rapid spread of mosses and limited steppe plant species disperse. Mosaic and staging of management measures are essential for steppe grassland spontaneous succession. How detailed in planning or condition creation should we be for stable and long-term steppe restoration, remains a question.

Segetal vegetation in the Ciuc Basin neighbouring Miercurea-Ciuc (Eastern Carpathians Romania)

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Keywords: segetal vegetation, landscape change, agricultural intensification, extensive agriculture, weed diversity, crop diversity

The biodiversity of the montane hay meadows nearby Miercurea Ciuc and the grassland areas are well-analysed and known worldwide for their richness. The intramontanic Middle Ciuc Basin is located close by. It is characterised by a high dominance of small-scale and subsistence agriculture with a punctual high percentage of arable fields which give a great tribute to the floral biodiversity (segetal vegetation) in the area. To point out representative relations between the agriculture use and the vegetation itself in the Middle Ciuc Basin the biodiversity was measured within an area of 35.8 km² in the Middle Ciuc Basin and quantitatively analysed in dependence on agriculture farming and natural conditions. The results have been classified and evaluated on vegetation aspects. By applying the Braun Blanquet system 200 different arable fields, each plot measuring an area of 25 m², have been analysed with a result of a total amount of 133 species. Nine species from the Red Lists from Germany for arable fields are included. On average 13.1 species have been found on one plot. With a high percentage of 30%, the hemicryptophyte species indicate the impact of an extensive agriculture. The data were evaluated with the Ellenberg Indicator values and showed an average nitrogen value of 5.6 which indicates an extensive usage without any eutrophication in the region. Also the total area is dominated from a high diversity of different main crops. The evaluation of natural conditions, such as height above sea level, hillslope, exposure, soil type (n=200), pH- values (n=48) and further soil chemical analysis characterise the area as favourable for agriculture farming with loamy- clayey soils and a good base supply. In general the segetal vegetation is connected with the cultivation of the main summer and winter crops and due to this, requires a different farming management. The results illustrate this aspect with clearly different amounts of winter, respectively summer green species. This aspect is also shown in the DCA analysis, where the different species are dependent on the cultivation of winter and summer crops. Coherences between natural conditions and the biodiversity of the segetal flora could not be linked in any identifiable relationship.

There is still more research needed on segetal vegetation in the regional area, but in long term perspective and in reference to the global development of agriculture structure, the high amount of segetal vegetation biodiversity in the basin should be preserved.

Role of traditional ecological knowledge in conservation of Carpathian grasslands

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Keywords: traditional ecological knowledge, Carpathians, semi-natural grasslands, management

Carpathian grasslands are extremely rich in species and types. Several species-richest grasslands in the world were recorded in the Carpathians. Numerous vascular plants are endemic to grassland habitats of the Carpathians or their subunits. Numerous types of natural or semi-natural grasslands are confined in their distribution to the Carpathian Mts. Along with the habitat conditions; historical development and traditional agriculture have shaped the recent Carpathian grasslands. To maintain this extraordinary diversity, not only species and habitats should be conserved, it is necessary to maintain the processes, which contributed to grassland formation and evolution. Recently, the decline of the traditional rural culture evokes questions on the proper and efficient grassland conservation without maintaining the principal driving force and using just modern analogies of something that already disappeared. How we can get and apply the traditional ecological knowledge and what should be its role in recent grassland conservation? How the maintained traditional rural culture in the Carpathians can contribute to grassland conservation at the European scale? These and related topics will be presented in my contribution.

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Grazing intensity effects on the vegetation and soil type in a North African pseudo-savanna

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Keywords: rangelands, vegetation cover, grazing pressure, soil type

The main objective of our study was to determine degree of pastures and to evaluate the impact of grazing on the floristic diversity and dynamic of plant communities of rangelands in Bouhedma national park and its adjacent areas. Forty sample plots were selected using the method of stratification to determine cover vegetation, degree of grazing, counting number of excrement for wild and domestic animals. Results obtained indicated that the floristic composition was characterised by a high diversity level of flora inside the park. The floristic richness is important especially in the plain and wadi beds. The botanical analyses show that *Gymnocarpos decander*, *Rhanterium suaveolens* and *Retama raetam* have a high proportion in many areas. Faecal analysis of wild animals inside the park shows that antelopes pasture plains and open environments and they move much to make the selections of palatable species. In the outside of the park, the floristic composition was characterised by a low diversity level of flora. The floristic composition showed that the plant communities are characterised by the non-palatable species like *Astragalus armatus*, *Atractylis serratuloides* and *Allium roseum*. The important ecosystem degradation is visible outside the park because of the great pressure on species and overgrazing. Analysis of faeces of domestic animals showed the presence of large numbers of sheep, goats, cattle, camels and horses outside the park. Finally we noticed that unlike antelopes and because of the lack of palatable species, domestic animal grazed all moderately palatable species and in many cases non-palatable species due to the large number of livestock which exists outside of the park. The magnitude of this pressure can be seen with soil type. The sandy and gravelly soils was more diversified and high more productive than limestone and loamy soil, whereas the latter were more resistant to grazing.

Rangeland yield variation and floristic composition in Bouhedma National Park

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Keywords: Floristic composition, Rangeland production, vegetation cover, Natural pasture, National Park

Rangelands represent the most important feed sources for wild animal species in Bouhedma National Park. The objective of the present study was to investigate rangeland to explain yield variations and floristic composition of a natural pasture in the protected area of Borj Bouhedma (Bouhedma National Park). Twenty sample plots were selected using the method of stratification to determine vegetation covering (cover-abundance scale) and to inventory the floristic composition. The pastoral production is determined using a destructive method. Ten sample plots, of one m² each, were selected to determine biomass of species (Fresh matter). Results obtained indicated that the floristic composition was characterised by a high diversity level of flora and revealed the presence of 88 species. The floristic richness is important especially in the plain of the park on the deep soil and wadi beds. The floristic composition showed that the plant communities of the natural pasture are characterised by the dominance of annual species (67%). The botanical analyses show that *Gymnocarpus decander*, *Rhanterium suaveolens*, *Retama raetam* and *Stipa capensis* have a high proportion in many areas. In many place of the park, the continuous use of pastoral resources has considerably reduced the palatable pasture species and has allowed the appearance of low pastoral value species such as *Hamada schmittiana*, *Astragalus armatus*, *Arisarum vulgare* and *Allium roseum*. The results show large yield variations, the biomass produced varies between 621.4 kg FM of Fresh matter (FM ha⁻¹) and 1465.9 of Fresh matter (FM ha⁻¹). In rocky and stony soil, the results indicated that this pasture is characterised by limited biomass production and it should be regenerated in order to assure a sustainable productivity of pastoral potential to wild animal species.

The LIFE project Integrated Protection of Rare Butterfly Species of Non-forest Habitats in the Czech Republic and Slovakia – ”Butterflies CR – SR“

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Keywords: LIFE project; Natura 2000; Grasslands; Butterfly species

The objective of the project is to contribute to halt the loss of biodiversity and strengthening the Natura 2000 network in the project area through the active protection of non-forest habitats and species of Community and national importance, through applying suitable management, and by maintaining and restoring their favourable conservation status.

Target species: *Colias myrmidone*, *Parnassius mnemosyne*, *Parnassius apollo*, *Maculinea arion*, *Maculinea nausithous*, *Maculinea teleius*, *Maculinea alcon*, *Lycaena dispar*, *Eriogaster catax*, *Euplagia quadripunctaria*.

Main conservation issues: 1) Succession of woody vegetation (site overgrowing) due to absence of traditional management in non-forest habitats; 2) Changes in traditional management methods at non-forest sites; 3) Increasing fragmentation, isolation and homogenisation of non-forest habitats.

The core conservation actions: Introduction and improvement of traditional management of non-forest habitats in White Carpathian Mts; Development of new CAP subsidy programmes aimed at the important butterfly habitats and its practical verification within the project area; Special conservation measures for the threatened species of butterflies; Restoration management of non-forest habitats (mowing, grazing).

Coordinating beneficiary: Nature Conservation Agency of the Czech Republic

Duration: 01.01.2011 – 31.12.2016

Budget: €6,447,900 (160 million CZK), 50% EC

Ontomorphogenesis and populations of the Crimean endemic rare species *Anthemis sterilis* Steven

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Keywords: endemic, rare, ontomorphogenesis, populations, *Anthemis sterilis*, Karadag

Anthemis sterilis Steven is a caulescent rosellate biennial with conodiy and storage tap root, caudex short-lived plant, which is protected at the regional level in Crimea.

There are four local populations of *A. sterilis* in Karadag, which are characterised by compact-diffuse type of individuals placement at the population field depending on character of the age spectrum in certain clusters. It is determined that *A. sterilis* ontogenesis includes three periods and five age stages: latent (seeds) pregenerative (seedlings (p), juvenile (j), immature (im), virgin (v) plants) and generative (generative (g) plants). Because of complete necrosis of individuals at the end of the single reproductive cycle we hadn't opportunity for grading generative period and separating post-generative. However, small part of generative plants had activation of axillary tillering, which provides another flowering next growing season. This phenomenon is typical for low generative individuals with 1–4 flowering shoots (most generative individuals have 15-35 pcs.) and lots of vegetative rosellate shoots.

The phases of morphogenesis of individuals are detected. The size and morphological polyvariance of individuals of different biomorphs were ascertained. It was found that ecological and coenotic conditions of habitats have significant influence on the appearance of different types of polyvariance.

During ontomorphogenesis at the early age stages *A. sterilis* individuals use spring rains and moisture, which was formed by melting snow, for development and their conversion into immature and virgin plants. After that high temperature period causes forced rest of *A. sterilis* in summer. Then virgin and generative plants use late-summer or autumn rains for forming autumn rosellate shoots.

Populations of *A. sterilis* are located on the rocky tops of the ridges in Karadag at areas with xerophytic vegetation with 5–10% projective coverage and density of 1–4 individuals per 1 m². Some parts of the populations are confined to petrophyte areas formed by *Poa bulbosa* L., *Bromus japonicus* Thunb., *Stipa lessingiana* Trin. et Rupr. sods with the greatest density of vegetation.

Populations of *A. sterilis* are obligatory deficient with dominance of generative plants and are characterised by relatively high death rate at the early stages of development. They are more or less stable. Because of species' low competitive ability, only seed reproduction, germination and further development depending on the spring rains, its populations are vulnerable and they need further population investigations.

The effect of common milkweed (*Asclepias syriaca*) on the native sandy flora. Is it a neutral alien or a noxious invader?

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Keywords: clonal spreading; competition; functional traits; invasion; old-field; sandy vegetation; seed mass; specific leaf area

Common milkweed (*Asclepias syriaca*) is an invasive “super species” with extended non-native area in Europe and usually persists in disturbed habitats. However, no study to date has focused directly on its role in the invaded vegetation. The few former papers just partly dealing with the effects of common milkweed reported no effects of this invader on the natural flora. However, milkweed is a fast-growing competitor with effective clonal spreading and seed dispersal ability and broad leaves. Hence, it is unlikely that the effects of such a competitor invader like the common milkweed remain neutral to native flora and vegetation. This contradiction suggests that there is a need to test the effects of milkweed on native sandy flora and re-consider the former findings. To explore the effect of milkweed on the natural sandy flora, we studied the vegetation of late-successional sandy old-fields invaded by milkweed. To identify the most sensitive species groups we performed trait-based analyses; we studied leaf-height-seed traits and clonal spreading ability. Our study sites were situated in the largest calcareous sandy region of Hungary (Kiskunság, Central-Hungary). We detected no effect of milkweed on total species richness; still, it had a negative effect on the cover of native grassland species. The negative effect of milkweed was the most pronounced on the cover of species with low specific leaf area, low seed weight and low clonal spreading ability (i.e. low competitive ability). Our findings indicate that late-successional sandy grasslands invaded by milkweed form undesirable ecosystems and the invasion of milkweed can delay the colonisation of native grassland species and arrest the succession in an unwanted stage. In these habitats, milkweed has significant negative impact on the natural grassland species; thus, the eradication of milkweed is crucial for the protection of the native flora of the sandy regions.

Seed banks of Central-European grasslands (overview)

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Keywords: grassland, seed bank, soil seed density

The studies of seed bank of natural and semi-natural habitats received an increasing scientific interest in last decades because researchers claimed that seed bank may have important role in the preservation and restoration of grasslands and other habitat types. Thus, many studies have been conducted to identify the dynamics and composition of seed banks in different grassland-types and to evaluate their role in vegetation dynamics. We reviewed seed bank studies in Central Europe. For this we searched for the papers in English language available online in the Web of Science database. We found in total 35 studies from different countries, from different types of grasslands like calcareous, loess, alkali, wet, dry, sandy grasslands from lowlands to subalpine regions. The studies found a large variety in seed bank density, lowest values from the unmanaged, sandy grasslands and subalpine pastures and highest values from fen meadows and a limestone grasslands. The detected seed bank density was influenced by the used methodology. Most studies used the seedling emergence method to measure the seed bank density and diversity. Disturbed sites had higher seed bank diversity and density than undisturbed, abandoned sites. After the cessation of management, the young grasslands seed bank was composed mainly of seeds of weed and ruderal species. With the process of succession the species number and also the seed number increased but the relation was not linear, the highest seed bank density was typical in the middle succession stage. Studies were carried out using different soil layers and found that upper soil layer contains more seeds and species. The fewer species present in lower soil layers were characterised with persistent seed bank. Species with many, small seeds or seeds with hard seed-coat were more persistent than species with bigger seeds. Many species only had short-lived seeds such as the majority of rare and endangered species and also loess specialist and woody species. The similarity between seed bank and vegetation composition was higher in young grasslands and decreased with succession. Because of this and the low similarity between seed bank and vegetation studies claimed that restoration of grasslands is not possible only from seed bank.

