



## Best practice in management and restoration of European dry grasslands

SER EUROPE SUMMER SCHOOL ON ECOLOGICAL RESTORATION

MTA Centre for Ecology, Hungary

August 20-24, 2018

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## Welcome

to SER Europe summer school 2018, an intensive 5-day program focusing on the state, threats, management and restoration of dry grassland habitats in Europe, many of which are under Natura2000 protection.

The summer school is held by the



under the auspices of



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The program includes both theoretical aspects and practical issues related to the state, threats, management and restoration of dry grasslands with a special focus on Natura2000 areas. The course is aimed at site managers, ecologists, students and policy makers and will provide participants with state-of-the-art information during field visits and lectures. The language is English.

We hope that the course will give a frame for intensive exchange between participants and lecturers. You can also bring an own showcase from your work to discuss it with participants, researchers and practitioners.

Conference Organizer

## Thematic Framework

The majority of grasslands are semi-natural in Europe resulting from the long history of clearing natural forests and subsequent extensive grazing and mowing for human purposes. Within the past decades such semi-natural grasslands become strongly reduced in area and diversity due to the intensification of agricultural production and the abandonment of traditional extensive management.

Central and Eastern Europe has preserved high-value grasslands that harbour many endemic or relict species, especially from the steppe and forest-steppe flora. Land abandonment following the fall of the socialist systems resulted in large areas suitable for restoration and conservation especially in low productive areas. At the same time, there is a high risk of invasion of alien plants and animals at abandoned land, and climate change impacts the dynamics of recovery and persistence of dry grasslands.

The course will provide contributions on the present state and richness of dry grasslands, the major threats deriving from global change, the possibility of spontaneous recovery of these grasslands, methods to facilitate recovery and the implementation of suitable management schemes to maintain habitats and preserve biodiversity by applying traditional knowledge. The course will include indoor lectures and inspiring field visits in the Pannonian region.

In the field trips, special attention will be paid to the following NATURA 2000 habitat types:

- 1530 Pannonic salt steppes and salt marshes
- 6190 Rupicolous pannonic grasslands (*Stipo-Festucetalia pallentis*)
- 6210 Semi-natural dry grasslands and scrubland facies on calcareous substrates (*Festuco-Brometalia*)
- 6240 Sub-pannonic steppic grasslands
- 6250 Pannonic loess steppic grasslands
- 6260 Pannonic sand steppes

## Planned program

|                               |   |
|-------------------------------|---|
| <b>Monday<br/>20.08.2018</b>  | <b>Welcome in Budapest</b>  |
| 16.00-17.00                   | Registration  |
| 17.00-17.30                   | Halassy, M.: Introduction   |
| 17.30-19.00                   | Talks   |
| 19.00-20.00                   | Ice-breaking party  |
| <b>Tuesday<br/>21.08.2018</b> | <b>General talks in Vácrátót<br/>MTA Centre for Ecological Research</b>   |
| 8.00-8.45                     | Ride to Vácrátót  |
| 9.00-10.00                    | Janisová M.: Grasslands, their threats and management in Europe   |
| 10.00-11.00                   | Bartha, S.: European gradients of resilience in the face of climate extremes (SIGNAL)   |
| 11.00-12.00                   | Kollmann J.: Restoration of invaded grasslands in a changing world: Impacts of invasive plants and climate changes on ecosystem functioning |
| 12.00-13.00                   | Jongepierová, I.: Grassland Restoration in the White Carpathian Mts.  |
| 13.00-14.00                   | Lunch break   |
| 14.00- 15.00                  | Guided tour in the Botanical Garden   |
| 15.00-16.00                   | Varga, Anna: Integration of traditional ecological knowledge into nature conservation   |
| 16.00-17.00                   | Lengyel, Szabolcs: The influence of habitat management and restoration on animal communities  |
| 17.00-19.00                   | Ride to Kunsági Major   |
| 19.00-20.00                   | Dinner in Kunsági Major   |
| 20.00-21.00                   | Talks   |

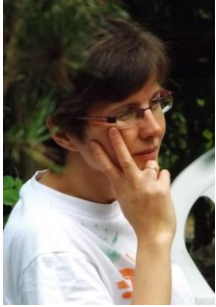
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|---------------------------------|---|
| <b>Wednesday<br/>22.08.2018</b> | <b>Field visit to Fülöpháza<br/>Kiskunság National Park</b>   |
| 8.00-8.30                       | Csecserits, A. Spontaneous recovery of sand grasslands  |
| 8.30-9:00                       | Kövendi-Jakó, A. Restoration potential of sand grasslands   |
| 9.30-12.00                      | Fülöpháza Sand Dunes with Ferenc Pál Szabó, Kiskunság National Park (field visit)   |
| 12.00-13.00                     | ExDRain experiment (field visit)  |
| 13.00-14.00                     | Lunch break at Fejes-tanya (sandwiches)   |
| 14.00-16.00                     | Invasive species in dry grassland recovery and restoration (field visit)  |
| 16.00-19.00                     | Ride to Fecskeház, Hortobágy  |
| 19.00-20.00                     | Dinner in Fecskeház   |
| 20:00-21:00                     | Talks   |
| <b>Thursday<br/>23.08.2018</b>  | <b>Field visit to kurgans and alkali and loess grasslands<br/>Hortobágy National Park</b>   |
| 8.00-9.00                       | Török, P.: Grasslands, their threats and management in Eastern Europe - an overview   |
| 9.00-10.00                      | Deák, Balázs: The role of historical monuments in nature conservation – Ancient burial mounds as refugees for steppe vegetation in agricultural landscapes of Eurasia |
| 10.00-13.00                     | Visit of kurgans  |
| 13.00-13.00                     | Lunch break (sandwiches)  |
| 13.30-18.00                     | Visit of restored alkaline and loess grasslands   |
| 19.00-20.00                     | Dinner in Kaparó Csárda   |
| 20.00-22.00                     | Ride to Budapest accommodations   |
| <b>Fri 24.08.</b>               | <b>Field visit to Zámolyi.medence<br/>Pro Vértes Nature Park</b>  |
| 8.00-9.00                       | Bucharova, A. The choice of seed materials for restoring plant communities  |
| 9.30-11.00                      | Ride to Csákvár   |
| 11.00-11.20                     | Snacks at Dohányos-ház  |
| 11.30-15.00                     | Field visit   |
| 15.00-16.30                     | Lunch at Dohányos-ház   |
| 16.30-18:00                     | Ride to Budapest  |
| 18:30-19:30                     | Talks   |
| 20.00-21.00                     | Dinner  |



