

## Final Report

### Seed banks and community assembly in grassland dynamics

NKFI KH 139938 project (earlier project ID: KH 126476)

PI: Orsolya Valkó

#### 1 Summary of the research

We studied the role of seed banks in the formation and maintenance of grassland diversity. In our multi-site study we followed the vegetation and seed bank development in landscape-scale restoration projects in the Hortobágy National Park, East-Hungary, which offered ideal research settings for studying the role of seed banks. We studied short- and medium-term vegetation and seed bank dynamics in successfully restored grasslands, with a special emphasis on the depletion of weed and build-up of grassland specialist seed banks. We tested the role of initial site conditions and current management on the seed bank dynamics. We found that even in the mid-successional stages, the seed bank of restored grasslands is dominated by weeds, and the build-up of the seed bank of grassland specialist species is a slow process. Based on these findings we tested and developed a method called ‘establishment gaps’ that can increase the diversity of species-poor restored grasslands. By the removal of the vegetation in gaps, we can decrease microsite limitation, while by sowing diverse seed mixture, we can decrease propagule limitation. We published a review paper about the role of seed bank in habitat restoration in a changing climate. The results of this KH project provide a solid scientific basis for future research in my recently established Lendület Seed Ecology Research Group.

#### 2 Most important results and achievements

##### 2.1 Key publications

We published nine papers about the core topics of the proposal, i.e., vegetation and seed bank dynamics in dry grasslands and their importance in restoration. In all these publications, the PI is either first or last (senior) author.

- We published a paper about the role of soil seed bank in the post-restoration vegetation dynamics of alkaline and loess grasslands (Valkó et al. 2021 *Restoration Ecology*).
- We published a paper about the role of establishment gaps in increasing the diversity of species-poor restored grasslands (Kiss et al. 2021 *Restoration Ecology*).
- Our paper about establishment gaps and zoochory has been accepted for publication recently (Kiss et al. 2021 *Journal of Vegetation Science*)
- We published a synthetic review on the role of seed bank in grassland and wetland restoration in the face of climate change (Kiss et al. 2018 *Restoration Ecology*).

- We provided a conceptual framework on the role of seed dispersal and seed bank in determining restoration trajectories and identified the key points where the processes can be supported by active restoration actions (Török et al. 2018 *Restoration Ecology*).
- We published new data on the germination potential of 75 species (Kiss et al. 2018 *Acta Botanica Hungarica*).
- We studied the effect of grazing by two cattle breeds on the vegetation dynamics of alkaline grasslands and wetlands (Kovácsné Koncz et al. 2020 *Applied Vegetation Science*).
- We studied the spontaneous vegetation recovery of Mediterranean grasslands with or without grazing exclusion (Labadessa et al. 2020 *Tuexenia*).
- We published a paper about the recovery of extremely overgrazed alkaline grasslands (Varga et al. 2021 *Arid Land Research and Management*).
- Besides the above listed key publications, several other papers, related to various aspects of the KH project, studying the biodiversity and vegetation dynamics of dry grasslands have been published in the project period. For the full list of these papers, please
- Besides primary publications, the PI submitted and defended her DSc thesis entitled 'Új módszerek a gyepek biodiverzitásának megőrzésére és rekonstrukciójára' [New methods for the conservation and restoration of grassland biodiversity].

## References

- Kiss, R., Deák, B., Tóthmérész, B., Migléc, T., Tóth, K., Török, P., Lukács, K., Godó, L., Körmöczi, Zs., Radócz, Sz., Kelemen, A., Sonkoly, J., Kirmer, A., Tischew, S., Švamberková, E., Valkó, O. (2021): Establishment gaps: biodiversity hotspots to support the colonization of target species in species-poor grasslands. *Restoration Ecology* 29(S1): e13135. [IF2019: 2.721]
- Kiss, R., Deák, B., Tóthmérész, B., Migléc, T., Tóth, K., Török, P., Lukács, K., Godó, L., Körmöczi, Z., Radócz, S., Borza, S., Kelemen, A., Sonkoly, J., Kirmer, A., Tischew, S., Valkó, O. (2021): Zoochory on and off: A field experiment for trait-based analysis of establishment success of grassland species. *Journal of Vegetation Science* (accepted for publication on 17 June 2021) [IF2019: 2.698]
- Kiss, R., Deák, B., Török, P., Tóthmérész, B., Valkó, O. (2018): Grassland seed bank and community resilience in a changing climate. *Restoration Ecology* 26 (S2): S141-S150. [IF2018: 2.544]
- Kiss, R., Sonkoly, J., Török, P., Tóthmérész, B., Deák, B., Tóth, K., Lukács, K., Godó, L., Kelemen, A., Migléc, T., Radócz Sz., Tóth, E., Balogh, N., Valkó, O. (2018): Germination capacity of 75 herbaceous species of the Pannonian flora and implications for restoration. *Acta Botanica Hungarica* 60: 357-368.
- Kovácsné Koncz, N., Béri, B., Deák, B., Kelemen, A., Tóth, K., Kiss, R., Radócz, Sz., Migléc, T., Tóthmérész, B., Valkó, O. (2020): Meat production and maintaining biodiversity: Grazing by traditional and crossbred beef cattle breeds in marshes and grasslands. *Applied Vegetation Science* 23: 139-148. [IF2019: 2.574]