Communities of Class *Festuco-Puccinellietea* Soó ex Wicherek 1973 in the Sea of Azov coastal zone: structure, management, conservation

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Keywords: vegetation, the Sea of Azov coastal zone, Class *Festuco-Puccinellietea*, protection

Class *Festuco-Puccinellietea* includes phytocoenoses of perennial grasses and shrubs, found in saline steppe, saline meadow and halophytic ecotopes of the Sea of Azov coastal zone. Communities of the class mainly occur on accumulative forms – spits and their analogues. They usually are in estuarine ecosystems of Azov rivers, on the banks of the estuaries and sea bays (Sivash and the Gulf of Taganrog). Their area in the coastal zone of the Sea of Azov is more than 30 000 hectares. From the marine shallows, marshes and swamp ecotopes they occupy areas next to communities of classes *Phragmito-Magno-Caricetea*, *Juncetea maritimi*, *Salicornietea fruticosae*, which are formed in the lower forms of relief with sod-swampy saline soils. On the opposite side these communities adjacent to phyto-coenoses of classes *Festuco-Brometea* and *Festucetea vaginatae* (on sandy ecotopes) which tend to higher relief forms (slopes, uplands etc.), with black soils. Phytocoenoses of class *Festuco-Puccinellietea* are among the most highly productive in the region (17-25 cwt / ha in average). Areas with them are intensively used as pastures, hayfields and collection of medicinal plants. In the last 5-10 years there is a tendency to use these areas for recreational development as well.

We have studied these communities in the Sea of Azov coastal zone from 1998 to 2015 according to methods accepted in Braun-Blanquet system. It is established that the communities of the class combine 24 associations (including 5 subassociations and 11 variants), which belong to 10 alliances within 7 orders. On accumulative forms and in the flooded areas of estuaries there are mainly distinguished communities of 4 orders: *Scorzonero-Juncetalia gerardii*, *Puccinellietalia*, *Artemisio santonicae-Limoniotalia gmelinii* and *Lepidietalia latifolii*. Coenoses of three orders (*Festuco valesiaca-Limoniotalia gmelinii*, *Puccinellio festuciformis-Camphorosmetalia monspeliaca* and *Glycyrrhizetalia glabrae*) tend to clay substrates, which received development on the shores of estuaries and bays.

Along the Ukrainian seashore communities of the class are protected as part of Kazantip Nature Reserve, three national parks and a number of reserves. In Russia they are protected in natural park “Donskoi” and in several sanctuaries. Areas with these communities are included in the Ramsar wetlands (Eastern Sivash, Molochnyi Estuary, Don River delta and others). For some protected objects in Ukraine there are developed management plans for these communities that lie in periodic mowing, grazing and restoration. In the future it is necessary to develop measures that will lead to a more environmentally sound usage of the coastal zone areas, where these communities grow.

Semi-natural grasslands of National nature park "Pyryatynsky" (Ukraine): syntaxonomy and conservation

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Keywords: semi-natural grasslands, syntaxonomy, conservation, national park

Semi-natural grasslands are plant communities, which have been continuously mown or used as pasture. These are areas covered with herbaceous plants and where natural turf and vegetation have preserved and human activity is mainly limited to harvesting. Semi-natural grasslands are very representative type of vegetation in National nature park "Pyryatynsky" (Ukraine). According to results of our investigations in 2010-2015 (Kovalenko, 2016) mown or used as pasture grasslands of national park belong to 11 alliances and 4 classes. The least disturbed semi-natural grassland habitats are covered by the vegetation of *Magno-Caricion gracilis* Gehu 1961 alliance (*Galio-Caricetum* Balátová-Tuláčková in Balátová-Tuláčková *et al.* 1993, *Caricetum vulpinae* Nowinski 1927 *et al.*). All plant communities of class *Molinio-Arrhenatheretea* Tüxen 1937 (*Agrostion vinealis* Sipaylova *et al.* 1985, *Trifolion montani* Naumova 1986, *Trifolio pratensis–Festucion pratensis* Goncharenko 2002, *Molinion* Koch 1926, *Deschampsion caespitosae* Horvatič 1930, *Alopecurion pratensis* Passarge 1964, *Calthion* Tüxen 1937, *Filipendulion ulmariae* Segal 1966 alliances and 9 associations) are used as pasture and regularly mown. The largest area of semi-natural grasslands is occupied by plant communities of association *Festucetum regeliana* Solomakha *et* Shelyag-Sosonko in Golub *et al.* 2003 (*Juncion gerardii* Wendelberger 1943). The most trampled salty meadows belong to association *Agrostio stoloniferae–Juncetum ranarii* Vicherek 1962. Degraded meadows of national park we classified as separate class *Agrostietea stoloniferae* Oberdorfer *ex* Klotz 1995 (*Plantagini-Prunellion* Elias 1980 with 3 associations and *Potentillion anserinae* Tüxen 1947 with 3 associations and 2 variants). Semi-natural grasslands are refugia for conservation of many rare plant species (*Gladiolus tenuis* M. Bieb., *Dactylorhiza majalis* (Rchb.) P.F.Hunt & Summerh., *Ostercicum palustre* (Besser) Besser *et al.*). The preservation of the network of meadows is the basis for the survival of species richness and diverse gene pool in semi-natural grasslands.

Thousand-seed-weight, germination ability and establishment rate of native species used in grassland restoration in Hungary

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Keywords: Germination percentage, Seed mass, Reintroduction, Sandy grassland

Knowledge on germination ability and thousand-seed-weight data of native species can support grassland restoration to better estimate necessary seed amount. The aim of our restoration project is to reconstruct a mosaic of steppe oak forest and grasslands in LEGO factory, in the town of Nyíregyháza (Hungary). Several seed introduction methods are applied, among others, sowing of commercially purchased and collected seeds. In the present study we measured seed weight and tested germination ability of 17 sown species with and without a month-long cold treatment, and compared germination success with field establishment success. Seed sorts of 800 seeds were counted to measure thousand-seed-weights. Germination of 4 x 100 seeds per species was tested with or without cold treatment. Seeds were placed on sterile, wet filter paper under room temperature and germinated seeds were counted weekly. Based on the results of thousand-seed-weights, significant differences were detected by Mann-Whitney non-parametric test for 4 species (*Achillea collina*, *Festuca rupicola*, *Plantago lanceolata*, *Potentilla argentea*) compared to literature data. We have new data on the germination percentage of two dominant grasses of sandy grassland (*F. pseudovina* and *F. vaginata*). Cold treatment decreased the germination probability of four grass species (*Corynephorus canescens*, *F. pseudovina*, *F. rupicola* and *F. vaginata*), while two dicots (*P. lanceolata* and *Silene vulgaris*) germinated significantly better after the cold treatment, tested by ANOVA. In both cases some species (*F. pseudovina*, *Silene vulgaris*) had a germination percentage exceeding 90%. However, some species did not germinate under either condition (*Salvia nemorosa*, *Lotus corniculatus*). Germination success was much higher in laboratory conditions than establishment success under field conditions, where establishment was influenced by several factors (drought, competition etc.). Our results complete the knowledge on seed germination and can contribute to cost effective restoration planning and purchase of seeds.

Does grazing enhance dry grassland bryophyte diversity? An experimental study in Estonian alvar grassland

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Keywords: dry grassland, bryophyte, biodiversity, disturbance.

Semi-natural grasslands in calcareous substrates in Europe are known to have high plant diversity. Due to decrease in grazing and mowing they are losing their area very fast and thus threatening the biodiversity. The majority of studies have been targeted on vascular plants, but also bryophytes have often an important role in community functioning. Our aim was to find out how the diversity of moss layer is influenced by small-scale disturbances that are generated by the cattle and to estimate the relative importance of diaspore bank and aerial dispersal in gap regeneration.

We investigated the bryophyte layer of an abandoned Estonian alvar-grassland, using 10 x 10 cm² permanent plots. We had two treatments: 1) plots with simulated disturbance, and 2) plots with sterile soil for estimating aerial dispersal. Plots were analysed once a year during six years.

In the plots of simulated disturbance almost all species, mostly perennials, that were present in the intact vegetation, emerged during the first year after the vegetation removal. In the next years short-lived bryophytes and colonists became more frequent. Although in the last year some short-lived species and colonists disappeared and perennials increased their cover, the species richness in disturbed plots remained higher than in control plots and the species composition was *ca* 34% different.

In plots where aerial dispersal was estimated, mostly short-lived species and colonists emerged during the first years. Most of the perennial species, present in the surrounding grassland, appeared also and began slowly increasing their covers. The colonist species still dominated in the last year of investigation. Although the species number in control plots and treatment plots was almost similar in the last year, the species composition differed *ca* 45%.

In treatment plots we registered 11 bryophyte species not found in control plots. Four of them were new to the study site.

Our study gives explanations to the dynamics in alvar moss layer and points to the importance of small-scaled disturbance, usually caused by grazing, in maintaining the bryophyte species richness.

Changes of meadow vegetation of the Forest and Forest-Steppe zones of Ukraine in the second half of the 20th and beginning of the 21st century

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Keywords: *Agrostion vinealis*, destruction coefficient, *Festucion pratensis*, grassland, Indicator Values, *Potentillion anserinae*

The main factors affecting the condition of meadow vegetation in the Forest and Forest-Steppe zones are grazing and mowing, especially excessive, as well as opposite processes of demutation and overgrown by trees and shrubs under abandonment. In addition, the meadow vegetation is affected by water regime changes caused by both the drainage of floodplains and their flooding due to construction of ponds and reservoirs. All of these factors are inextricably linked to the socio-economic conditions of the state. The changes that have occurred over the past 70 years in Ukraine, obviously have affected the state and structure of meadow vegetation as well as environmental conditions of their habitats. In this regard, it would be interesting to find answers to the following questions:

- 1) how have the structure and state of meadow phytocoenoses changed over the past 70 years due to changes in land use?
- 2) How have environmental properties of meadow phytocoenoses changed?
- 3) What types of meadow phytocoenoses are the most sensitive, and which are the most resistant to these changes.

Materials for the study were relevés from the Ukrainian Grassland Database, in particular 218 relevés of the *Agrostion vinealis* alliance (steppic meadows), 609 relevés of the *Festucion pratensis* (mesic meadows) and 367 relevés of the *Potentillion anserinae* (wet meadows). The relevés were divided into groups according to their date. Further the data were stratified using the heterogeneity-constrained resampling in JUICE program to obtain an equal number of relevés in the groups. For each group average values of the destruction coefficient as well as Didukh Indicator Values were calculated. Statistical significance of differences between groups was calculated using the Student criterion in STATISTICA program. On the base of the destruction coefficient calculation it was revealed substantial change in structure of the *Agrostion vinealis* communities, minor for *Potentillion anserinae*, and such changes is not revealed for communities of the *Festucion pratensis*. Were showed a decreasing of values for humidity, variability of damping, soil aeration, light, increasing for values of soil acidity, carbonate content, thermoregime, ombroregime, cryoregime and fluctuations (decrease followed by an increase) for factors of salt regime, nitrogen content and continentality along the time trend. These changes are manifested most significantly in the *Agrostion vinealis* communities. The most resistant to these changes were *Potentillion anserinae* community. The revealed regularities should be used for planning the management of grassland communities.

Identifying and monitoring High Nature Value grasslands using an indicator plant approach

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Keywords: HNV, plant indicators, butterflies, dry grasslands, historical maps

High nature value (HNV) semi-natural grasslands are biologically important but threatened habitats. There is a need to reliably identify HNV grasslands and monitor their biodiversity value. The Sighișoara-Târnava Mare Natura 2000 SCI still has extensive areas of HNV grassland, including traditional hay meadows and low intensity pastures. However, there are threats and pressures which cause loss of these grasslands and degradation of their quality. Botany and butterfly surveys in the summers of 2014, 2015 and 2016 have been undertaken at 80 sites across the SCI. A guide to indicator plants of the Târnava Mare HNV dry grasslands has been used to identify whether HNV grassland is present at these sites and monitor their quality. The relationships between a range of indicator plant metrics and butterfly diversity are assessed as a means to evaluating the usefulness of the HNV indicator plant approach to assessing the HNV quality of grasslands. The land use of the grassland sites over the last two hundred years is also identified from historical maps, in order to ascertain whether the indicator plant metrics vary on sites with differing histories. The research contributes to our ability to identify and monitor the conservation importance of semi-natural grassland sites.