Introduction to SER-  
Eurosité Summer School

August 20th is the greatest national holiday for Hungarians, celebrated with day-long festivities followed by spectacular fireworks throughout the country. August 20th commemorates the foundation of the Hungarian state, it's like Hungary's 4th of July. Also called as St. Stephen's Day, remembering Stephen I, the first king of Hungary and founder of the Kingdom of Hungary, who was canonized on August 20th, 1083 by Pope Gregory VII. St. Stephen was the first king of Hungary. He ruled from 1000 or 1001 until 1038. He was the first Christian ruler in Hungarian history. The day is also known as "the day of the new bread" or the day of the Foundation of Hungary.

People don't work on this day and at night there are fireworks in Budapest and bigger cities. The celebration attracts many people to the banks of the river Danube.



**Melinda Halassy, PhD.** is senior researcher at MTA Centre for Ecological Research, Institute of Ecology and Botany, Vácrátót, Hungary. She is engaged in ecological restoration of grassland vegetation since 1995, including studies on spontaneous recovery of sand grassland, seed bank and seed dispersal. Since 1995, she was involved in several projects focusing on the restoration of sand grassland vegetation with various techniques in the Kiskunság National

Park. She is one of establishing members of Society for Ecological Restoration (SER) Europe chapter, serving as its first secretary and currently as board member. Currently she studies the impact of surrounding landscape on restoration success on long-term datasets.

Introduction to Restoration Ecology, SER Europe and Restoration in Hungary

*Restoration ecology aims to assist in the recovery of the ecological integrity of ecosystems that have been damaged, degraded or destroyed by human activity. The Society of Ecological Restoration Europe (SER Europe) is a network of restoration experts, exchanging knowledge and expertise for the promotion of ecological restoration in Europe.*

SER Europe is a network of restoration experts, exchanging knowledge and expertise for the promotion of ecological restoration in Europe. Our network is open to Scientists, Practitioners, Policy makers and other restoration enthusiasts. Join us to help restore Europe's ecosystems and the many services they provide to society!

The Aichi Biodiversity Targets of the Convention on Biological Diversity and the EU Biodiversity Strategy 2020 both define 15% of degraded land to be restored by 2020. The implementation of this goal seems to be retarded in many countries, and only few member states or regions have carried out restoration prioritization to guide the process.

Our research group made a database of terrestrial restoration interventions carried out in Hungary by nature conservancy between 2002 and 2016. We compared the degree and type of restoration efforts to the area and type of degradation at the habitat level. Finally, restoration interventions are linked to raises on the scale of the four levels of ecosystem condition to estimate progress towards the 15 % Aichi target in Hungary.



The MTA Centre for Ecological Research, Institute of Ecology and Botany is situated in the National Botanical Garden of Hungary. The 180-year-old romantic landscape-designed garden, also a national monument and nature conservation area, is the richest scientific plant collection of Hungary. The scenes of this 27 hectare park are engaging in all four seasons. There are 62 nesting bird species in the garden, while 22 fish species inhabit its waters and 73 species of molluscs find their homes in its area. Annual plant exhibitions, intimate trails, rose and geranium collections, and countless tiny wonders of nature await our guests throughout the year. The Carbon House visitor centre was constructed in 2012 as a passive house that hosts a conference centre and an exhibition area.

Grasslands: their state, threats and management in Europe



Mgr. Monika Janišová, PhD. is researcher at Institute of Botany, Slovak Academy of Sciences, in Banská Bystrica, Slovakia, engaged in study of grassland vegetation since 1993, including studies on grassland diversity, classification, ecology, and management. Since 2005, she was involved in several projects focusing on the variability of grassland vegetation at various geographical scales (Slovakia, the Carpathian Mountains, Central Europe, Europe, Palaearctic biogeographical realm). She is one of

establishing members of the Eurasian Dry Grassland Group (EDGG) serving as one of its chairs for ten years (2008-2017) and involved in numerous activities of this international organization focused on grassland research and conservation. Since 2015, she is vice-president of the International Association for Vegetation Science (IAVS) and she works as editor of its newsletter - the IAVS Bulletin. She edited several special issues in international journals (*Tuexenia*, *Plant Biosystems*, *Biodiversity & Conservation*, *Agriculture, Ecosystems and Environment*) focusing on diversity of grassland vegetation. She also contributed to the recent world overview on grassland diversity, management and conservation initiated by the EDGG.

## Grasslands, their threats and management in Europe

Grasslands of Europe account for a high fraction of the continent's biodiversity in many taxonomic groups despite only a small fraction of Europe would be covered naturally by grasslands, and the fraction of threatened species is particularly high in this habitat type. In Central, North and West Europe semi-natural grasslands were made to intensive grasslands using synthetic fertilizers and pesticides, drainage of wet grasslands, increased cutting frequency and lowered cutting height in meadows, higher stocking rates on pastures as well as frequent re-sowing with artificial seed mixtures. In more marginal and less productive sites, the utilization of semi-natural grasslands was largely given up and they either developed into shrublands or forests through natural succession. At the landscape scale, the continuous grasslands became fragmented, and their area and connectivity decreased.

Agri-environmental schemes (AESs) as part of the current agricultural policy subsidize nature-friendly management of grasslands in the European Union, but for obtaining such subsidies, it is often only required to implement the corresponding management in a relatively small area of the managed grasslands including also grassy margins. The beneficial effect on species richness is questionable in landscapes with only few natural habitats, and in some cases – especially in extensively used landscapes with a relatively high proportion of natural habitats – even negative effects were found. It is also important to decrease landscape-scale fragmentation by creating buffer zones around grassland fragments to mitigate the negative influences and corridors between them to restore migration routes and meta-population dynamics. Restoration using regional seed mixtures could be a promising option and effective conservation of species richness is feasible by combining traditional grassland management with extensive mosaic management at the scale of the entire landscape. There is a general lack of tested landscape-scale conservation strategies that also consider alternative grassland management techniques, such as rotational mosaic mowing, prescribed burning or extensive semi-open pasture landscapes.

