

Final report

OTKA PD 111807

The role of species pool, seed banks and plant traits in grassland dynamics

2015-2017

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Aims of the project

The project focused mechanisms sustaining grassland biodiversity, with a special focus on seed banks, species pool and plant traits in colonisation dynamics. We aimed at to study mechanisms sustaining grassland biodiversity in colonisation windows to evaluate the effects of local species pool and soil seed banks in grassland dynamics. We studied succession on soil-filled former drainage channels as open soil surfaces for colonisation to evaluate the short- and long-term recovery of grassland biodiversity. We established colonization windows by biomass removal in restored grasslands, where a dense perennial grass cover had already developed. To improve biodiversity, we sowed high-diversity seed mixtures to the colonization windows. We also assessed the role of environmental factors (soil parameters, micro-topography and landscape context) in regeneration dynamics.

Key results of the project

- ❖ ***Colonisation windows.*** We developed a regional high-diversity seed mixture and tested its applicability in increasing the diversity of species-poor restored grasslands in a Hungarian-German international project. Our paper demonstrated that colonisations windows can overcome both propagule and microsite limitation and can support grassland diversity without the threat of weed encroachment (Valkó et al. 2016 *Tuexenia*).
- ❖ ***Comparison of restoration and plant introduction methods.*** We compared the applicability of three methods of plant introduction, i.e. seed sowing, transplantation and translocation in the restoration of degraded grasslands on ancient burial mounds. We identified the advantages and drawbacks of each method and provided direct implications for the restoration practice (Valkó et al. 2018 *Nature Conservation*).
- ❖ ***Grassland recovery on linear landscape elements.*** In our multi-site study we evaluated grassland recovery on soil-filled drainage channels. We found that alkali grasslands can recover quickly on these linear surfaces within six years (Valkó et al. 2017 *Ecological Engineering*). We also found, that fine-scale micro-topographic heterogeneity supports a higher diversity but lower cover of perennial grasses (Deák et al. 2015 *Basic and Applied Ecology*).
- ❖ ***Grassland restoration by passive restoration and seed sowing.*** We compared the effectiveness of spontaneous grassland recovery and active restoration by seed sowing

in terms of biodiversity and maintaining ecosystem services, such as weed control and biomass production (Valkó et al. 2016 *Ecosystem Health and Sustainability*). We provided a trait-based analysis of perennial crop-mediated succession for the first time (Kelemen et al. 2017 *Ecology and Evolution*). We developed and tested the applicability of high-diversity seed mixtures in vineyard inter-rows (Miglécz et al. 2015 *Scientia Horticulturae*).

- ❖ **Role of seed bank in grassland recovery.** We published a comprehensive book chapter about the role of seed bank in grassland recovery (Kiss et al. 2016 *Nova Science Publishers*) and a paper about the effects of seed bank on grassland recovery on sandy old-fields (Török et al. 2017 *Restoration Ecology*). We also organised a Special Issue in the Journal *Restoration Ecology* entitled „Seed banks and seed dispersal – Promising sources of restoration”. A review paper on seed bank and climate change has just been accepted in that issue (Kiss et al. 2018 *Restoration Ecology*).
- ❖ **Factors shaping the species composition of alkali grasslands.** We revealed the scale-dependent effects of grazing in shaping the species composition of alkali and sandy grasslands (Godó et al. 2017 *Tuexenia*). We revealed that the dominant grass species, *Festuca pseudovina* ameliorates micro-sites and supports plant coexistence in dry alkali grasslands (Kelemen et al. 2015 *Ecological Complexity*). We used self-organising maps for revealing the precipitation-driven changes in the species composition of alkali grasslands (Lukács et al. 2015 *Tuexenia*).
- ❖ **Seed traits and seed dispersal.** We proved that there is a trade-off between seed mass and range size, which can also explain the rarity of several plant species (Sonkoly et al. 2017 *Ecology and Evolution*). We published seed mass records for approximately 150 vascular plant species of the Hungarian flora (Török et al. 2016 *Acta Botanica Hungarica*) and data on the germination capacity for 75 species (Kiss et al. 2016 *Acta Botanica Hungarica*). We revealed that goose species play an important role in the long-distance dispersal of plant species between habitats along a moisture gradient (Tóth et al. 2016 *Plant Ecology*).
- ❖ **Management of grassland biodiversity.** In an international cooperation with Swedish and German scientists, we provided a meta-analysis comparing the use of grazing and mowing in grassland conservation (Tälle et al. 2016 *Agriculture, Ecosystems and Environment*). We revealed that dormant-season small-scale single prescribed fire can be a promising tool for biodiversity conservation in alkali grasslands (Valkó et al. 2016 *Science of the Total Environment*). Contrary, too frequent large-scale spring burning was found to be detrimental for the conservation values of semi-natural grasslands (Valkó et al. 2018 *Science of the Total Environment*). We provided evidence for the harmful effect of *Asclepias syriaca* on sandy grassland species with low competitor ability (Kelemen et al. 2016 *Applied Vegetation Science*).
- ❖ **Role of environmental factors in shaping grassland species composition.** In our multi-site, multi-proxy study we revealed that woody encroachment, recent and historical disturbance and slope angle are the major drivers of the plant species composition in isolated grassland fragments (Deák et al. 2016 *Biological Conservation*). We also proved the biodiversity conservation potential of ancient burial mounds in the steppe regions of Kazakhstan (Deák et al. 2018 *Plant Ecology and Diversity*).