Characteristics of Podillia meadow steppes ecotopes (Ukraine)

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Keywords: steppe, Podillia, ecology

The aim of our study was to compare the values of leading ecological factors characterising ecotopes of Podillia meadow steppes. Seven meadow steppe plots were chosen for the analysis (Homets Mt. ("Znesinnia" Regional Landscape Park), Stradchanska and Koroleva Mts ("Roztochia" Reserve), Lysa, Bila, Sviata, Vysoka, Kasova and Chortova Mts). They represent Podillia meadow steppes belonging to the steppe region of Eurasia, namely the East European block of provinces. 48 complete geobotanical relevés have been made on the territory located in Lviv and Ivano-Frankivsk regions.

The method of ecological factors' phytoindication was used to calculate the values of the following parameters: thermoregime (Tm), continentality (Kn), humidity (Om) and fridity of climate (Cr), soils humidity (Hd) and humidification variability (fH), the content of acid (Rc), nitrogen (Nt), carbonates in the soil (Ca) and total soil salt regime (Tr). The data are statistically processed.

The most common formations of meadow steppe vegetation in the region are *Cariceta humilis*, *Koelerieta gracilis* and *Festuceta sulcatae*. The forest-steppe zone is quite heterogeneous within Ukraine according to its orography and geomorphology. On the right-bank Ukraine such structural elements like Volyno-Podillia and Prydnistrovska highlands are distinguished. The studied objects represent Podillia steppe meadows located within Podillia highland. The meadow steppe communities were formed on the watersheds and rapid south slopes as well as on the poor carbonate soils. Despite of the fact that they include species being common in the East-European forest-steppe zone, they are closer to the central European type. The ecotopes of Kasova and Chortova Mts. appeared to be the most similar to real north meadow steppes, widespread on the left-bank Ukraine, while those of Khomets' and Stradchanska Mts are more related to forest ecotopes. The ecotopes of Lysa, Bila, Sviata and Vysoka Mts occupy an intermediate position. Distribution of meadow steppes vegetation in Podillia region closely correlates with measures of climatic and, especially, edaphic factors, which are ecological determinatives in forming meadow steppes' vegetation of this region. Our results show that thermoregime and climate continentality have the greatest impact among the climatic factors influencing the meadow steppe plant communities. Among the edaphic factors the most important are soil humidity, acidity and content of carbonates.

Grassland restoration: Best practice of sod transplanting by considering spontaneous colonisation pattern

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Keywords: grassland restoration, sod transplanting, spontaneous colonisation

Sod transplantation is well known as a very efficient method for establishing species-rich grassland. Advantages over other restoration measures like seeding are the transfer of even diaspore missing individuals of vascular plants, ground mosses and lichens, soil biota, microorganisms and even small animals. In addition, sod transplantation proved to achieve high transfer rates of target species, especially when carried out in early spring or late autumn, combined with relatively low degrees of weed infection.

So, translocation of sods of species-rich grassland should be a standard procedure for (1) mitigation measures or, (2) enrichment of existing species poor grassland, given that donor sites are available, but only on condition that respective sites are demanded by building activities when the destruction of those sites is inevitable.

Apart from the rather expensive restoration method of sod transplantation, natural colonisation can be a cost-effective supplement in the course of grassland restoration, given that donor sites are directly bordering.

To maximise the effect of both restoration measures, while simultaneously reducing the costs for the generation of species rich grassland, we recommend a combination of sod transplantation with self-colonisation. As we found out in previous studies, most vascular plants in species-rich grassland achieve a colonisation distance of 10 m within a few years – consequently, the distance between individually applied sods could theoretically reach up to 20 m. Nevertheless, we propose a maximum distance of 10 m because individual sods do not likely contain the whole species pool of transplanted sites.

An already tested approach is establishing sod patches in the restoration area with a size of 15 x 15 m (225 m²), resulting in a final ratio of 1:3 between transplanted sods and the whole restoration area. Yet, we propose to use 5 x 5 m (25 m²) sod transplantation patches: First, we should gain a higher colonisation probability of small, stress-tolerant species because their dispersal might otherwise be limited by higher growing plants in their surroundings. Second, 25 m² should be enough for establishing a stable vegetation patch as a source for further colonisation. Third, the ratio of sod transplantation and the whole restoration area could be increased from 1:3 to 1:10.

Soil mite communities from heavy metal polluted grasslands from Transylvania, Romania

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Keywords: soil mites, grasslands, heavy metals

Soil mites are ubiquitous invertebrates, which can be found in different types of terrestrial ecosystems (including grasslands) and habitats (humus, litter, on plant, moss, decaying matter, in bird nest, on mammals). They record high number of species and numerical abundance and they are widespread all over the world. Soil mites are involved in various ecological functions, as: nutrient cycling, decomposing of organic matter, regulation of the population densities of other invertebrates (as springtails, nematodes, enchytraeids). From 1980, they have gained an increasing interest as bioindicators, being able to provide qualitative and quantitative modifications as a response to pollution.

In Europe, researches concerning the impact of heavy metals pollution on predator soil mite communities (*Acari: Mesostigmata*) from grassland, are few. Mostly saprophagous and detritophagous mites (*Acari: Oribatida*), from forest ecosystems, were been used. This research established the soil pollution level, with heavy metals (As, Cu, Mn, Ni, Pb, Zn), from twelve grasslands, located in the Transylvania region, Apuseni Mountains. We proposed to highlight the impact of this phenomenon on soil mite communities, taking into account the distance from the pollution source, the degree of pollution (the total metal load), the cumulative influence of heavy metals and environmental factors, as: soil temperature, humidity, acidity, carbon content, nitrogen, and C/N ratio. The measured concentrations of heavy metals for the investigated grasslands exceeded the reference values, according to the national legislation. Three groups of grasslands were established based on different degrees of soil pollution: two of them were classified as the most polluted, five as the medium polluted and another five the less disturbed.

66 predator mite species were identified, with 961 individuals. Each investigated grassland was described by a characteristic structure of the soil mite populations. The less polluted ecosystems has recorded the highest species diversity and numerical abundance, in comparison with the most polluted areas, where the situation was on opposite. Using multivariate statistical analysis, we observed that mite communities from the most polluted areas were distinguishable from those from less polluted grasslands. Some heavy metals (As, Cu, Pb, Zn) influenced the soil mites from highly polluted ecosystems, while Mn and some environmental variables were strongly correlated with mite communities from the medium polluted areas. Soil temperature was the main factor influencing mites from the less polluted ecosystems.

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Habitat characteristics of a vulnerable species, *Arnica montana*, in the northern region of Romanian Eastern Carpathians

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Keywords: *Arnica montana*, Eastern Carpathians, vegetation, habitat

Arnica montana is a wild species with decreasing populations in numerous European countries. Listed in the fifth appendix of the Habitat Directive (also in Romanian Red List of vascular species), it is considered a vulnerable species due to excessive collection. Still, in Romania, it is relatively frequently met in certain mesophytic grasslands or some secondary communities installed after forest clear-cutting, on more acid and nutrient-poor soils. Our study tried to elucidate which are the main plant communities and habitat types with *Arnica montana* in northern region of Romanian Eastern Carpathians and which are the main factors shaping their floristic composition; also, if there are differences in the numbers of rosettes, flowering rosettes, inflorescences and fruits depending on habitat type and field management and what are the relationships between numbers of rosettes, flowering rosettes and inflorescences and some environmental factors. Field investigations were carried out in the summer periods of 2015-2016. Floristic composition, total number of rosettes, flowering stems and inflorescences were registered in three plots of 1m x 1m, in each studied site. Soil samples were collected from the A horizon. Plant communities with *Arnica montana* were identified using hierarchical clustering, validated by silhouette index and corrected Rand index and linked to phytosociological syntaxa based on diagnostic species. Ordination methods (detrended and canonical correspondence analysis) related the plant communities to environmental data and permitted the observation of the effect of each environmental variable on species composition. Relationships of rosettes number / plot, flowering stems and inflorescences / plot with some vegetation, climatic and edaphic factors were assessed using generalised linear models. Six plant communities with *Arnica montana* were identified in the study area: *Festuco rubrae-Agrostetum capillaris* Horvat 1951 (incl. subass. *nardetosum strictae* (Csürös et Resmeriță 1960), Oroian 1998), *Violo declinatae-Nardetum* Simon 1966, *Scorzonero roseae-Festucetum nigricantis* (Pușcaru et al. 1956) Coldea 1987, *Campanulo abietinae-Vaccinietum* (Buia et al. 1962) Boșcaiu 1971, *Cetrario-Vaccinietum gaultherioidis* Hadač 1956 and *Campanulo abietinae-Juniperetum nanae* Simon 1966. Their floristic composition was mainly shaped by altitude, soil and climatic conditions. The number of rosettes/plot, flowering stems and inflorescences significantly varied depending on habitat and plant community, with the highest values registered in mountain hay meadows. The total number of rosettes/m² was mainly influenced by altitude, soil pH, vegetation cover and mean annual precipitation. The number of flowering rosettes and inflorescences varied depending on organic matter in soil and the fruits number/inflorescence depended on mean annual precipitation.

Environmental Policy Processes for pastures: contributions of local institutions to climate change adaptation and sustainability in Norway and Mongolia

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Keywords: Norway, Mongolia, pastures, policy, land rights, reindeer, camels, sheep

The paper presents comparatively environmental policy processes related to formalising rights to land and other resources (water, migration routes) in two apparently different pastoralist systems: the Sámi reindeer management system in Norway, and the Mongolia pastoralist system in the desert-steppe ecotone in the central part of Mongolia.

By applying an analytical approach common in political ecology and historical institutionalism, the paper explores what elements of the policy process are important, how they are negotiated, argued for, and put in place as well as the social processes involved in the negotiation and the final implementation. I aim to draw a conceptual map of the process that looks critically into the politics of the process, how science, technocracy and expertise are used, and argued as a discourse. In addition, I want to show how actor-oriented and practice-based approaches to policy-making, rather than the local application of general policy frameworks are better approaches, which are more likely to secure the resilience of these systems in the face of environmental (e.g. climate change, biodiversity reduction) and social (e.g. out-migration of youth, encroachment on the pastures) changes.

The examples show the need for creating new spaces of engagement for environmental policy-making. Such spaces can contribute for instance to ensuring that local forms of distributing access to resources and in general for managing them are included in the policies and protected by them. In the two cases I present, it becomes apparent that when these local arrangements and concerns are not included, both the ecological and the social part of the system suffer. There are obvious lessons and warning signs that are applicable to the current CAP and current efforts of formalising the management of grasslands in many parts of Europe. The mistakes being made in Norway and Mongolia should nevertheless not be understood only in terms of bad arrangements (e.g. formalised private property) but also, and more importantly, in terms of bad processes- in which local voices and tested practices are not included.

Effects of prescribed burning on arthropods

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Keywords: fire, alkali grassland, Isopod, spider, ground beetle, rove beetle

Grasslands in Europe are threatened by the cessation of traditional management (grazing, mowing). Appropriate prescribed burning management could be a crucial treatment in maintaining these grasslands. Prescribed burning can prevent the accumulation of litter, increasing of fuel loads resulting in regular wildfires, and encroachment of herbaceous competitors or woody species. Nevertheless, there are contrasting opinions on the effects of prescribed burning on plants and arthropods of grasslands. We studied the impact of dormant-season prescribed burning on ground-dwelling arthropods (isopods, spiders, ground beetles and rove beetles) in a low-productivity steppe grassland. We collected these arthropods by unbaited pitfall traps. Our findings showed slight increase in the total abundance and species richness in the burnt plots compared to the controls; however, these differences were not statistically significant. Number of individuals and species as well as Shannon diversity of the three most abundant arthropod groups did not differ significantly between the burnt and control plots. Species-level analyses demonstrated that most arthropod species were not affected by fire. Out of the most frequent arthropods, the abundance of *Titanoteca veteranica* spider species increased and the abundance of *Trochosa robusta* spider species decreased in the burnt plots. Our findings suggested that prescribed burning does not damage the arthropod fauna, because these can easily recolonise the burnt patches from the surrounding unburnt areas. Our results supported that dormant-season prescribed burning could be a feasible management method in alkaline grasslands, because it did not threaten the majority of arthropods.