Dengler, J., Janišová, M., Török, P., & Wellstein, C. (2014). Biodiversity of Palaearctic grasslands: a synthesis. *Agriculture, Ecosystems & Environment*, 182, 1-14.



**Sándor Bartha, PhD** is scientific advisor at MTA Centre for Ecological Research, Institute of Ecology and Botany, Vácrátót, Hungary. His research team is working in the field of functional community ecology studying the relationships between fine-scale community structure and stability of ecological systems. Stability analysis is particularly relevant today when ecological systems meet with unprecedented environmental extremes, such as climate and land use changes as well as the spread of invasive species.

Currently, they are experimentally investigating the resistance and resilience of grasslands to drought and invasive species in an international collaboration. In addition to this he is also involved in the elaboration of vegetation monitoring methods related to agri-environmental programs and nature conservation management of Natura 2000 sites. The group is developing indicators with which the damage to ecosystem functions and, consequently, threats to the ecological services can be detected at an early stage.

## European gradients of resilience in the face of climate extremes (SIGNAL)

How grasslands differ in vulnerability to extreme events (to extraordinary stresses and disturbances)? How land use affects the stability of grasslands and the reliability of ecosystem services? Are damaged and restored communities more vulnerable to global change events?

The Biodiversa SIGNAL project analysed the effects of three major components of global change: climate change, land-use change and biotic invasions on semi-natural grasslands at 10 field sites across Europe and the Middle East (from Belgium to Israel). We combined field experiments (applying locally-scaled meteorological droughts at low-intensity used grasslands), biodiversity experiments in mesocosms and invasion research.

Drought reduced biomass production by 30% in the biodiversity experiments . Species richness improved resilience one year after the drought, while resistance was not affected by biodiversity. We found no clear correlations between drought effects, mean biomass production and mean species richness per site in the field experiments, and drought effects were more variable among sites. Aboveground biomass production decreased due to drought at the more xeric sites while mesic grasslands appeared to be resistant to drought. However, xeric grasslands were resilient to climate extremes showing rapid recovery of biomass production within one year. The responses to biotic invader were also variable depending on site conditions and invader species traits.

Drought responses were modulated by legacy effects from prior land use and prior climate extremes. For example, in the Hungarian grassland, prior (natural) droughts had caused a mosaic of dominant vegetation types (grass, dicot or legume dominated) which significantly influenced the dynamics in the years following the SIGNAL drought. As such, the presence of certain dominant plant groups before drought could be used to predict responses in the years following drought.

De Boeck, H. & Jentsch, A. 2017. EUROPEAN GRADIENTS OF RESILIENCE IN THE FACE OF CLIMATE EXTREMES. Signal Policy Brief.



**Prof. Dr. Johannes Kollmann** is the Chair of Restoration Ecology at Technische Universität München, Munich, Bayern, Germany. The research of Prof. Kollmann focuses on the restoration of ecosystems destroyed by human activities. In particular, he investigates semi-natural reference systems, criteria for selecting plants for restoration purposes, plant-animal interactions, invasive alien species and the long-term monitoring of restored systems. Prof. Kollmann studied biology and chemistry at the Universities of Kiel and Freiburg.

He did his doctorate in vegetation ecology at the University of Freiburg. Following a postdoc stay at the University of Cambridge, he became a lecturer at the Swiss Federal Institute of Technology in Zurich. In 2000, he accepted a position at the University of Copenhagen, and in 2010 moved to the Chair of Restoration Ecology at TUM. Prof. Kollmann is a member of several scientific associations and co-editor of a number of international environmental journals. He is regularly called on as an expert in Germany and abroad.

Staab, K., Yannelli, F., Lang, M. & Kollmann, J. (2015) Bioengineering effectiveness of seed mixtures for road verges: Functional composition as a predictor of grassland diversity and invasion resistance. *Ecological Engineering*, 84, 104–112.

Yannelli, F.A., Hughes, P. & Kollmann, J. (2017) Preventing plant invasions at early stages of revegetation: The role of limiting similarity in seed size and seed density. *Ecological Engineering*, 100, 286–290.

Yannelli, F.A., Koch, C., Jeschke, J.M. & Kollmann, J. (2017) Limiting similarity and Darwin's naturalization hypothesis: understanding the drivers of biotic resistance against invasive plant species. *Oecologia*, 183, 775–784.

Yannelli, F.A., Karrer, G., Hall, R., Kollmann, J. & Heger, T. (2018) Seed density is more effective than multi-trait limiting similarity in controlling grassland resistance against plant invasions in mesocosms. *Applied Vegetation Science*. doi10.1111/avsc.12373

## Restoration of invaded grasslands in a changing world: Impacts of invasive plants and climate changes on ecosystem functioning

Disturbed areas offer great opportunities for restoring native biodiversity, but they are also prone to invasion by alien plants. The negative impact of invasive alien plant species on biodiversity and ecosystem functions have fostered an increased interest in understanding the factors explaining biotic resistance of plant communities used for restoration. Experiments were developed to test the diversity-invasibility, limiting similarity and Darwin's naturalization hypotheses. These hypotheses also provide evidence for other emerging factors that should be taken into account when designing seed mixtures for restoration. They are based on the idea that by increasing the number of species in a community or the similarity between the invaders and the native community, fewer resources would be left for the invasive alien species. Results agree with the idea that there is a positive relationship between diversity and biotic resistance. Most likely as a consequence of resource use complementarity driven by diversity in rooting characteristics. As a result, in terms of the design of seed mixtures for restoration, by increasing the number of species with different in rooting traits one can assure resource capture, leaving fewer resource available for invaders. Only partial support was found for the limiting similarity hypothesis from a plant trait perspective. Instead, the effect of density, biomass and priority had a clearer effect on the establishment of invasive alien species. Darwin's naturalization hypothesis, i.e. a positive effect of relatedness on biotic resistance was also supported, but was not able to completely exclude invasive species.