Dissemination of project results

Papers

We published in total 25 papers, including 17 in impact-factored journals. The total impact factor of the papers related to the project is 42.206. Out of the impacted papers, I am first author in 5, last author in 2 and corresponding author in 11 papers. The complete list of publications can be found on the NKFI and MTMT servers.

Conferences

I presented the results of the project at the following conferences.

International conferences

- ❖ 1st International Conference on Community Ecology (Budapest, 28-29 September 2017) – here I was awarded by the 3rd prize of the Young Community Ecologist Award
- ❖ Annual Symposium of the International Association for Vegetation Science (Palermo, 20-24 June 2017) – here we organised a special session about Seed bank and seed traits
- ❖ European Geosciences Union General Assembly 2017 (Wien, 24-28 April 2017) – here I was asked to organise a workshop
- ❖ Natural and human-driven fire regime and early land-cover changes in Central and Eastern Europe – A Global Paleofire Working Group Workshop. (Frankfurt am Main, 5-8 December 2016) – here I was an invited plenary speaker
- ❖ 13th Eurasian Dry Grassland Conference (Sighisoara, 20-25 September 2016) – here I was awarded by the 2nd best oral presentation award, and my student Szilvia Radócz with the best poster award
- ❖ 10th European Conference on Ecological Restoration (Freising, 21-26. August 2016) – here we organised two special sessions and initiated a Special Issue about „Seed banks and seed dispersal – Promising sources of restoration” in the journal *Restoration Ecology*
- ❖ 4th European Congress for Conservation Biology (Montpellier, 2-6 August 2015)
- ❖ 58th Annual Symposium of the International Association for Vegetation Science (Brno, 19-24 July 2015)
- ❖ 12th European Dry Grassland Meeting (Mainz, 22-27 May 2015)
- ❖ European Geosciences Union General Assembly (Vienna, 12-17 April 2017)

Hungarian conferences

- ❖ XI. Hungarian Conference on Conservation Biology (Eger, 2-5 November 2017)
- ❖ 6th Symposium on Quantitative Ecology (Budapest, 13 October 2017)
- ❖ 7th Hungarian Conference on Landscape Ecology (Szeged, 25-27 May 2017)
- ❖ “Frontiers and international trends in restoration ecology and conservation biology” (Budapest, 11 May 2017)
- ❖ 3th Conference on the Sustainable Development in the Carpathian basin (Gödöllő, 17 March 2016)
- ❖ 11th Conference on the Current Flora- and Vegetation Research in the Carpathian basin (Budapest, 12-14 February 2016)
- ❖ Hungarian Ecological Congress (Veszprém, 12-14 August 2015) – here I was a plenary speaker and I received the Young Scientist Award of the Hungarian Ecological Society

Other results, grants and awards during the project period

- ❖ I was chief of guest editors of two special issues in the journal *Hacquetia* and led the writing of two synthesis papers (Valkó et al. 2018 *Hacquetia* and Valkó et al. 2016 *Hacquetia*)
- ❖ Young Scientist Award of the Hungarian Academy of Sciences (2018)
- ❖ Award for the Most Cited Review Paper in Basic and Applied Ecology (2017)
- ❖ "Woman Researcher of the Year" in the University of Debrecen (2017)
- ❖ Young Community Ecologist Award, 3rd prize (2017)
- ❖ Post-doctoral Grant of the New National Excellence Program (2017)
- ❖ I have defended my habilitation thesis (2017)
- ❖ 2017 Women in Science award in Agricultural Sciences from the HAS, UNESCO and Women in Science Association
- ❖ 2016 Bolyai János Scholarship of the Hungarian Academy of Sciences
- ❖ 2016 MTA-TIT 1st Prize for the Best Paper in the journal *Természet Világa*
- ❖ 2016 National Youth Excellence Scholarship
- ❖ 2016 Scholarship of the Universitas Foundation
- ❖ 2016 Young Investigator Prize, 2nd prize for oral presentations, Eurasian Dry Grassland Conference
- ❖ 2016 Tutor Scholarship, Balassi Institute, Márton Áron Scholarship
- ❖ 2015 Young Investigator Prize of the Hungarian Ecological Society
- ❖ 2015 Campus Hungary Mobility Grant (Germany, Austria)
- ❖ 2014 L'Oreal – UNESCO for Women in Science Prize
- ❖ 2014 Campus Hungary Mobility Grant (Russia)

Research plans and grants for the future

I won an NKFI KH project entitled 'Seed bank and community assembly in grassland dynamics' (Grant Agreement Number: NKFI KH 126476). Thus, in the future, I will continue and extend research on seed bank, focussing on the particularities of seed banks of alkali grasslands, mediated by salt and drought stress.

I won an NKFI FK research grant entitled 'Plant diversity in fragmented rural landscapes – Linear elements and human-mediated dispersal' (NKFI FK 124404). For the implementation of this FK project, experiences gained related to seed traits and seed dispersal in the PD OTKA project will provide a good scientific basis.

I will join the BIODESERT Research Group led by Fernando Maestre in the Universidad Rey Juan Carlos in Spain, for a three-month long mobility supported by the NKFI ERC-16-M.127070 grant. This will give me a unique opportunity to learn from a leading international research group, acquire knowledge in study designing, sampling and analytical techniques and project management, which will be a great support for my future research.

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