Effects of spring and autumn prescribed fires on plant species diversity and ecological groups in a dry grassland

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Keywords: semiarid grasslands, fire ecology, community dynamics, invasive species, restoration ecology

Wildfire is of the major components of dry grasslands, which may significantly affect their composition and dynamics. However in the recent decades, it is intentionally being used for restoration of grazing lands e.g. for reducing thorny shrubs and bushes. Two prescribed fires were applied at spring and autumn 2015, in a dry grassland, Dehbar, Torghabeh, Northeast Iran. In each time, fire was applied on four plots (10 m²), which were randomly selected in a landscape. A control (unburnt) plot was considered close to the each burnt plot. Plant measurements were conducted at the time of full vegetation growth (June) in 2015 and 2016. Canopy cover, density and frequency were recorded for all plants, growing in the burnt and unburnt plots. Important value index (IVI) was calculated for the plant ecological groups, classified based on Raunkiar (1939). Spring burning (SB) increased species diversity and evenness but reduced species richness, in the first year. Contrasting results were found one year after SB, i.e. higher richness but lower diversity and evenness in the burnt as compared to the control plots. Autumn burning (AB) reduced species diversity, richness and evenness indices. IVI of hemicryptophytes were increased (33.3%), geophytes reduced (32%) and therophytes were unchanged, one year after SB. A drastic reduction (37%) was found in IVI of chamaephytes one month after SB, but they could recover to same level as unburnt site after a year. AB increased IVI of hemicryptophytes (10%) and therophytes (13%), reduced that of chamaephytes (21%), whereas geophytes were unchanged. In general, BS was advantageous because of increasing species richness and replacing perennial grasses and forbs in the expense of invasive and geophyte species such as *Poa bulbosa* and *Rosa persica*, but it was ineffective in reducing importance of thorny and aromatic shrubs. Autumn burning was more effective on reducing the invasive shrubs but it negatively increased therophytes and invasive geophyte species, also reduced species diversity indices.

Allelopathic activity analysis of the invasive grassland species *Elaeagnus angustifolia* L. by the method of Neubauer & Schneider

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Keywords: nitrogen fixation, allelopathy, vegetation cover, symbiotic association, actinomycetes, phytogenic field

Russian olive (*Elaeagnus angustifolia* L.) is an invasive transformer species, which has spread through the territory of Ukraine. One of the possible causes of the changes in the grassland vegetation cover is the allelopathic activity of the species. It has symbiotic association with the nitrogen-fixing actinomycetes of genus *Frankia* and in that way is able to cause the changes within the boundaries of its phytogenic field (Studnik-Wójcikowska et al., 2009) increasing the content of nitrogen in soil.

During the fieldwork in 2015, there were collected samples of soil in order to conduct an analysis applying the Neubauer & Schneider method on the base of the ecological laboratory of the National University of "Kyiv-Mohyla Academy".

In the result the morphological parameters of the plants within and beyond the tree crown had no significant differences. Particularly, the average length of the aboveground part of a plant had 18.2 cm and 18.7 cm within and beyond the tree crown respectively. The average length of the underground part of a plant had 9.3 cm and 8.8 cm respectively. The changes in dry biomass were also observed insignificant. In particular, the average dry biomass of the aboveground part of 100 plants within and beyond the tree crown had 0.75 g and 0.81 g respectively; and the average dry biomass of the underground part of 100 plants within and beyond the tree crown had 0.64 g and 0.63 g respectively. The survival rate among the experimental plants slightly differed and correspond 72 % and 84 % within and beyond the tree crown respectively. The statistical analysis showed that the difference in the average length of the aboveground part of a plant was the only one reliable.

Conclusively, the method of Neubauer & Schneider is not appropriate to assess the allelopathic abilities of *E. angustifolia*, as the only one parameter out of four had significant difference within and beyond the tree crown. Also it will be better to take soil samples for the analysis near the old olives where the impact on grassland vegetation cover is more remarkable.

Traditional vs present management system of semi-natural grasslands from Southern Transylvania, Romania – a conservation perspective

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Keywords: agri-environmental schemes, biocultural diversity, biodiversity conservation, traditional practices, Transylvanian Saxons

Traditional management systems continue to play a decisive role in creating and maintaining semi-natural habitats of high nature value in several cultural landscapes throughout Europe, including Transylvania, Romania. Such systems are mainly the outcome of fine-tuned human activity, their outstanding biodiversity being the result of historical uninterruptedness. More than 50% of Europe’s most highly valued biotopes occur in low-intensity farmlands; semi-natural temperate grasslands (incl. Transylvania, Romania) harbour global species records of vascular plants. The low-intensity practices and ecological knowledge underlying the predominantly subsistence agriculture make these regions real biocultural hotspots. The knowledge regarding land-use dynamics and finely-tuned practices needed for their maintenance is usually not formalised in written form and therefore most of it goes lost on the way towards globalisation.

Using a wide range of historical documents and our field experience we present an overview of the traditional and the current management systems applied in semi-natural grasslands from Southern Transylvania. We aim to show the strict rule system that the Saxon communities had for managing their pastures and meadows and how different conservation and agri-environmental regulations support or hinder the maintenance of the traditional management system. We present how management practices were timed in accordance with flowering phenology, to allow the regeneration of pasture plants. This was done in close connection with several feast-days (*i.e.* start of grazing on April 24, the feast of St. George; start of mowing in the Heumonat, meaning ‘hay month’ around July 20, the feast of St. Margaret), adapted yearly to the particular weather conditions, showing how land management was an integral part of the spiritual and cultural aspects of life in Saxon communities. We present how the abandonment of certain management elements, like mowing and shift of the grazing regime can lead to substantial changes in the vegetation. By analysing the differences between the traditional system and the present situation, we aim to provide valuable information for the conservation management of the biodiversity-rich semi-natural grassland habitats and restoration of those that are gradually degrading.

Considering that the traditional management in the study region is related to a disrupted social structure following the mass emigration of Saxons, we argue for the importance of knowledge-transfer and embedding the key elements of this system in the present grassland management. We call for raising the awareness regarding the decisive role of a socio-economic system strengthened by an adequate policy framework in supporting this process.

Spatial patterns of species diversity of grasslands within Ampoi River catchment in the Romanian Carpathians

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Keywords: grasslands, spatial patterns, species diversity, river catchment, Romanian Carpathians

The Ampoi River Valley from Transylvanian region crosses beautiful landscapes with great biodiversity value integrated among areas where mining activities have had the greatest impact on the environment. People from these areas use the grasslands for grazing and hay productions. In order to assess the diversity aspects of different grasslands in Ampoi River catchment, our study was performed in the five grasslands from Ampoi River catchment, recording species composition and coverage of the vegetation (%) in 5 plots set in every area at different altitudes and different degree of soil pollution (recorded with XRF), each plot divided in 4 subplots, each of 10 m².

Spatial patterns of species diversity change over multiple scales, from quadrat level toward landscape level. The species diversity varied in correlation with soil pollution, management activities and natural soil structure. Low species diversity was encountered in plots where the soil was shallow and the bedrock appeared near the surface (skeletal and substrate without vegetation); also, the areas were overgrazed and trampled by sheep and goats. In contrast, high species diversity was found in areas with well-structured deep soil in meadows that the private owners apply another management type than grazing animals (mowing for hay production). Evidence from statistical analysis indicate that in the studied vegetation communities, species abundance and equitability play an important role in Shannon-Weaver diversity variation.

Spatial patterns of species diversity vary great deal across catchment areas; the grasslands from Ampoi River catchments are semi-natural grasslands managed by local stake-holders (grazing, mowing). The heterogeneity of micro-habitats within plots is high with abrupt transition from xerophilous vegetation to hygrophilous vegetation as a result of changes in the substrate (calcareous, acidic, argillaceous, *etc.*) or gradient and aspect (exposition) within a small area.

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The diversity of medicinal and aromatic plants encountered in various Natura 2000 habitats in the Gurghiu Mountains

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Keywords: grasslands, habitats, Mureș county, Transylvania, medicinal plants

Research on medicinal plants used in various human disorders is particularly important and timely, as an alternative to medication. The studied semi-natural mountainous grasslands occur in the Gurghiu mountains. Special interest today worldwide for herbal medicine has led us to study the Gurghiu mountains medicinal plants used in various diseases. In order to identify the taxa we used classical methods, described in the literature. Phytosociological indices were used to make a quantitative estimation of medicinal species and statistical analyse was also carried out. Four plant associations were identified. These plant associations belong to 3 types of Natura 2000 habitats. The phytosociological surveys were taken on altitudes between 504-1634 m. For this study 78 surveys were analyzed. The highest number of medicinal species was recorded in 6520 Mountain hay meadows Natura 2000 habitat namely in *Festuco rubrae-Agrostietum capillaris* association (98 medicinal species). A great number of medicinal species was recorded in *Telekio-Petasitetum hybridi* association that belong to 6430 Hydrophilous tall-herb fringe communities of plains and of the mountain to alpine levels Natura 2000 habitat (96 medicinal species). The inventory of medicinal species has led to the identification of 148 taxa containing certain therapeutic chemical compounds.

Sustainable management of semi-natural grassland – from interdisciplinary research to participatory implementation - An example from the Apuseni Mountains in Romania

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Sustainable development of the local communities in rural areas is strongly connected to the use and management of the resources. The Romanian cultural landscapes particularly in the mountainous regions of Transylvania, are composed of a semi-open mosaic of meadows, pastures and forests, with high values concerning biodiversity and nature conservation. Here one can still find large areas with traditional land-use, which are in the same way of special interest for the cultural heritage and for further regional development strategies.

During 2000-2004, Albert Ludwigs University Freiburg initiated an interdisciplinary research project called "Project Apuseni – a chance for Țara Moșilor", with focus on the transformation process in the mountainous region of the village of Ghețari, with evaluation of development strategies, and recommendations for sustainable development. Within the study area 491 plant species (358 species of vascular plants) were identified, 242 (49%) of them were medicinal plants. Amongst the medicinal species there was *Arnica montana*, which was unsustainably used (over-harvested, with poor quality of the fresh material, low acquisition price, unfair trade).

This framework has created the premises for starting the Arnica Project (Conservation of Eastern European medicinal plants: *Arnica montana* in Romania), led by WWF UK and financed during 2004-2007 by the Darwin Initiative Foundation.

Based on these projects, the Arnica System was established, aiming at conservation of oligotrophic grasslands within the cultural mountainous landscape and improvement of local people living standard by sustainable use of the natural resources, in this case medicinal plants and in special *Arnica montana*.

Semi-natural grasslands with *Arnica montana* are situated on sloppy land, with bedrocks or semi-acid or alkaline rocks, on soils having a thin useful layer, well drained, on acid soils and having poor nutrient supply. The typical habitats are mountain meadows generally used through in a mixed system (mowing and grazing). In the Apuseni Mountains, *Arnica montana* occurs in the grassland types with: *Nardus stricta*, *Festuca rubra* and *Festuca rubra* with *Agrostis capillaris*. In Natura 2000 Program (Annex 1) the *Nardus stricta* meadows appear as priority (code R 6230) and mountain hay meadows (code R 6520).

Enhance of local interest in semi-natural grasslands becomes particularly important for the conservation of biodiversity and cultural landscapes. Turning to account these habitat types in a sustainable use creates new sources of income for locals. The economic benefits gained by locals through sustainable management of *Arnica* and other medicinal plants are essential for the existence of these habitats.

Brief description of the “Yelanetskyi Steppe” Nature Reserve (Mykolaiv Region, South Ukraine)

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Keywords: steppe conservation, nature reserve, South Ukraine

The reserve was established in 1996 for the conservation of the natural landscape of South Ukraine. It is situated at the southwest edge of the Ukrainian Crystalline Shield characterised by dissected landscape. The initial area of the reserve was 1676 ha. It included a large deep and branched gully with granite outcrops on the bottom and limestone on the slopes. In 2016, it was enlarged to 3010.65 ha due to adjoining of a new plot, the so-called “Mykhailivskyi Steppe”. The Reserve’s location in the forb-bunchgrass steppe belt, ranging with the forest-steppe in the north and the bunchgrass steppes in the south, causes the combined traits of its flora and fauna. Gully slopes are covered with natural steppe vegetation; the phytocoenosis dominated by *Festuca valesiaca*, *Stipa capillata*, *S. lessengiana*, *S. ukrainica*, *Caragana frutex*, *Thymus dimorphus*, *Caragana scythica*, *Achillea nobilis* occupy the largest areas. Meadow vegetation locates in the gully bottoms. The upper interfluves and top slopes are recovering after ploughing; they form fallow lands at the different stages of succession, partly overgrown with shrubs. There are also small pine and black locust plantations in the Reserve. An enclosure of 60 ha is used for bison grazing. The animals were introduced in the gully “Rosa” before the reserve establishment, and 17 bison are still being kept as an old brand. The key target of the reserve is to monitor natural restoration of steppe community after anthropogenic impact and to maintain diversity of the South Ukrainian steppes.

A total of 615 vascular plant species is known for the Reserve. Of these, 26 species are listed in the Red Data Book of Ukraine, and seven species in the European Red List (*Astragalus dasyanthus* Pall., *Chamaecytisus skrobiszewskii* (Rehmann) Rothm., *Caragana scythica* (Kom.) Pojark., *Dianthus hypanicus* Andr., *D. lanceolatus* Stev. ex Reichenb., *Melica chrysolepis* Klok., *Silene hypanica* Klok.). The Reserve is a locality of the endemics, limited by southwestern Ukraine and Moldova and/or having disjunctive geographic areas (*Genista scythica* Pacz., *Astragalus odessanus* Besser, *Eremogone cephalotes* (M. Bieb.), *Thymus moldavicus* Klokov et Des.-Shost., *Scutellaria verna* Besser, etc.).