**Anna Varga, PhD** is an ecologist, ethnobiologist from Hungary. Her main research interests are the biocultural diversity of the silvopastoral systems (wood pastures, forest grazing). She is also interested in community-based conservation, environmental education and conservation optimism movement. She studies abandoned wood pasture restoration and the integration traditional ecological knowledge and landscape historical data into restoration works. She was involved the AGFORWARD agroforestry

innovations research project, where she focused on the High Nature and Cultural Value Agroforestry. She is an alumni of the Global Environments Summer Academy (2011), and has a PhD (2018) from the University of Pécs. She was Student Representative of the International Society of Ethnobiology Board between 2012 and 2014. She is Board member of the Society for Conservation Biology Europe Section from 2018. Currently she works as assistant research fellow at the Traditional Ecological Knowledge Research Group of the MTA Centre for Ecological Research. You can find more information about the Hungarian silvopastoral systems at this page: <https://www.facebook.com/faslegeloerdo/>

## Integration of traditional ecological knowledge into nature conservation

Abandonment or change of traditional (pre-modern) management systems threaten semi-natural grasslands worldwide. A new opportunity and, at the same time, a new challenge has unfolded for nature conservation in the past few years: to enhance the efficiency of conservation management through the use of traditional ecological knowledge (TEK) in strategic and practical decision-making. Understanding existing traditional grassland management could greatly help to improve our ability to preserve biodiversity in traditionally managed landscapes.

From a conservation perspective, the use of TEK is particularly important in the case of those habitats of the cultural landscape that are created and maintained by local people (e.g. mountain hay meadows and wood pastures). The gap between traditional local communities and government conservation approaches could be bridged and conservation management and decision making could become more efficient if rangers have possibility to learn, adapt and use TEK during their work. Besides TEK holder rangers could have a consultant role between local people and conservation officers and enrich the adaptive capacity of the traditional ecological knowledge.

Subsidy systems should encourage the maintenance of traditional management systems, support the still existing local traditional communities and also in protected areas management systems should build on the experiences of small-scale traditional farmers.

Varga A., Heim A., Demeter L., Molnár Zs. (2017): Rangers bridge the gap: integration of wood-pasture related traditional ecological knowledge into nature conservation. In: Roué, M., Molnár, Zs. (eds.). Knowing our Land and Resources: Indigenous and local knowledge of biodiversity and ecosystem services in Europe & Central Asia. Knowledges of Nature 9. UNESCO: Paris, pp. 78-91.



Ivana Jongepierová RNDr. is a botanist and conservationist at the White Carpathians Protected Landscape Area Administration, Czech Republic, where she has been working for more than thirty years. Since 1983 she has also been chairperson of the Bile Karpaty local branch of the non-profit Czech Union for Nature Conservation. She is a member of the board of the Czech Botanical Society. Her main interests are management, restoration and recreation of mainly species-rich grasslands in the White Carpathian Mts. In 1985 she initiated the restoration of abandoned meadows and resumption of regular mowing at these sites, and ten years later the preparation of a regional seed mixture for grassland re-creation on arable land. To this date about 600 hectares have been re-created in the White Carpathians. She has been involved in several projects dealing with the impact of different management regimes on grassland vegetation and species richness, since 2000 mainly on the development of vegetation of re-created grasslands (in cooperation with e.g. the University of South Bohemia České Budějovice, Masaryk University Brno and Botanical Institute Třeboň). She has published several articles on this topic and edited a number of publications on grasslands and ecological restoration.

## Grassland Restoration in the White Carpathian Mts.

Dry grasslands in the Protected Landscape Area and Biosphere Reserve of the White Carpathian Mts. in the eastern part of the Czech Republic, central Europe, belong to the species richest plant communities (on a scale of a few m<sup>2</sup>) in the world. Many of the grasslands were converted to arable land in the second half of the 20th century, but in the past two decades many of the arable fields have been re-grassed, most of them using commercial low-diversity clover-grass seed mixtures, some of them however by spontaneous succession or using a regional species-rich seed mixture. We asked how grasslands restored in various ways differ in their successional trajectories towards long-existing grasslands as reference sites, particularly in species richness and participation of target species.

Grasslands restored in the three different ways converged in their species composition and developed generally towards reference grasslands. Considering the number of target grassland species, sowing of regional seed mixtures was the most successful, especially in the beginning, but processes of spontaneous succession led virtually to the same number of target species, even at sites re-grassed with commercial seed mixtures, but more slowly. Development of sites re-grassed spontaneously and by sowing commercial seed mixtures led to the establishment of more mesic vegetation (*Arrhenatherion*) than when using the regional seed mixture, which was predominantly composed of species typical of dry grasslands (*Bromion*). Thus, restoration of the most valuable dry grasslands should preferably be based on using properly designed regional seed mixtures.

Prach, K., Jongepierová, I., Řehouňková, K. & Fajmon, K. (2014). Restoration of grasslands on ex-arable land using regional and commercial seed mixtures and spontaneous succession: successional trajectories and changes in species richness. *Agriculture, ecosystems & environment*, 182, 131-136.



Szabolcs Lengyel, PhD, DSc is scientific advisor at the Department of Tisza River, Danube Research Institute, Centre for Ecological Research, Hungarian Academy of Sciences. He does research in Ecology, Evolution and Conservation Biology. He was leader of the Grassland restoration and marsh protection in Egyek-Pusztakócs (LIFE04NAT/HU/000119, 2004-2008), the largest active restoration of grasslands on former crop-lands in Europe at the time. His team continues to monitor the changes in plant and animal communities after the various restoration and management actions. He is also interested in the organization of animal communities, ant-plant relationships, formation and operation of landscape-scale patterns in biodiversity, the theory and practice of biodiversity monitoring. He is expert in several animal taxon from insects to birds and mammals.

## The influence of habitat management and restoration on animal communities

Ecosystem/habitat restoration has become a major goal of international biodiversity policy. However, restorations are often limited in space or time, and we know little on whether and how restoration and management affect animal communities. We assessed the local and landscape-scale effects of habitat restoration and management on different faunal groups in the Egyek–Pusztakócs marsh system (Hortobágy National Park, Hungary), site of the largest active restoration of marshes and alkali and loess grasslands on former croplands in Europe.