- Labadessa, R., Deák, B., Valkó, O. (2020): No need for grazing exclusion – Sheep grazing supports the recovery of grasslands even from the early successional stages. *Tuexenia* 40: 429-443. [IF2019: 1.000]
- Török, P., Helm, A., Kiehl, K., Buisson, E., Valkó, O. (2018): Beyond the species pool: Modification of species dispersal, establishment and assembly by habitat restoration. *Restoration Ecology* 26 (S2): S65-S72. [IF2018: 2.544]
- Valkó, O., Deák, B., Török, P., Tóth, K., Kiss, R., Kelemen, A., Migléc, T., Sonkoly, J., Tóthmérész, B. (2021): Dynamics in vegetation and seed bank composition highlight the importance of post-restoration management in sown grasslands. *Restoration Ecology* 29(S1): e 13192. [IF2019: 2.721]
- Varga, K., Csízi, I., Monori, I., Valkó, O. (2021): Threats and challenges related to grazing paddocks: Recovery of extremely overgrazed grassland after grazing exclusion. *Arid Land Research and Management* 35(3): 346-357. [IF2019: 1.148]

## 2.2 Presentations

We presented our results at the following international conferences:

- European Congress for Conservation Biology (Jyväskylä, Finland, 2018)
- Annual Symposium of the International Association for Vegetation Science (Bozeman, USA, 2018)
- 48th Annual Meeting of the Ecological Society of Germany, Austria and Switzerland (Vienna, Austria, 2018)
- Island Biology Conference (St. Denis, La Réunion, France, 2019)
- 49th Annual Meeting of the Ecological Society of Germany, Austria and Switzerland (Münster, Germany, 2019)
- Eurasian Grassland Conference (Graz, Austria, 2019)
- European Geosciences Union General Assembly 2019 (Vienna, Austria, 2019)
- Reproductive Strategies Symposium (Debrecen, Hungary, 2019)
- European Geosciences Union General Assembly 2020 (online conference, 2020)

We presented our results at the following Hungarian conferences:

- 11. Magyar Ökológus Kongresszus (Nyíregyháza, 2018)
- XIX. Kolozsvári Biológus Napok (Kolozsvár, 2019)
- XII. Aktuális Flóra- és Vegetációkutatás a Kárpát-medencében Konferencia (Debrecen, 2018)
- Magyar Tájökológiai Konferencia (Kisvárd, 2019)

In total we received four conference awards: 1st best oral presentation (Réka Kiss), 2nd best poster (Katalin Lukács) and 3rd best oral presentation (Laura Godó) on the Eurasian Grassland Conference (Graz, 2019) and 2nd best poster prize (Orsolya Valkó, Island Biology Conference, La Réunion, 2019). The PI's MSc student, Ágnes Tóth received the 3<sup>rd</sup> prize at the OFKD

conference. The topic of her research was the ecological significance of deeply buried seeds in alkaline grasslands.

### ***2.3 Conference organization***

The PI was chief organizer (together with Tamás Székely and Zoltán Németh) of an international symposium entitled „*Reproductive Strategies from Genes to Societies – Frontiers in Plant and Animal Reproduction Research*”. The topic of the Symposium is strongly related to the topic of the KH project, as the reproductive strategies of plants and plant communities was a focal topic of both. The homepage of the symposium is: <https://konferencia.unideb.hu/en/reprostrat>

### ***2.4 Dissemination and public outreach***

The PI regularly disseminated news on the project on their scientific blog, both in English and Hungarian <https://deak-valko.blogspot.com/>. The researchers gave interviews in online platforms and several radio channels both in the Hungarian and the international media. They gave seminar talks at the Conservation Biology Seminar of the Hortobágy National Park, the seminar of the University of Szeged, Department of Ecology and the University of Debrecen, Department of Evolutionary Zoology and Human Biology. They participated at the Researchers’ Night (Kutatók Éjszakája) in 2020 where they disseminated the results of their seed ecological research.

### ***2.5 Continuation of the research, plans for the future***

The PI established a new research group (Lendület Seed Ecology Research Group) at the Institute of Ecology and Botany, Centre for Ecological Research. The funding provides a great opportunity to broaden the scope of our seed-based research projects.