The vertebrate fauna of the Reserve includes one fish, 5 amphibian, 6 reptilian, 137 bird, and 28 mammal species. 53 species are listed in the Red Data Book of Ukraine, 15 mammal and 121 bird species in the Appendices of the Bern and Bonn Conventions. The invertebrate fauna is worth studied; its list does exceed 300 species.

Cattle grazing and cursorial arthropods in steppe gullies of north-eastern Ukraine. What groups are best indicators?

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Keywords: arthropod assemblages, cattle grazing, steppe ecosystems, north-eastern Ukraine

Fire and grazing are the key factors of steppe evolution. Grazing intensity of various cattle breeds and its impact on pasture ecosystems are fairly well studied in heathlands, alpine and subalpine meadows, sandy dunes and alkali sandy steppes. Response of plants is better understood than the response of consumers. In the East European Plain, only the vegetation component of pasture biota has been investigated to date, while the invertebrate community has remained unstudied. In the hardly grazed steppes, grazing was considered a negative factor and had never been recommended as a conservation tool. Recently, the livestock is rapidly decreasing in Ukraine, the pastures are abandoned, and we have very little time to study the impact of grazing on various components of the steppe biota.

We investigated cursorial spiders and insects on slopes and bottoms of the two steppe gullies, which had a long grazing history. In one gully, grazing was ceased in early 1990s. Spider assemblages were richer in species and individuals in the bottom of ungrazed gully but they lost their steppe traits because of the encroachment of meadow and forest-edge species. The most specific and stable steppe assemblage has been formed on the ungrazed slope.

The true bug assemblages were more diverse on both grazed and ungrazed slopes; they increased in numbers on the grazed slope, and did not change with grazing in the bottoms. All the true bug ecological groups (trophic guilds, steppe or meadow specialists, and grass or ground dwellers) responded the site orographic position regardless grazing management.

The beetle assemblages reached maximal abundance on the ungrazed slope due to the high number of the *Tenebrionidae*. The grazed gully bottom attracted other families, like *Curculionidae*, *Carabidae*, and *Scarabaeidae*. Only *Dermestidae* preferred ungrazed gully bottom, meanwhile the total number of beetles in this habitat was the lowest. Orthopterans were the most abundant on the grazed gully slope. Ants, in contrast, were least abundant.

Our research confirmed that different arthropod groups respond differently to the influence of the same factor. Spiders, ground beetles and darkling beetles were the most sensitive to both orographic position and management. Spiders preferred undisturbed steppe while beetles were more diverse in the grazed one. Thus, patched grazing can be used in steppe management for enhancing landscape heterogeneity and maintaining local biodiversity.

Restoration projects supporting biodiversity of kurgans in the Hortobágy National Park

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Keywords: loess grassland, mowing, protected species, species transplantation, seed sowing

Fragments of the loess grasslands are often preserved only in areas which are inadequate for arable farming. In many cases kurgans harbour the last remnants of dry grasslands in lowland areas, such as the Great Hungarian Plain. They also have an essential role in preserving cultural and landscape values and harbour several rare plant and animal species. Given the scattered distribution of kurgans small-scale and volunteer NGO projects can largely contribute to preserve or restore their biodiversity. Our aim was to restore five kurgans in the Egyek-Pusztakócs region (Hortobágy National Park) between 2011-2014, by controlling invasive species, mowing and introducing loess grassland species. Two kurgans were managed by hand-mowing three times a year, two by mowing machinery once a year and one by extensive sheep grazing. We controlled the invasive species *Lycium barbarum* by mowing three times a year and herbicide application in autumn. Grassland matrix species (*Festuca rupicola*, *Dianthus ponederae*, *Filipendula vulgaris*, *Salvia austriaca* and *S. nemorosa*) were introduced by seed sowing, while rare loess grassland specialist species (*Anchusa barrelieri*, *Amygdalus nana*, *Centaurea sadleriana* and *Phlomis tuberosa*) were introduced by planting or transplanting individuals from endangered populations. We found that the applied measures were effective in suppressing *Lycium barbarum*. However, the species has a very good regeneration potential from its rhizome system, thus for the long-term sustainability of results, mowing multiple times per year or the introduction of extensive grazing is necessary. We found that all introduced species established and survived better on kurgans managed by hand-mowing and grazing compared to ones managed by heavy mowing machinery. We emphasise that proper management of kurgans is essential for controlling invasive species and for the long-term survival of matrix and specialist species typical to loess grasslands.

Relationships between species diversity and invasibility in a dry grassland

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Keywords: species diversity, invasibility, grazing intensity, community stability

Species diversity can significantly affect plant community stability, invisibility and dynamics. Livestock grazing is a selective process, which may increase frequency of some species, but reduce that of rare and susceptible species. Light grazing may provide opportunities for entrance of new species into a closed plant community, and hence increase its species diversity. This research was aimed to test whether an increase in species diversity due to light grazing provides biological resistance against the entrance of new species, or it may increase diversity of both native and invasive species, via increasing heterogeneity and resource availability. A study was conducted at 8 sites along a livestock grazing gradient, started from highest use in areas close to watering points towards the no-grazing site at an enclosure. Study area was in a semi-arid grassland, in Baharkish, Quchan, Iran. Plant sampling were conducted in spring 2016, at the time of full vegetative growth. Within each site, 10 plots of 1.5 m² were randomly established, in which number of plant species, and frequency and canopy cover of each species were recorded. Plant traits such as life form, growth form, maximum height, width and length, leaf length and area, and leaf dry and wet weight were measured for all plant species in each quadrat. Livestock grazing intensity was quantified by measuring micro-traces and dungs. Different species diversity indices were measured and compared along the grazing gradient. Highest species diversity was under light grazing intensity, whereas highest frequency of invasive species were under the most intense livestock grazing intensity. These results indicate biological resistance under the light grazing intensity, in which higher species richness prohibited extension of invasive species within the plant community.

National conservation and management programme for grassland habitats of EU importance in Latvia

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Keywords: grassland conservation, policy, Natura 2000, synergy

The national conservation and management programme for grassland habitats of EU importance is being developed in the frame of the LIFE+ project “National Conservation and Management Programme for Natura 2000 sites in Latvia”. One of the main aims was to prepare restoration and management guidelines for EU importance habitats. It was an open process involving experts, managers and governmental institutions. The guidelines are available online and the book will be published at the end of 2016 (both in Latvian, and in English). In the frame of synergistic cooperation with the Ministry of Agriculture a compulsory training was introduced in 2016 for farmers who receive the RDP support. The book of guidelines will be an obligatory textbook. The guidelines are partly integrated in the prescriptions of agri-environmental measures.

Another aim was to prepare a national programme for restoration of EU grassland habitats in Natura 2000 sites in Latvia for the next decade. It was an urgent task because a half of the total area of EU grassland habitats is presently deteriorating. Another half is managed under the Rural Development Programme (RDP). Still, only 15 % of managed area is in a favourable conservation status. Priority areas for restoration were determined using landscape-ecological criteria.

The project is financed by the EC LIFE+ programme (Project No. LIFE11 NAT/LV/000371 NAT-PROGRAMME). http://nat-programme.daba.gov.lv/public/eng/about_the_project/

Feather grass expansion in dry grasslands of north-eastern Ukraine

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Keywords: cattle grazing, abandonment, *Stipa*

The research was carried out in north-eastern part of Kharkiv Region. Historically, six species of feather grass are typical in non-sandy soils of north-eastern Ukrainian dry grasslands: *Stipa capillata*, *S. pennata*, *S. lessingiana*, *S. pulcherrima*, *S. tirsia* and *S. dasyphylla*. In the second half of the twentieth century feather grass communities became extremely rare due to widespread intensive grazing. Livestock grazing began to decrease after the 1990s. Since 2005 the confinement feeding of cattle has begun to replace the common practice of traditional pastoralism with herders. The trees began to colonise the gully bottoms after abandonment immediately. However, feather grass species, which were gradually appearing as free-standing individuals, began to form feather grass communities only after 10-12 years without cattle grazing. Approximately 5 years after the abandonment of cattle grazing, occurrences of feather grasses in existing plant communities had started to be noticeable. It took an additional 5-7 years for feather grasses to reach the constant maximum of their cover value. Simultaneously, there was an expansion of feather grasses in the surrounding plant communities. Currently, *S. pennata* and *S. capillata* are the most commonly recorded species; *S. dasyphylla* is rarely observed. The expansion of *S. pennata* and *S. capillata* goes into all dry grasslands located near refuges of feather grasses that survived until the abandonment of cattle grazing. Compared to *S. capillata*, *S. pennata* has a greater range of habitats as well as plant communities in which it occurs. Presently, monodominant communities of *S. capillata*, *S. pennata*, *S. pulcherrima* and *S. tirsia* already exist. There is also a variety of communities dominated by species of forbs rather than feather grasses. Unauthorised burning of dead plant matter – the phenomenon that has become a common practice to be used after the abandonment of grazing – does not preclude an expansion of feather grasses into plant communities, and perhaps even contributes to it.

Environmental education about grassland biodiversity, pasture management and research social utility

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Keywords: Biodiversity, Grassland, Pasture management, Environmental education

Dry grassland ecosystems represent a fundamental resource of plant species richness and are defined as 'habitat of priority importance' for nature conservation by EU, in particular as orchid species concerns. Biodiversity conservation depends on key elements such as habitat productivity, plant species functional features, type of management, density and grazing behaviour of herbivores.

Information about the aforementioned interactions can offer key knowledge to promote grassland biodiversity conservation and for management decision making, and may help to improve the governance of economic benefit as indicated by EU agricultural policies. In this perspective, the dissemination of information could be a paramount tool to understand the importance of environmental scientific researches for the territory development.

In the Marche Region, the agri-environmental project for the biodiversity guardianship comes from the grassland research activities, provided economic aid to the farmer that manages the natural grassland systems in agreement with European Community guidelines for the biodiversity maintenance and the use of animals for habitat prevention/maintaining.

Research projects have been turned into an environmental educational project aimed to educate and sensitise the primary school children to the environmental issues, in addition to show the social utility of research.

Our environmental educational project was carried out by means of the following steps:

- definition of biodiversity and ecosystem,
- illustration of grassland plant and animal biodiversity,
- biodiversity threats and their interplay with other environmental, social and economic issues,
- example of research project leading with biodiversity conservation, animal welfare and zotechnic activities.

Students of the first university degree in Natural and Environmental Sciences participated to the project with the aim to acquire specific competences about scientific dissemination.

Children have shown great involvement and attention towards environmental problems.

How modifications of forage features related to inter-annual rainfall variations affect sheep morpho-physiological characteristics

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Keywords: Grassland systems, Climate change, Pasture productivity, Body Condition Score, Rumen keratinisation

The sub-Mediterranean climate, mostly characterising the mountain regions sited all around the Mediterranean basin, is a variant of the Temperate bioclimate, characterised by winter cold stress and summer drought stress, the intensity and duration of which depend on the elevation gradient and land form factors. Models for the sub-Mediterranean regions indicate a strong increase of summer dry conditions and a more marked inter-seasonal and inter-annual variability, with maximum changes in summer and minimum changes in winter.

We aimed to assess the interplay among plant community characteristics, inter-annual climatic variations and sheep morpho-physiological features to model the responses of sub-Mediterranean pastoral systems to climate change and management modification.

We tested the hypothesis that the inter-annual climatic variability affects grassland productivity and feed value with different intensity (depending on slope angle and aspect) and causes variations in sheep rumen features (epithelium keratinisation degree) and animal body state estimated by means of Body Condition Score (BCS) method. We postulated that there is a significant correlation among grassland features, rumen characteristics and animal body state.

Results showed that in the sub-Mediterranean climate increased summer drought stress negatively affects forage quantity and quality, and that type and direction of changes are quite different from those reported for both Mediterranean and Temperate regions. In particular, the most negatively affected plant communities were those of productive habitats, which also undergo a strong decrease of the summer forage re-growth ability. These habitats are foundational for the sustainability of extensive sheep farming in sub-Mediterranean mountains, since those of south-facing slopes are normally fully dry in summer. Grasslands of south-facing slopes are more affected by the decrease of late-spring/summer rainfall variation, and by the seasonal rainfall patterns. Changes in forage features, and in particular the increasing fibre amount led to increase the rumen keratinisation. When the degree of keratinisation increases, the absorptive ability decreases, so we can infer that drought intensification reflects in a sheep's lessened ability to absorb nutrients because of increases in the rumen keratinisation degree, negatively affecting also the animal body state. Differences of BCS among years were significant in late summer, which is the mating period for sheep. In the driest year the end-August BCS drops down largely below the value considered sufficient to ensure the animal breeding/milking performances. Reduction of summer rainfall greater than 15–20% compared to the normal average value might be detrimental for semi-extensive rearing sustainability in sub-Mediterranean climate.