Different animals groups responded differently to restoration. Management is more important for mammals than grassland restoration per se at the local scale, which is expected for habitat generalists such as small mammals in contrast to specialists such as plant-feeding invertebrates. E.g. grassland restoration resulted in significant increases in species richness and abundance of Orthoptera. Amphibians and birds responded positively to burning and grazing in marshlands.

We thus conclude that a mosaic of restored and spatiotemporally varied management of grasslands and marshlands will provide the best chances for the persistence of diverse animal communities in dynamic landscapes.

Mérő TO, Bocz R, Polyák L, Horváth Gy, Lengyel Sz (2015): Local habitat management and landscape-scale restoration influence small mammal communities in grasslands *Animal Conservation* 18: pp. 442-450.

Mérő TO, Lontay L, Lengyel Sz (2015): Habitat management varying in space and time: the effects of grazing and fire management on marshland birds *Journal of Ornithology* 156: pp. 579-590.

Mester B, Szalai M, Mérő TO, Puky M, Lengyel Sz (2015): Spatiotemporally variable management by grazing and burning increases marsh diversity and benefits amphibians: A field experiment *Biological Conservation* 192: pp. 237-246.

Rácz, I. A., Déri, E., Kisfali, M., Batiz, Z., Varga, K., Szabó, G., & Lengyel, S. (2013). Early changes of orthopteran assemblages after grassland restoration: a comparison of space-for-time substitution versus repeated measures monitoring. *Biodiversity and conservation*, 22(10), 2321-2335.





## Spontaneous Recovery and Restoration Potential of Sand Grasslands

Fülöpháza Sand Dunes is one of the most interesting sand-dune areas in Central Europe. The rich variety of the surface was created by the predominant north-western, south-eastern winds, which have heaped dozens of meters of sand and loess. There are still a number of drifting sand dunes in the area. The dunes are covered with open sandy grasslands, and give home to ample insect population. In the eastern part of the area there used to be a number of sodic lakes in beds that had been created by the wind. These lakes all dried out during the drought of the 1980s, and are rarely filled up with water any more.



**Anikó Csecserits, PhD** is a plant ecologist working for MTA Centre for Ecological Research. As Ms and PhD student she studied the spontaneous regeneration ability of the calcareous sand grasslands in Kiskunság, Hungary. Afterwards she took part in experimental researches about the distribution potential of an invasive plant species, of the ragweed (*Ambrosia artemisiifolia*). As post doc she worked partly on restoration project aiming to restore dry sandy habitats in Easter part of Hungary in a factory area together with Melinda Halassy. Partly she studied the role and importance of different assembly rules shaping the species and vegetation composition in primary and secondary grasslands. She works at the MTA Centre for Ecological since 2003, with several interruption because of maternity leaves. She is member of the IAVS (International Association for Vegetation Science) and its working group EDGG (Eurasian Dry Grassland Group).

Csecserits, A., Czúcz, B., Halassy, M., Kröel-Dulay, G., Rédei, T., Szabó, R., ... & Török, K. (2011). Regeneration of sandy old-fields in the forest steppe region of Hungary. *Plant Biosystems-An International Journal Dealing with all Aspects of Plant Biology*, 145(3), 715-729.

Albert, Á. J., Kelemen, A., Valkó, O., Miglécz, T., Csecserits, A., Rédei, T., ... & Török, P. (2014). Secondary succession in sandy old-fields: a promising example of spontaneous grassland recovery. *Applied Vegetation Science*, 17(2), 214-224.

Lhotsky, B., Kovács, B., Ónodi, G., Csecserits, A., Rédei, T., Lengyel, A., ... & Botta-Dukát, Z. (2016). Changes in assembly rules along a stress gradient from open dry grasslands to wetlands. *Journal of Ecology*, 104(2), 507-517.

Csecserits, A., Botta-Dukát, Z., Kröel-Dulay, G., Lhotsky, B., Ónodi, G., Rédei, T., ... & Halassy, M. (2016). Tree plantations are hot-spots of plant invasion in a landscape with heterogeneous land-use. *Agriculture, Ecosystems & Environment*, 226, 88-98.

## Spontaneous regeneration as a possible way of restoration of sandy grasslands in Central-Hungary

Abandoned agricultural fields are potential sites for the regeneration of natural vegetation, and land abandonment is a widespread phenomenon in the developed world. However there is a few studies, which make large-scale or long-term researches on successional processes.

In the first case study I present the result of our large-scale research, where we studied the vegetation of old-fields in the whole Kiskunság, central Hungary. We compared the old-fields differing on the basis of time of abandonment with the other semi-natural (open and closed grassland and forest) and man-made habitats of the region. We looked for the richness and cover of predefined species groups (all species, neophytes, and characteristic species of natural habitats). In general, the medium- and old-aged old-fields only slightly differed from each other, and were more similar to open natural grasslands than to closed ones, although they occupied environments that were intermediate between open and closed grasslands. The dominance of alien species only slightly declined with old-field age and was much higher than in natural grasslands.

In the second case-study I present our long-term research, where we followed the successional process of old-fields in the Kiskunság National Park. In this more detailed research we used not only pre-defined groups of species, but also the traits of plant species. Using traits helps the interpretation and generalization of results. We found, that as long as several species groups re-establish well on old-fields, the trait composition remain different from primary grasslands and are still in developing state. Moreover the spreading of perennial invasive species on old-fields can change the species and trait composition.

Our results indicate the necessity of restorative management in certain cases.



ExDRain (Extreme Drought and Rain Manipulation Experiment)

is a climate field experiment to study the impact of a single extreme drought (two treatment levels: extreme drought in 2014 / control) combined with long-term chronic precipitation change from 2015 (four levels: 2-month drought / 1-month drought / control / irrigation) on dry grassland. Till now, the results suggest that some ecosystem functions may recover very fast after extreme events, even if composition remain very different. In addition while aboveground net primary production (ANPP) recovery after extreme event was found unrelated to chronic precipitation manipulations after the extreme event, compositional recovery was dependent on precipitation levels.