Naturalness indicator values as a tool for estimating success in grassland restoration

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Keywords: Austria; diversity; degradation; regeneration; similarity; target species;

How should the somehow vague term of restoration success be measured? This is a critical question owing to the European law, where in fact creation of proper replacement habitats is a prerequisite for the permission of projects which trigger a loss of species or habitats protected by the Habitats Directive. In addition, replacement habitats must be established before protected habitats are damaged, due to the precautionary principle.

Previous studies have used indices that relied on a comparison to reference sites, for example the number of a predefined pool of target species or compositional similarity. However, since restoration sites have rarely exactly the same biotic and abiotic conditions as reference sites, plant communities in restored sites will never be fully similar to the reference. Furthermore, such classic indices fail when reference sites are lacking or degraded. Hence, considering that limiting factors in restoration projects like site availability, abiotic site conditions or structure on landscape level cannot be overcome in every case, there is a need for an alternative index that evaluates the conservation value of a restored site independently from reference sites. We propose that naturalness indicators can be an option to measure restoration success.

The approach of using naturalness indicators makes use of the fact that plants are able to indicate environmental parameters, including degradation and regeneration. However, unmodified naturalness indicator values have one disadvantage when used as a measure of restoration success: Unlike most of the other measures, mean naturalness indicator scores do not take diversity into account.

We compared and measured the restoration success of four methods for grassland restoration (sod transplanting, natural colonisation, hay transfer, seed mixtures) with six different indices (total species number, target species number, Shannon index, similarity to reference sites (FPFI), mean naturalness and a modified naturalness index). We could show, that the modified naturalness index (species number x naturalness) had a high correlation with the number of target species and compositional similarity. Thus, our case study demonstrated that the concept of naturalness can be an option to estimate restoration success, but it has to be combined with diversity to provide a valuable measure in grassland restoration.

Effects of grazing on plant species composition of Natura 2000 grassland and shrubland habitat types of Central Portugal

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Keywords: Natura 2000, semi-natural grasslands, species richness, herbivory

The Natura 2000 network of protected sites was established for ensuring the long-term conservation of threatened species and habitat types in European Union. Natura 2000 sites must be managed to maintain a favourable conservation status in accordance with the ecological requirements of the classified species and habitat types.

Calcareous grasslands are a Natura 2000 priority habitat supporting a high diversity of plant species including many species of special conservation status.

Management practices, such as grazing, are common in Natura 2000 sites. In the Mediterranean regions grazing can be used to reduce wildfire hazard by preventing shrub encroachment and maintaining open mosaic habitats.

A grazing experiment was conducted in Serras de Aire e Candeeiros Natural Park, Central West Portugal, in an area managed by a Rural Development Cooperative that owns a flock of 200 local breed goats (Serrana race, Ribatejana ecotype) which are used to produce traditional cheese.

We analysed the effects of grazing on calcareous grassland-shrubland through a grazing exclusion experiment. Ten paired plots of 100 m² (10m x 10m) were randomly established in 2010. Each pair consisted of a fenced plot, to exclude grazing by goats, and an adjacent unfenced plot. Floristic surveys of vascular plants, bryophytes and lichens were conducted in spring 2016. Plant diversity and species composition was estimated in five 1m x 1m quadrats in each fenced and unfenced plot.

We found no significant differences in plant species richness and diversity, but there were differences in plant species composition between fenced and unfenced plots. Annual legumes had significantly higher percentage of ground cover in grazed plots. For example: *Trifolium scabrum* 2.0 ± 3.7 vs. 0.6 ± 1.3 in unfenced vs. fenced plots. Results may reflect effects of grazing on plant communities, allowing the colonisation of nitrophilous plant species, more adapted to disturbance, in unfenced plots.

Our results confirm that grazing can be used to shape plant species composition of grassland habitats. Further work, however, is needed to better understand the effects of grazing on other groups such as bryophytes and on conservation status of these habitat types.

Comparison of Mountain and Plain Steppes from the Conservation standpoint

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Keywords: Mountain Steppes, Caucasus, Conservation, Chorological Class

As already discussed, mountain steppes of the North-Caucasus are generally consistent with the description of the habitat type **E1.2** Perennial calcareous grassland and basic steppes (EUNIS classification) being the habitat type of European importance. We have studied the conservation specificity of the mountain steppes in comparison with several variants of steppes situated on the plains and lowlands of the Southern part of European Russia. We have compared common size, configuration, vegetation, and fauna of typical dry grassland sites in mountains and plains. When speaking about animals we paid a special attention to the biotope size being necessary for surviving of their viable populations (a chorological class).

Mountain steppe vegetation occupies intramontane highly insolated depressions with dry and hot summer micro-climate conditions. Usually the mountain steppe sites are of a small size and situated on the slopes of the mountain canyons. These circumstances even more aggravate both the risk and the consequences of the habitat fragmentation. Both large undulates and carnivores occur in the mountain steppe sites but not obligatory. Mountain steppe sites are too small for becoming a critical biotope for large mammals during the evolution of the last ones.

In fact, *Mustela eversmannii* and *Vormela peregusna* are the largest mammals preferring mountain steppes and similar biotopes in Northern Caucasus. They are species of European importance and therefore their presence indicates high conservation value of the sites.

However, there are larger mammals and large raptor birds in Caucasus – just these species should be on the top of the self-regulation system of the mountain natural communities. Therefore, we consider mountain steppes not as a separate natural community but as a part of the whole mountain biome. Properly established Protected Area supporting the mountain steppe should include not only a mountain steppe site it-self but the associated biotopes too.

This is similar to the Forest-Steppe communities of the Central Russian plain: Raptor bird can regulate the rodent populations in steppe sites but a lot of such birds nest in forest islets.

By contrary, open dry grasslands of the Caspian lowland (Republic of Kalmykia) are large enough for hosting viable populations of mammals belonging to the highest chorological class – both herbivorous (Saiga Antelope) and carnivorous (Wolf). Open dry grasslands predominate and may be the main target object of conservation efforts as a self-regulating biome. Associated biotopes are smaller and usually included in the large dry grassland area.

A new aspect of grassland vegetation dynamics: The presence of cyanobacterium colonies can affect establishment success of plants

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Keywords: allelopathy; cyanotoxin; establishment success; alkali grassland; germination; growth; *Nostoc*; terrestrial plants

Cyanobacteria can be important drivers of vegetation processes in several terrestrial habitats such as deserts and alkali grasslands. Their effects on the vegetation have already been studied in arid environments where they occur as constituents of soil crusts, while the effects of their macroscopic colonies in temperate grasslands remain unknown. Cyanobacteria produce various metabolites having adverse effects on several organisms like aquatic plants and terrestrial crops, but their effects on the natural flora of terrestrial habitats have not been studied previously. We conducted a literature search to gather existing knowledge about the effects of toxic cyanobacteria on the germination and growth of terrestrial plants. Then, we aimed to test the chemical effects of a *Nostoc* (Cyanobacteria) extract on the germination and growth of species occurring in alkali habitats to investigate whether cyanobacteria may alter community structure and diversity via affecting the establishment success of plants. We collected Cyanobacterium colonies in Hortobágy, East-Hungary, and the experiments were carried out in a glasshouse in the Botanical Garden of the University of Debrecen, Debrecen (Hungary). Field-collected *Nostoc* colonies were used to prepare a cell-free water extract and treatments (watering with *Nostoc* extract and watering with tap water only) were tested on 3×100 seeds of nine alkali grassland species. After five weeks, seedling number, seedling length and fresh- and dry weight were measured. We have found that previous papers have studied 27 species in this respect, but as they were mostly focused on crops irrigated with cyanobacteria-containing water, the effects on the natural flora remained largely unknown. We found that species identity and treatment had a significant effect on almost all variables, but their interaction only affected germination rate and fresh weight. Seedling length and fresh- and dry weight only decreased significantly in the invasive *Hordeum jubatum*, but germination rate decreased significantly in five species. Based on our findings, terrestrial cyanobacterium colonies occurring in temperate grasslands can have an effect on the establishment success of grassland plants, through which they may be important in determining which species can be assembled into the community. The interaction of plants and cyanobacteria may even change that outcome of plant–plant interactions, through which cyanobacteria may play an important role in shaping diversity, species composition and structure of natural plant communities.

Assessing spatial heterogeneity of biomass production in Hungarian grasslands

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Keywords: biomass, coefficient of variation, ecosystem services

By studying the functional organisation of plant communities we can get information about their stability and, in this context the quality and sustainability of the ecosystem services (*e.g.* the amount of biomass production). In our study we assessed grasslands of different types, dynamical states and diversity focusing on the amount and spatial variation of biomass.

Our aim was to develop easily measurable indicators for characterising grassland communities from the point of view of functioning and the quality of ecosystem services. We studied sandy and loess grasslands, steppe meadows and old fields (altogether 40 transects at 9 sites distributed across Hungary).

Aboveground biomass was sampled in 50 cm x 50 cm quadrats together with coenological relevés. At each site the sampling design consisted of 31 quadrats arranged regularly at 2 m intervals along a 60 m transect. For data analyses the coefficient of variation (CV%) of biomass and the alpha and beta diversity of coenological data were compared. The coefficient of spatial variation decreased with increasing mean biomass in natural grasslands. However, this trend did not appear in old field vegetation. In case of old fields the CV% of biomass proved to be higher comparing with natural grasslands. The seasonal dynamics of biomass was monitored monthly (between March and August) at three sites. The theoretically expected trend of monotonous increase of mean biomass with decreasing spatial variation was found only at one site with the most pristine grassland vegetation. The repeated biomass sampling (from gradually shifting spatial positions) resulted in irregular temporal patterns at the two other grassland sites of more complicated land-use history (with repeated strong anthropogenic disturbances in the past). Our results suggest that community level functioning is better regulated in natural, undisturbed grasslands and the related functional patterns are applicable to indicate dynamical states and naturalness. The survey was funded by the OTKA K 105608 project.

Functional response of an invasive tall grass (*Brachypodium genuense*) to environmental variability in sub-Mediterranean climate

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Keywords: Specific Leaf Area; trait plasticity; pasture productivity; competitive ability

Semi-extensive farming cessation and settlement abandonment are threatening European pastoral landscapes and their biodiversity, affecting species assemblage and ecosystem functioning. This process typically involves the invasion of coarse tall grasses mostly with competitive stress-tolerant strategies and quickly developing mono-dominance stands. A problematic species in this respect is *Brachypodium genuense* (DC.) Roem. et Schult., an endemic, rhizomatous, tall-grass occurring in the semi-natural grasslands of the Italian peninsula over 1200-1400 m a.s.l. Because of this, we need to deepen our understanding of ecological factors allowing its spread, and of the relationships between its functional features and environmental constraints. The latter is a key issue since traits reflect the trade-offs among different functions within a plant and variations in resource availability proved to determine their intra-specific variation. Therefore, the intra-specific trait variation assessment is a paramount condition to predict species performances in the light of environmental changes.

We hypothesised that *B. genuense* was able to spread and dominate the grassland communities undergoing a wide range of environmental conditions, thanks to its ability of changing its performances, showing large morphological and physiological plasticity, mirrored by high variations of traits, namely Specific Leaf Area (SLA), individual height and tussock cover values.

The study area encompasses the Monti Sibillini National Park (central Italy), characterised by limestone bedrock, within the temperate region, near the border of the Mediterranean one.

We found that in more productive conditions (deeper soil, medium/high pH values, north-facing slopes, and “conservative” land forms) populations of *B. genuense* showed higher SLA, plant height and cover values. This underlies a fast-growing strategy based on high resource acquisition/use rate, as well as higher competitive ability for above-ground resources (e.g. light). The opposite trend emerged for unproductive/dry conditions (south-facing slopes, shallow soils, lower pH values). Under these constraints, SLA, plant height and cover value decreased underlying a slow-growing strategy with high conservation and low acquisition rate of resource. In addition, we found that very high nitrogen amount might have a detrimental effect on *B. genuense* individuals decreasing the SLA values, thus requiring the plant to change the growth strategy.

We also inferred that the invasive/dominant behaviour of competitive-stress tolerant tall grasses is related not only to clonal integration strategy, plant height, litter deposition, etc., but also to the morphological plasticity of leaves, allowing plants to maintain the coordination of multiple resource capture and, hence, to sustain dominance.

Functional diversity of high mountain pasture communities: a trait based comparative study

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Keywords: plant functional traits, trait variability, Rao's diversity

Objective: Revealing differences in functional structure and diversity of two community types and exploring the effects of plant dominance on the trait variability.

Location: Beklemeto region, Central Balkan National Park, 1560-1700m altitude.

Method: We established six environmentally similar sampling sites on six hilltops of the mountain ridge. One *Nardus stricta*-dominated and one *Vaccinium* spp.-dominated community stand have been sampled at each site. In each stand, we recorded species presence/absence data in 5 x 5cm contiguous micro-quadrats along 52m long transects and used the species frequencies as an estimate for species abundance. We collected information from databases and own measurements about three main plant functional traits - specific leaf area (SLA), seed mass (SM) and plant maximum height (MH) for all the species present in the records. We calculated community-weighted mean trait value (CWM) of every stand to assess shifts in trait means among stands. We calculated Rao's quadratic diversity index for each trait within each stand to assess functional diversity. Regression analysis was applied to estimate correlation between functional diversity and species diversity on the bases of diversity indices (Rao's index and Simpson index). We used t-test statistic for comparing functional diversity between two community types.

Results: Species diversity was considerably higher within *Vaccinium*-dominated stands compared to *Nardus*-dominated ones (Simpson index). There was positive correlation between species diversity and functional diversity considering Rao's index for seed mass and maximum plant height across all stands. Stronger variability in CWM for specific leaf area was detected among the *Nardus*-dominated stands compared to the *Vaccinium*-dominated stands and opposite tendency for seed mass. The t-test showed significant difference in the Rao's diversity index values between two community types for MH and SM.

Conclusions: As there is significant difference in Rao's index values between community types and functional diversity increase with species diversity we conclude that *Vaccinium*-dominated community type has higher functional diversity than *Nardus*-dominated community type. Compositional and abundance variability of the dominant species are of major importance for variability of the trait averages within community types.

Hydrologic fluctuations trigger structural changes in steppe-wetland ecotones but have no effect on ecotone position

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Keywords: steppe, wetland, ecotone, edge effect, microtopography, soil organic matter content

Ecotones between plant communities have received considerable attention among ecologists in the context of fragmentation, climate change and the management of heterogeneous landscapes. However, the predictability of ecotone dynamics is low and the processes taking place within ecotones are still poorly understood. In this study I aimed to characterise the positional and structural dynamics of ecotones in an ecotone-rich steppe-wetland landscape of Hungary in relation to the fluctuations of water regime and to other, comparatively stable environmental gradients, namely microtopographic and soil texture gradients.

I established thirteen permanent transects, starting in steppe patches and ending in adjacent wetland patches, and surveyed their vegetation in three consecutive years with highly different water regime. The first and the third years were rather humid, while the second year was a droughty one. Ecotone positions were objectively determined with the split moving window technique. Ecotone structure was characterised by the compositional contrast across the ecotone positions. I also mapped the microtopography of the transects and measured the gradients of soil organic matter content to identify potential boundaries in elevation and soil texture, respectively.

Ecotone positions did not follow the fluctuations of the water supply but were highly stable and coincided with elevation boundaries, confirming that microtopography is a major determinant of ecotone position. Soil boundaries were also found but mostly downhill to the ecotones. Water regime significantly influenced the compositional contrast of the ecotones: When the water supply was high, contrast was also high, but under drier conditions the contrast decreased. These changes could be explained by asymmetric edge effects: In the droughty year, wetland edges became similar to steppe edges due to the decrease of wetland specialists and the increase of steppe specialists, but steppe edges did not exhibit an opposite transformation in wet years. This asymmetry may have had a role in pushing soil boundaries downslope but the currently steppe-like soil of wetland edges could also make wetland edges more prone to edge effects; thus, the cause-effect relationship between soil texture and the structural dynamics of the ecotones is difficult to disentangle. In sum, the dynamics of the studied ecotones depends on a complex interaction of various drivers and determinants, and while ecotone positions were stable due to the constraining effect of microtopography, a dynamic environmental factor, water supply could restructure the ecotones through eliciting differential edge effects, which led to a seemingly dominant nature of steppe communities over wetland communities.

The effectiveness of passive restoration in vegetation recovery of calcareous sand grasslands

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Keywords: grassland restoration; seed bank; spontaneous succession; grassland biodiversity

Passive restoration (*i.e.* considering spontaneous dispersal and vegetation recovery processes) are increasingly involved in grassland restoration, because they offer a cost-effective solution compared to technical reclamation methods. Studying old-fields using the chronosequence method including abandoned fields of different age and target calcareous sand grasslands we aimed at to answer the following questions:

- (i) How fast and successful is passive restoration in the recovery of calcareous sand grassland vegetation in old-fields?
- (ii) Which species contribute to the seed banks of old-fields and target grasslands?

The cover of vascular plants was recorded in early May and late June 2012. The seedling emergence method with bulk reduction procedure was used in seed bank analyses. We found that spontaneous succession is a vital option in grassland recovery because the majority of the species can be recovered in the first 10-20 years. In open grasslands only sporadic seed banks were detected, while several hygrophytes had dense seed banks in closed grasslands (*Holoschoenus romanus* and *Juncus articulatus*). Most target species possessed at most sporadic seed banks. The development of seed banks in old-fields were progressed towards to that of target grasslands and the proportion of ruderal species decreased with time (*e.g.* *Conyza canadensis* or *Ambrosia artemisiifolia*). Our results indicated that the success of grassland recovery can be strongly influenced by seed dispersal and is the most promising when target species can immigrate at the very beginning of the succession.

Seed dispersal potential and notes on the diet of the endangered Lesser White-fronted Goose

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Keywords: alkali landscape, animal-mediated plant dispersal, *Anser erythropus*, germination, vulnerable species, wetland

Recent studies found that endozoochorous seed dispersal by waterfowl is an important dispersal strategy for numerous plants. With a germination experiment, we evaluated the endozoochorous dispersal potential of the endangered Lesser White-fronted Goose (LWfG, *Anser erythropus*) and larger goose species (*A. anser* and *A. albifrons*) in their autumn and spring staging areas (Hortobágy, East-Hungary). We tested the following hypotheses: (i) The amount and species composition of germinable seeds in the droppings of the habitat specialist LWfG and generalist larger goose species have a different species composition, (ii) Droppings contain less germinable seeds and less species in spring than in autumn, when most species disperse their seeds. We collected droppings of LWfG and larger goose species in their feeding habitats in spring and autumn staging areas. Droppings were concentrated and germinated on trays filled with steam-sterilised soil in a greenhouse. LWfG dispersed more species typical to alkali habitats, and lower amounts of weeds compared to larger goose species, which confirmed our first hypothesis. We recorded higher total species numbers and species number of annuals, wetland species and weeds in autumn, which supported our second hypothesis. We found that the studied goose species used a wide range of feeding habitats; thus, they can play an important role in dispersing seeds between a range of habitats which they use for feeding. Based on the seed content of the droppings, LWfG is confined to natural habitats; thus for effective protection of this vulnerable species, it is crucial to preserve to natural feeding habitats in their staging areas.

Selection of livestock type is more important than just setting grazing intensity in short-grass steppic grasslands

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Keywords: sheep, cattle, short-grass steppic grassland, functional diversity, leaf-traits, Rao

Nowadays, the conservation and restoration of biodiversity in open landscapes including various types of grasslands became a high priority task. To restore and maintain grasslands most parts of Europe low intensity grazing by cattle or sheep is frequently suggested. We studied the effects of grazing on vegetation composition, species richness and diversity, and functional diversity under various grazing intensities. We selected short-grass steppic grasslands in Hortobágyi National Park, East Hungary. Short-grass steppic grasslands are generally used as pastures, and grazed by cattle (Hungarian grey cattle) or sheep. The levels of grazing intensity were low to medium (0.5-1.5 au/ha) and high (2.5-3 au/ha) and the grazing intensity corresponded to the typical grazing regimes applied in the region. We studied leaf-traits (LDMC, LDW, SLA, LA) and other plant traits like: start of flowering, flowering period, rosette forming, specific plant height, clonal spreading ability and seed weights. We also classified the species into simplified life form groups, and 'legume' and 'non legume' species groups for the analyses. We tested the following study hypotheses: (i) sheep grazing maintains grasslands with a lower taxonomic- and functional diversity and lower amount of forbs than cattle grazing, (ii) the effect of grazing is highly intensity dependent and the differences detected between cattle and sheep grazed grasslands are more marked at low grazing intensity than at high ones. We found that the species richness was lower in sheep grazed grasslands and decreased with increasing intensity of grazing. Shannon diversity and evenness were affected by the livestock type but not by the grazing intensity; lower scores were typical in sheep-grazed plots. The cover of forbs was lower in sheep-grazed plots than in cattle-grazed ones. The multi-trait functional divergence was affected by the intensity and we detected different trends between the two livestock types. The Rao's quadratic entropy was higher in cattle grazed plots. In case of single traits most of the community weighted means (CWM) were affected by the livestock type. The taxonomic- and functional diversity were lower in sheep grazed ones. Our results suggest that the selection of the livestock type in short-grass steppic grasslands is more crucial in conservation than the adjustment of grazing intensity.

Increasing biodiversity of restored grasslands using establishment gaps

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Keywords: sown grassland, alkali grassland, loess grassland, restoration, seed mixture

We studied vegetation changes in former croplands sown by low-diversity seed mixtures in East-Hungary. Our aim was to evaluate the usefulness of low- and high-diversity seed sowing in grassland restoration. We also tested a novel approach by creating establishment gaps for increasing the diversity of species-poor sown grasslands. We compiled a high-diversity seed mixture containing 35 species, and created establishment gaps (1×1-m, 2×2-m and 4×4-m size, created by the mechanical removal of vegetation) in species poor sown grasslands. Three years after sowing low-diversity seed mixtures vegetation was characterised by a high cover of sown grass species and low cover of weeds. Our results showed that using low diversity seed mixtures offer a viable solution for grassland restoration. By creating establishment gaps we can successfully introduce rare target species to the species-poor restored grasslands. We found that all sown species established in the gaps and many of them maintained or increased their first-year cover to the second year. Larger establishment gaps were characterised by higher cover of sown species compared to the smaller ones. Therefore, in restoration practice larger restoration gaps are recommended.

The interaction between mesic and steppic grasslands on the boundary of temperate and boreal zones

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Keywords: *Festuco-Brometea*, *Molinio-Arrhenatheretea*, distribution, ecological characteristics, Lithuania

Lithuania is on the boundary between temperate and boreal zones. It is the main reason for occurrence of various and unique grasslands communities in Lithuania. In these communities diverse species compositions that are characteristic of *Molinio-Arrhenatheretea* and *Festuco-Brometea* communities are found. Such origin of the communities cause a lot of difficulties for classification of phytocoenosis. The main goal of the research was to assess the impact of *Molinio-Arrhenatheretea* species upon *Festuco-Brometea* communities and evaluate the relation of the characteristic species of the classes and communities' layout on topographical elements of river valley terrain.

The data were collected in the northern Lithuania (Lielupė, Venta, Šventoji and Bartuva rivers basins). All relevés were collected according to the classical Braun-Blanquet school methods. Environmental conditions were evaluated using Ellenberg indicator values and topsoil chemical components (N, P₂O₅, K₂O, pH, humus) as well as site topographical features (slope inclination and exposition, terraces level). Data were analysed using Juice 7.0, R-project and Past 3.1 software.

In all data set (129 relevés) species characteristic of 5 phytosociological classes were found; in total 260 plant species were registered in communities. Most species are characteristic of *Molinio-Arrhenatheretea* class (on average 17.6 ± 7.41 species per relevé) and *Festuco-Brometea* class (7.38 ± 5.16). The portions of species characteristic of *Trifolio-Geranietea* (0.35 ± 0.65), *Koelerio-Corynephoretea* (0.11 ± 0.34) and *Calluno-Ulicetea* (0.38 ± 0.61) are not significant, and most of these species are sporadic. The species characteristic of other phytosociological classes are merged into one group, on average 5.07 ± 2.17 species per relevé.

The general linear model shows negative moderate correlation between species characteristic of *Molinio-Arrhenatheretea* and *Festuco-Brometea* ($r_p = -0.64$, $p < 0.05$). The data set was divided into four groups according to occurrence of communities in site topographical elements. The positive moderate correlation ($r_p = 0.55$, $p < 0.05$) is between species characteristic of *Molinio-Arrhenatheretea* and *Festuco-Brometea* communities situated on steep slopes, while in communities situated on gentle slopes no significant linear relation is recorded ($r_p = 0.12$, $p > 0.05$). There is a main trend (negative moderate and weak correlation) in communities situated on high level terraces ($r_p = -0.36$, $p < 0.05$) and low level terraces ($r_p = -0.48$, $p > 0.05$), but the latter one is not statistically significant.