Spontaneous regeneration & restoration experiments

Studies of spontaneous regeneration and restoration started in Fülöpháza in 1995. The target of restoration is the endemic Pannonian sand grassland that is under protection of the EU (Pannonic sand steppe, habitat code 6260). These grasslands were destroyed because of the establishment of arable fields and forest plantations from the 1900s. Land abandoned is continuous from the 1960s that provides opportunity for spontaneous regeneration and restoration. The regeneration is hindered by invasive species, lack of dispersal agents and lack of permanent seed banks. The restorative methods tested include chemical application to control invasive species, mowing, carbon amendment and seeding.



# The role of historical monuments, low and high diversity seeding in the conservation and restoration of alkali and loess grasslands

The Hortobágy – the first Hungarian national park – has an almost flat landscape, sprawling, continuous grasslands with wetland mosaics, the most extensive of its kind in the whole of Europe, comprising of alkaline marshes, meadows, dry alkaline pastures and remnants of loess-steppe vegetation. The National Park is not only the first but also the biggest (82,000 hectares) Hungarian national park to date, also a World Heritage and Ramsar site and a Biosphere Reserve.





**Peter Török, PhD, DSc** is an associate professor at the University of Debrecen and as scientific advisor the leader of the MTA-DE Lendület Functional and Restoration Ecology Research Group. He is working on various research topics related to grassland biodiversity and dynamics and seeks cost-effective possibilities of sustainment and restoration of biodiversity on multiple scales. He defended his Ph.D. in 2008 in topic of seed banks and grassland restoration. So far he published more than 60 scientific papers in ISI journals. He is one of the chairs of the Eurasian Dry Grassland Group (EDGG) since 2011, and a former member of SER Europe Board. In 2017, he was elected to the Young Academy of Europe. He was involved in editing of several special issues focusing on grassland biodiversity and restoration in journals of *Agriculture, Ecosystems and Environment*, *Biodiversity and Conservation* and *Restoration Ecology*, and he is member the editorial board of *Applied Vegetation Science* and *Tuexenia*. He was involved in the very recent overview "Grasslands of the World" and contributed to the Eastern European and Overview chapters.

## Grasslands, their threats and management in Eastern Europe - an overview

The Eastern European socio-economic region covering the post-socialist countries of the Central and Eastern Europe (excluding East Germany and the European part of Russia) and the Balkan harbours a high proportion of grassland habitats. The permanent grassland area in the region, based on the available literature and statistics, is higher than 29 million hectares, out of which at least 10–30% are high-value natural or semi-natural grasslands. In most countries there are large areas covered with partly degraded grasslands (fallow, semi-improved grassland, abandoned grasslands), which, with appropriate restoration and conservation measures, can be turned into diverse semi-natural grasslands. Eastern European grasslands harbour many endemic or relict species, especially numerous species characteristic to the steppe and forest-steppe flora. Human use of semi-natural grassland services has mostly declined in recent decades, leading to a decline in area and biodiversity of semi-natural grasslands. In spite of the increased re-use in some countries because of the subsidies provided by the EU, some promising examples of good practice and wise use of grassland in many regions, the overall future trends for semi-natural and natural grasslands are not very promising. Although the conservation system is well established in terms of nature protected areas, the real conservation effort gives negligible results in several countries because of negative demographic, economic and socio-political drivers.

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**Balázs Deák, PhD** is professor assistant at the Department of Ecology, University of Debrecen. Formerly worked at the Hortobágy National Park Directorate as a biologist and project coordinator (LIFE projects and EU funded national projects). Main field of scientific interest: Grassland biodiversity; Ecology of fragmented and isolated habitats; Effects of landscape and local environmental factors on the biodiversity of dry semi-natural grasslands; Effects of small scale environmental heterogeneity on the species composition of grasslands; Application of remote sensing in habitat mapping and quality assessment; Grassland restoration and management; Prescribed burning and fire ecology. CV and list of publications are available at: [deak-valko.blogspot.com](http://deak-valko.blogspot.com).

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## The role of historical monuments in nature conservation - Ancient burial mounds as refuges for steppe vegetation in agricultural landscapes of Eurasia

Steppe is among the most endangered biomes of the World. Existence of the steppic grasslands is especially threatened in Eastern and Central Europe, where more than 90% of the original steppes have been destroyed due to conversion into croplands, afforestation and other human activities. Currently, steppe vegetation is often restricted to small habitat islands unsuitable for ploughing. Besides the conventional habitat islands such as road verges, field margins, the ancient steppic burial mounds called 'kurgans' can also act as refuge for grassland species. Kurgans were built by ancient cultures (mostly by the Yamnaja culture) during the Eneolithics (3500-2500 BC). Their height ranges between 0.5-15 metres and their area is generally less than 1 hectare. Despite their small size, kurgans often act as biodiversity hotspots and harbour many red-listed species. High overall species richness and a high proportion of grassland specialists are maintained by a pronounced fine-scale environmental heterogeneity and the undisturbed status. Conservation role of kurgans differs in the Western and Eastern part of Eurasia. In the intensively used Western regions (Hungary, Ukraine, European parts of Russia) kurgans, which are generally embedded in agricultural fields, act as refuge for grassland species. In the pristine steppes of Eastern Eurasia (Kazakhstan, Mongolia) kurgans embedded in extent steppe grasslands have an important role in increasing the landscape scale diversity, as there are many species that are confined to the special micro-habitats provided by the kurgans. Even kurgans are protected natural elements in Hungary there are many factors threatening their vegetation. The most important threats are the intensified agriculture, construction works, and invasion of woody species. Their effective protection can be achieved by enhancing their legal protection, fine tuning the integration of kurgan protection into agrienvironmental schemes, and by well-designed restoration measures. Such measures involve grassland restoration by seed sowing or hay transfer, elimination of woody species and establishment of seminatural grassland buffers around the kurgans in order to reduce the negative effects received from the neighbouring agricultural fields.



## Ancient burial mounds

are iconic landscape elements of the Eurasian steppes and often act as refugia for grassland specialist species. The proportion of kurgans covered by steppe vegetation increases from west to east and from lowlands to uplands. Despite their small size, kurgans act as biodiversity hotspots and harbour many red-listed species. High overall species richness and a high proportion of grassland specialists are maintained by a pronounced fine-scale environmental heterogeneity. The main factors threatening the biodiversity of kurgans are intensified agriculture, construction works and woody encroachment. Introducing characteristic grassland species on cultural monuments offers a great opportunity to link issues of landscape and biodiversity conservation. By the revitalisation of cultural monuments ecosystem services can also be restored. We will visit several burial mounds, including well-conserved (Csípő-halom) and restored ones (Kócs-halom).