Supporting biodiversity by prescribed burning in alkaline grasslands – a multi-taxa study

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Keywords: biomass; fire; arthropods; management; steppe; vascular plants

There are contrasting opinions on the use of prescribed burning management in European grasslands. On the one hand, prescribed burning can be effectively used for the management of open landscapes, controlling dominant species, reducing accumulated litter or decreasing wildfire risk. On the other hand burning can have a detrimental impact on grassland biodiversity by supporting competitor grasses and by threatening several rare and endangered species, especially arthropods. We studied the effects of prescribed burning in dry alkaline grasslands of high conservation interest. Our aim was to test whether dormant-season prescribed burning can be an alternative conservation measure in these grasslands. We selected six sites in Hortobágy, East-Hungary: in three sites, a prescribed fire was applied in November 2011, while three sites remained unburnt. We studied the effects of burning on soil characteristics, plant biomass and on the composition of vegetation and arthropod assemblages (isopods, spiders, ground beetles and rove beetles). Soil pH, organic matter, potassium and phosphorus did not change, but soluble salt content increased significantly in the burnt sites. Prescribed burning had several positive effects from the nature conservation viewpoint. Shannon diversity and the number of flowering shoots were higher, and the cover of the dominant grass *Festuca pseudovina* was lower in the burnt sites. Graminoid biomass was lower, while total, green and forb biomass were higher in the burnt plots compared to the control. The key finding of our study was that prescribed burning did not decrease the abundance and diversity of arthropod taxa. Species-level analyses showed that out of the most abundant invertebrate species, 10 were not affected, 1 was negatively and 1 was positively affected by burning. Moreover, our results suggest that prescribed burning leaving unburnt patches can be a viable management tool in open landscapes, because it supports plant diversity and does not threaten arthropods.

Calcareous outcrops communities of Dniester Valley

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Keywords: *Stipo pulcherrimae-Festucetalia pallentis*, Dniester Valley, calcareous outcrops

Canyon part of the Dniester valley extends in 250 km from the mouth of Zolota Lypa River to the mouth of the Zbruch River within four districts of Ukraine: Ivano-Frankivska district, Ternopilska district, Khmelnytska district, Chernivecka district. Dniester Canyon is presented by rocks and cliffs with Silurian, Devonian, Jurassic and Neogene outcrops. Soils formed on loess and loam bedrocks, causing formed grey and black-forest soils, on products of weathering of carbonate rocks - sod-carbonate, actually are characteristic of retreating steep slopes and valleys of the Dniester River and its tributaries and Tovtry Plateau.

We have formed supraregional vegetation database on the relevés based on our investigation and other authors from Czech Republic (500), Romania (10), Moldova (20), Slovenia (10), Austria (8) and Ukraine (150). Vegetation database was created in TURBOVEG program and exported to JUICE software. We have obtained the results and distinguished clusters by TWINSpan Modified and detailed by PC-Ord. The optimal number of clusters was determined by OptimClass software. Ecological analysis was made by R-project and STATISTICA for Detrended Corresponded Analysis (DCA) based on Didukh ecological scales.

The results of our analysis were two alliances of *Stipo pulcherrimae-Festucetalia pallentis* order: *Galio campanulatae-Poion versicoloris* alliance and *Genisto tetragonae-Seselion peucedanifolii* alliance and also one alliance of *Alysso-Sedetalia* order: *Alysso-Sedion albae* alliance.

Ukrainian part of Dniester River, left bank of Dniester, the *Alysso-Sedion albae* alliance is represented by six associations: *Ajuga chia-Sedum acre* comm., *Sempervivum ruthenicum-Astragalus monspessulanus* comm., *Alyssum calycinum-Sedum sexangulare* comm., *Schivereckia podolica-Seseli libanotis* comm., *Aurinio saxatilis-Allietum podolici*, *Brachypodio pinnati-Seslerietum*: *Galio campanulatae-Poion versicoloris* alliance is represented by one association: *Poetum versicoloris*.

Moldavian part of Dniester River, right bank: *Genisto tetragonae-Seselion peucedanifolii* is represented by six associations: *Astragalo pseudoglauci-Koelerietum moldavici*, *Genisto tetragonae-Seselietum peucedanifolii*, *Astragalo pseudoglauci-Jurinetum stoechadifoliae*, *Helianthemo cani-Thymetum moldavici*, *Sileno supinae-Pimpinelietaum tragii*, *Teucrium polium-Pimpinella tragiium* comm.

We analysed if aspect and inclination are correlate with other environmental parameters (soil humidity, acidity, carbonate content, nitrogen content, aeration, thermoregime, ombroregime, continentality, light by Didukh scales) and concluded that aspect and inclination are depended by light, thermoregime, acidity and soil humidity. Inclination of slopes is not depended by any environmental parameters. In general, leading environmental parameters that affect limestone outcrops communities distribution are soil humidity, acidity, carbonate content, thermoregime and continental parameters.

Beginning the grassland restoration by means of grazing and haymaking

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Keywords: Meadow restoration, Grazing, Haymaking, Limestone mining, Cow, Pony

In 2016 we have begun an experiment on the grassland restoration in the Tul'skaya Oblast'. The project area consists of a former field being now in the use of the HeidelbergCement RUS LLC Enterprise and devoted for limestone mining after 10 years. Now the enterprise shall use it in line with its status of the Agriculture Lands.

The project idea is to implement the traditional livestock with year-round stabling and restricted grazing impact of a few cows and ponies. We expect restoring the meadow with high natural biodiversity. It will be a good example of the restoration opportunity provided by traditional livestock. At the same time the restored natural biodiversity will improve the soil fertility. It is important as before the beginning of the limestone mining the soil shall be collected and used for the recultivation of the previously spent quarry.

Actually we begin the primary restoration of the meadow. We have collected plant species occurring in various parts of the project area and found some ruderal plant species not native for the area. We have analysed the list of species using the ecological scales of L.G. Ramenskiy. Thus we identified what plant species belonging to native flora have the same ecological requirements as species currently occupying the project area. We will use this result in practical restoration with taking into account the specific livestock requirements to the flora of pastures. In line with local logistic situation a part of the project area should be under haymaking only. We expect to implement there the extended (3-4 weeks) mosaic mowing as being similar to the traditional Russian haymaking. Earlier we have tested such haymaking implementation as a tool for saving natural insect diversity.

We consider the presence of various rare species as an indicator of the close to natural state of an ecosystem. Presence of species of European importance can be such an indicator in some cases. Therefore we can consider the conformity of the project area to the criteria of the Emerald Network as an interim objective of the project.

Actually otters inhabit edge of the project area but it is still not enough for saying the restoration completed: the otters use only a small part of the project area and do not constitute a viable population. The presence on viable populations of vulnerable plant species or invertebrates, or not too large vertebrate will be just criterion of the success.

High level units of the *Festuco-Brometea* class vegetation in Ukraine

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Keywords: steppe, classification, dry grasslands, numerical analysis, Braun-Blanquet approach

In Ukraine studies of the steppe vegetation according to the Braun-Blanquet approach were started in the early 80th. Ever since more than 80 articles with 1466 relevés of *Festuco-Brometea* class were published. In addition, a significant proportion of relevés was made by different authors, which are stored in some national and private databases.

We collected a database of relevés of *Festuco-Brometea* class vegetation from Ukraine from all open sources. Additionally to the published materials, 3567 unpublished relevés were added (including our own data). Furthermore, 9907 relevés of this vegetation type from the other countries were used for comparison. The entire database included 14940 relevés. All dataset was unified by single criteria. An analysis was conducted using Modified TWINSpan Classification. Phi coefficient was used for the determination of diagnostic species of obtained clusters.

The analysis revealed that whole array of the data was divided into four main groups of clusters which correspond with main orders of the class. The first most separated group combines true steppe vegetation from the Pontic-Caspian region that we consider as new order *Galatello villosae-Stipetalia lessingiana*. Relevés from Ukraine are combined into 5 alliances (*Stipo lessingiana-Salvion nutantis*, *Tanaceto millefolii-Galatellion villosae*, *Artemisio tauricae-Festucion valesiaca*, *Poo bulbosae-Stipion graniticolae*, *Potentillo arenariae-Linion czerniaevii*). The second group corresponds with the order *Stipo pulcherrimae-Festucetalia pallentis* with unclear syntaxonomical position in alliance level. The third group corresponds with the mesic dry grasslands of *Festucetalia valesiaca*. Relevés from Ukraine are represented by 4 alliances which are distributed mainly within the forest-steppe zone and Crimean Mountains (*Festucion valesiaca*, *Adonido vernalis-Stipion tirsae*, *Veronico multifidae-Stipion ponticae*, *Androsaco tauricae-Caricion humilis*). The last group represents the *Brachypodietalia pinnati* order. Ukrainian relevés are combined into one alliance. Its communities are spread in the western part of the country.

The bugs (*Insecta: Hemiptera*) of the Central Asian steppes

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Keywords: hemipterans, steppe zone, aphids, true bugs, plant-hoppers

Grasslands are one of the most species-rich and diverse plant communities, important refuges for xerothermic species of plants and invertebrates, including endemics ones. The Eurasian Steppe, also called the Great Steppe, is the world's largest steppe ecoregion, characterised by grassland plains. The boundaries of this ecoregion are not precisely defined, however it is believed that is located from Eastern Europe to North China. In the north, the steppe borders the boreal forest (taiga) of central Russia and Siberia, while in the south it fades into desert, which in Central Asia is dissected by mountain ranges. Steppes are located within the temperate zone, in the interior of the continent, where the inflow of moist sea air is reduced and are characterised by a relatively dry climate with cold winters and hot summers. *Hemiptera* are piercing-sucking phytophags with a trophic determined host plants. Majority of them are strict monophagous connected with one botanic species or oligophagous species feeding on one genera of host plant. The poster presented provides information on bionomy and distribution of selected species of bugs (*Insecta: Hemiptera*) in the Central Asian steppes.

Effect of topography and land use in the past on mountain grassland vegetation

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Keywords: mountain grassland, altitude, land use

Mountain grasslands are among the most species-rich plant communities in Europe. This is due to the large variation of abiotic conditions and different ways of management. In numerous examples it has been found that important is not only the current management but also the time which elapsed since the conversion of arable land into grassland. For decades, changes in the rural economy in the Polish Carpathians have been observed. The grasslands were afforested or abandoned that started natural forest succession. Fodder for a decreased number of cattle and sheep is produced on former arable fields.

The aim of this study was to evaluate the importance of topographic factors (altitude, slope, exposition) and land use in the middle of the nineteenth century (grassland, arable land) on current plant species composition of grassland. The study was conducted in the catchment area of the Łomniczanka river in Beskid Sadecki (Polish Carpathians). Altogether 73 research plots were established in altitude gradient from 660 to 1060 m a.s.l. and on each plot plant species list was made. Land use of each plot area in the nineteenth century was determined according to archival cadastral maps. Phytosociological classification was made using TWINSpan and DCA analysis with CANOCO program. The Ellenberg ecological indicator values were also calculated.

In the highest altitude most common were communities with black berry (*Vaccinium myrtillus*), beneath the mat-grass communities (*Hieracio-Nardetum*) and in the lowest altitudes bent-grass meadows (*Agrostietum*). Along with increasing altitude a reduction in the number of species per plot and the Shannon-Wiener diversity index was observed. The values of Ellenberg indicator of fertility (N), reaction (R) and temperature (T) also decreased. There was only slight increase in moisture indicator value (F). Contrary to the expectations and the results of other studies no effect of land use (pasture versus arable land) in the past on the current state of the meadows vegetation was found. All of identified plant communities were found on former meadows, pastures and arable land and no difference between the indicator values for different use in the past was observed.

The main reason is probably that a long period of time elapsed since the conversion of arable land into grassland (all plots were located on sites being grassland in the 1980s) and an influence of habitat factors related to the altitude was overwhelming.

Relationship between fine-scale functional and coenological patterns in grasslands in Hungary

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Keywords: reliability, soil respiration, functional naturalness

The connection between biodiversity and functioning in ecosystems is one of the most important questions in ecology. We are interested in a special aspect of this topic: the reliability of ecosystems. An ecosystem can provide ecosystem services (e.g. biomass production, CO₂ emission etc.) properly if its functioning is constant or rather predictable, *i.e.* the variation of its functional attributes remains within given range despite of the fluctuations of environmental variables. The aim of this study was to characterise fine-scale vegetation structure and functional organisation in various grasslands and to evaluate their relationships in the context of ecosystem reliability. According to our hypothesis, the highest functional reliability is expected in spatially well-organised plant communities with high structural complexity at fine scale.

In our comparative study, we used a standard sampling protocol for detecting parallel the fine-scale patterns of structural and functional attributes of grassland vegetation. The cover of plant species was estimated in 10 cm and 15 cm diameter circles at 75 positions (at every 20 cm) arranged along 15 m circular transects. We also took biomass samples and measured soil respiration, soil temperature and soil moisture from the same positions. Fine-scale spatial patterns of species were sampled by recording the presence of rooting plant species in contiguous 5×5 cm and 10×10 cm micro-quadrats. Vegetation structure was evaluated by information theory models while functional patterns were analysed by geostatistics. We used the spatial and temporal variation (CV%) of functional attributes (e.g. soil respiration) for indicating the degree of ecosystem reliability. For comparing different degree of community organisations at wide range of ecological conditions, open sand grasslands, steppe meadows on sand and loess, wet meadows and regenerating grasslands on abandoned agricultural fields were sampled in Hungary (more than 70 transects at 11 sites distributes across the country). Lower CV% of soil respiration appeared in communities with higher structural diversity (higher maximum compositional diversity). This preliminary result supports our hypothesis that community level functioning is better regulated in communities with higher structural complexity and spatial organisation. From practical point of view, these communities provide more reliable ecosystem services. This study was supported by the project OTKA K 105608.