## Marsh-land of Egyek-Pusztakócs

has an area of approximately 10,000 ha, and situated in the western part of the national park (near Ohat-Egyek-Tiszafüred). Before the large water regulation campaigns of the 19th century, these marshes collected the huge floods of River Tisza. Hungary's first large-scale, landscape-based habitat rehabilitation program was initiated here in 1976. The basic purpose of the rehabilitation was to construct and operate a water supply system and to reconstruct the original hydrological conditions of the marsh-land. Restored marshes have a central role in the spring and autumn migration of birds. The second phase of the restoration (LIFE04NAT/HU/000119, 2004-2008) included the reconstruction of alkali and loess grasslands on ex-arable lands using low-diversity seed mixtures on a total of 760 hectares, which was one of the largest grassland restoration at that time in Europe. These grasslands are often species-poor because the sown grasses hamper the colonisation of target grassland forbs from the adjacent semi-natural grasslands. As a novel approach, high-diversity sowing in establishment gaps was tested in order to improve the diversity of formerly sown grasslands. During our trip we will visit typical alkali and loess grasslands, and grasslands re-constructed by low and high-diversity seeding. We will pass the bird rehabilitation centre of the national park, where they care for injured predators and storks and conduct in-situ species protection programs. Hopefully we will also see a wild colony of red-footed falcon (*Falco vespertinus*) in the Péteri-erdő

## Natura 2000 conservation & management



Vértesi Naturpark was established by Pro Vértes Nature Conservation Public Foundation to preserve the natural and cultural values of Vértes and its surroundings. Within the Naturpark Zámolyi-medence Natura 2000 site is a narrow depression basin of northeast-southwest direction in the south foreground of the Vértes Mountains. The Zámolyi-medence is a breeding, migratory and feeding area for numerous birds and part of an ecological corridor stretching between the Vértes, Velencei-hegység and Velencei-tó. Among the habitats of Community importance are Molinia meadows (6140), Lowland hay meadows (6510) and to a smaller extent Pannonic salt steppes (1530), Semi-natural dry grasslands (6210), Sub-pannonic steppic grasslands (6240), Pannonic loess steppic grasslands (6250) and wetlands and water habitats (3150, 5430, 6440, 7230). The simultaneous presence of the species with dry and wet ecological demands refers to the habitat diversity of the area



**Dr. Anna Lampei Bucharova** is a botanist and plant ecologist working at the University of Münster, Germany. She worked 4 years in practical nature conservation as a field botanist, which allowed to learn about practical problems from own experiences. Afterwards she has returned to science, but has stayed with practice as well – she aimed on research of rare species and their protection, setting priorities in species conservation and modelling fate of rare species population under condition of current land

use and climate changes. She is especially interested in applied part of science – nature conservation and restoration ecology. Currently, she is focused on nature-friendly ecological restoration and revegetation. Her current project is on the genetic differentiation and local adaptation among seed origins used for grassland restoration.

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## The choice of seed materials for restoring plant communities

One of the key questions in ecosystem restoration is the choice of the seed material for restoring plant communities. The most common strategy is to use local seed sources, based on the argument that many plants are locally adapted and thus local seed sources should provide the best restoration success. However, the evidence for local adaptation is inconsistent, and some of these inconsistencies may be due to different experimental approaches that have been used to test for local adaptation. While small-scale, single-species experiments may be useful for identifying the appropriate seed material for a specific restoration project, general patterns can only be detected in reciprocal transplant experiments with multiple species and sites.

Based on a common garden experiment in Germany, the majority of the study species fitness decreased with increasing geographical distance of seed origins or with increasing climatic differences between plant origins and experimental sites. In addition to these effects on plant fitness, increasing geographical or climatic distances of origin were often also correlated with increasing differences in plant phenology. Since phenology is important for biotic interactions, especially with pollinators and seed predators, using foreign seed sources may have cascading effects on local ecosystems. Although the predefined seed transfer zones are unlikely to match the exact genetic structure of many species, they serve their purpose by capturing a substantial amount of intraspecific genetic variation across species as was proved in a genetic differentiation analysis within multiple common grassland plants for Germany.



proper and sustainable grassland management technology whose application serves indeed the preservation of a large part of biosphere instead of being a description of required activities easy to check but having nothing at stake and being futile and superfluous.

## Pro Vértés Nature Conservation Public Foundation – Vértési Naturpark

Following the change of the political system, the utilisation of open habitats in Hungary has radically changed and traditional management methods have come again to the forefront requiring a totally new type of approach. Since the nature protective methods of traditional approach pursued using modern tools had no experiment proven practice yet in Hungary and international experiences were also rather poor, we considered it necessary to launch research similar to this but amidst the conditions of Hungary and to exchange experiences with those being active in similar conditions. During the pursuit of nature management activity we have to learn how to adjust day-to-day management tasks to the appearance or permanent occurrence of important individual indicator species. Experiences must be described as a technology to help those coming after us not to start everything afresh.

A research team has undertaken to examine and experiment a technology free of biases and dogmas on grasslands management, which pays equal attention to domestic experiences based on landscape historic activities as well as to novel, avant-garde type international research conducted on similar topics but yet missing from the current practice in Hungary. The objective of their research was to create a



**Participants of the SER Europe Summer School on Ecological Restoration 2018, Hungary**

**Best practice in management and restoration of European dry grasslands**

|    | <b>Surname</b> | <b>First Name</b> | <b>Organization</b>  | <b>Country</b>  | <b>e-mail</b>                    |
|----|----------------|-------------------|--|-----------------|----------------------------------|
| 1  | Bartha         | Sándor            | MTA Centre for Ecological Research, Institute of Ecology and Botany  | Hungary         | bartha.sandor@okologia.mta.hu    |
| 2  | Benyr          | Vera              | TU, Bergakademie, Freiberg   | Germany         | vera.benyr@web.de                |
| 3  | Botková        | Katarína          | Bratislavské regionálne ochrannárske združenie (BROZ)/Regional Association for Nature Conservation and Sustainable Development               | Slovakia        | katka.botka@gmail.com            |
| 4  | Cevallos       | David             | MTA Centre for Ecological Research, Institute of Ecology and Botany  | Hungary/Ecuador | david_cevallos@hotmail.com       |
| 5  | Csecserits     | Anikó             | MTA Centre for Ecological Research, Institute of Ecology and Botany  | Hungary         | csecserits.aniko@okologia.mta.hu |
| 6  | Deák           | Balázs            | University of Debrecen, Department of Ecology  | Hungary         | debalazs@gmail.com               |
| 7  | DeCock         | Eva               | Forest & Nature Lab, Department of Environment, Faculty of Bioscience Engineering, Ghent University  | Belgium         | EvaE.DeCock@ugent.be             |
| 8  | Durbecq        | Aure              | UMR IMBE (Institut Méditerranéen de Biodiversité et d'Ecologie marine et continentale) – UAPV (Université d'Avignon et des Pays de Vaucluse) | France          | aure.durbecq@gmail.com           |
| 9  | Halassy        | Melinda           | MTA Centre for Ecological Research, Institute of Ecology and Botany  | Hungary         | halassy.melinda@okologia.mta.hu  |
| 10 | Hess           | Manon             | Tour du Valat  | France          | hess@tourduvalat.org             |
| 11 | Ikonen         | Iiro              | ELY-centre for Southwest Finland (Centre for Environment, Traffic and Economic development )   | Finland         | iiro.ikonen@ely-keskus.fi        |
| 12 | Janicka        | Maria             | Faculty of Agriculture and Biology, Department of Agronomy, Warsaw University of Life Sciences–SGGW  | Poland          | maria_janicka@sggw.pl            |
| 13 | Janišová       | Monika            | Institute of Botany (Slovak Academy of Sciences), Department of Geobotany  | Slovakia        | monika.janisova@gmail.com        |

|    |                  |           |  |                |                                       |
|----|------------------|-----------|--|----------------|---------------------------------------|
| 14 | Jardim Arruda    | André     | Universidade Federal de Minas Gerais and Université d'Avignon et des pays de Vaucluse  | France         | ajarruda@gmail.com                    |
| 15 | Jongepierova     | Ivana     | White Carpathians Protected Landscape Area Administration  | Czech Republic | ivana.jongepierova@nature.cz          |
| 16 | Kollmann         | Johannes  | Technische Universität München, School of Life Sciences Weihenstephan  | Germany        | jkollmann@wzw.tum.de                  |
| 17 | Koren            | Toni      | Association Hyla   | Croatia        | toni.koren@hhdhyla.hr                 |
| 18 | Kövendi-Jakó     | Anna      | MTA Centre for Ecological Research, Institute of Ecology and Botany  | Hungary        | kovendi-jako.anna@okologia.mta.hu     |
| 19 | Lampej Bucharová | Anna      | University of Münster  | Germany        | anna.lampej-bucharova@uni-muenster.de |
| 20 | Lengyel          | Szabolcs  | MTA Centre for Ecological Research, Institute of Ecology and Botany  | Hungary        | lengyel.szabolcs@okologia.mta.hu      |
| 21 | Littera          | Pavol     | Bratislavske regionalne ochranarske zdruzenie (BROZ)/Regional Association for Nature Conservation and Sustainable Development    | Slovakia       | littera@broz.sk                       |
| 22 | Lu               | Shihai    | Institute of Environmental Ecology Science, Chinese Research Academy of Environmental Science                                    | China          | 13801287270@163.com                   |
| 23 | Moeneclaey       | Iris      | Forest & Nature Lab, Department of Environment, Faculty of Bioscience Engineering, Ghent University                              | Belgium        | Iris.Moeneclaey@ugent.be              |
| 24 | Paolinelli Reis  | Bruna     | MTA Centre for Ecological Research, Institute of Ecology and Botany  | Hungary/Brazil | brunapaolinelli@gmail.com             |
| 25 | Pawluśkiewicz    | Bogumiła  | Faculty of Civil and Environmental Engineering, Department of Environmental Improvement, Warsaw University of Life Sciences–SGGW | Poland         | bogumila_pawluskiewicz@sggw.pl        |
| 26 | Rong             | Yuping    | China Agricultural University  | China          | rongyuping@cau.edu.cn                 |
| 27 | Schelfhout       | Stephanie | Forest & Nature Lab, Department of Environment, Faculty of Bioscience Engineering, Ghent University                              | Belgium        | Stephanie.Schelfhout@ugent.be         |
| 28 | Škunca           | Luka      | GEONATURA Ltd. Consultancy in Nature Protection  | Croatia        | lskunca@geonatura.hr                  |

|    |              |           |   |         |                                |
|----|--------------|-----------|---|---------|--------------------------------|
| 29 | Stojak       | Josip     | IRES EKOLOGIJA Ltd.   | Croatia | josip.stojak@ires-ekologija.hr |
| 30 | Strazdiņa    | Baiba     | Latvian Fund for Nature   | Latvia  | Baiba.strazdina@ldf.lv         |
| 31 | Toledo       | Alejandra | particular  | UK      | alejandravtoledo@gmail.com     |
| 32 | Török        | Péter     | University of Debrecen, Department of Ecology   | Hungary | molinia@gmail.com              |
| 33 | Török        | Katalin   | MTA Centre for Ecological Research, Institute of Ecology and Botany                                     | Hungary | torok.katalin@okologia.mta.hu  |
| 34 | Vanhellemont | Margot    | Department of Biosciences and Food Sciences, Faculty of Science and Technology, University College Gent | Belgium | margot.vanhellemont@hogent.be  |
| 35 | Varga        | Anna      | MTA Centre for Ecological Research, Institute of Ecology and Botany                                     | Hungary | varga.anna@okologia.mta.hu     |



## Field trip route

Aug. 20. Budapest – aug. 21. Vác/overnight in Kunság Major – aug. 22. Kiskunság National Park/overnight in Fecskeház – aug. 23. Hortobágy National Park/overnight in Budapest – aug.24. Vértes (Dohányos-ház)

