Final Report

Plant diversity in fragmented rural landscapes – Linear elements and human-mediated dispersal

NKFI FK 124404 project

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1 Summary of the research

The research project focused on the mechanisms shaping the diversity and vegetation dynamics of grasslands in fragmented rural landscapes. We compared the species, functional and phylogenetic diversity of linear vs. patch-like fragments and continuous grasslands and evaluated their role in biodiversity conservation. We found that linear landscape elements are often subject to severe disturbance and their vegetation is characterised by species with high clonal spreading ability and small seeds. Despite the disturbances, we found that both roadside verges and river embankments can act as important biodiversity hotspots in human-modified landscapes. We tested mechanisms of human-vectored seed dispersal in a series of field and germination experiments. We showed that laundry washing can significantly influence the fate of the cloth-dispersed diaspores. Most of the washed propagules were still able to germinate, and germination success was negatively influenced by washing temperature. We also showed that laundry washing at high temperatures desynchronizes the germination, which might give an establishment advantage to species in a new environment and might be an important step in the process of biological invasion. To evaluate the ongoing attempts to tackle the problems caused by human-vectored seed dispersal, we reviewed the existing prevention and mitigation measures and identified the most important knowledge gaps related to the topic.

2 Most important results and achievements

2.1 Key publications

We published the following key publications about the core topics of the proposal. Publications where the PI or the members of the project team are first or last (senior) authors are marked with an asterisk.

- We tested the effect of laundry washing on the germination potential of cloth-dispersed propagules (*Valkó et al. 2020 *NeoBiota*).
- We published a review paper about the prevention and mitigation measures against human-vectored seed dispersal in protected areas (*Lukács & Valkó *Global Ecology and Conservation*).
- We published two Hungarian papers about the importance of human-vectored seed dispersal (*Lukács & Valkó 2018 *Kitaibelia*) and the importance of prevention and mitigation measures to tackle these problems (*Lukács & Valkó 2022 *Természetvédelmi Közlemények*)

- We published two key papers comparing the biodiversity potential (*Deák et al. 2020 *Biodiversity and Conservation*) and functional characteristics (*Deák et al. 2021 *Frontiers in Ecology and Evolution*) of linear vs. patch-like fragmented grasslands and continuous habitats.
- In a field experiment, we distinguished the effects of zoochory from other effects of cattle grazing on the functional characteristics of dry grasslands (*Kiss et al. *Journal of Vegetation Science*)
- We evaluated the potential of hay transfer as a measure for restoring species-rich grasslands in fragmented agricultural landscapes (*Valkó et al. 2022 *Journal of Environmental Management*)
- We wrote a critical review about the challenges of abandonment that is a major threat for fragmented grasslands across Europe (*Valkó et al. 2018 *Hacquetia*)
- Three researchers from our team participated in a study evaluating the biodiversity conservation potential of river embankments as linear landscape elements (*Bátori et al. 2020 *River Research and Applications*)
- Related to road ecology, we published a review paper in Hungarian about roadkill research in Hungary (*Borza et al. 2021 *Természetvédelmi Közlemények*)
- The PI participated in a study about the spread of a maritime halophyte species along continental roads (Fekete et al. 2018 *Preslia*)
- Besides the above listed key publications, several other papers, related to various aspects of the FK project, about the biodiversity and vegetation dynamics of dry grasslands have been published in the project period. For the full list of these papers, please see the list of publications in the EPR system.

References

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*Deák, B., Rádai, Z., Lukács, K., Kelemen, A., Kiss, R., Bátori, Z., Kiss, P.J., Valkó, O. (2020): Fragmented dry grasslands preserve unique components of species and phylogenetic diversity in agricultural landscapes. *Biodiversity and Conservation* 29: 4091-4110. https://doi.org/10.1007/s10531-020-02066-7 [IF2020: 3.549]

Fekete, R., Mesterházy, A., Valkó, O., Molnár V., A. (2018): A hitchhiker from the beach – The spread of a maritime, halophyte species (*Cochlearia danica* L.) along salted continental roads. *Preslia* 90: 23-37. https://doi.org/10.23855/preslia.2018.023 [IF2018: 3.071]

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*Lukács, K., Valkó, O. (2021): Human-vectored seed dispersal as a threat to protected areas: Prevention, mitigation and policy. *Global Ecology and Conservation* 31: e01851. https://doi.org/10.1016/j.gecco.2021.e01851 [IF2021: 3.969]

*Lukács, K., Valkó, O. (2022): Magterjedés az emberi ruházaton: megelőzési és védekezési lehetőségek. *Természetvédelmi Közlemények* 28: in press.

*Lukács, K., Valkó, O. (2018): A ruházat szerepe az ember általi magterjesztésben. *Kitaibelia* 23 (1): 77–86. https://doi.org/10.17542/kit.23.77

*Valkó, O., Labadessa, R., Palpurina, S., Burrascano, S., Ushimaru, A., Venn, S. (2020): Conservation and diversity of Palaearctic grasslands – Editorial to the 5th EDGG special issue in Hacquetia, *Hacquetia* 18 (2): 149-152.

*Valkó, O., Lukács, K., Deák, B., Kiss, R., Miglécz, T., Tóth, K., Tóth, Á., Godó, L., Radócz, Sz., Sonkoly, J., Kelemen, A., Tóthmérész, B. (2020): Laundry washing increases dispersal efficiency of cloth-dispersed propagules. *NeoBiota* 61: 1-16. https://doi.org/10.3897/neobiota.61.53730 [IF2020: 3.684]

*Valkó, O., Rádai, Z., Deák, B. (2022) Hay transfer is a nature-based and sustainable solution for restoring grassland biodiversity. *Journal of Environmental Management* 311: 114816. [IF2021: 8.910]

2.2 Presentations

We presented the results of the FK project at the following conferences:

International conferences:

- 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)
- Reproductive Strategies Symposium (Debrecen, Hungary, 2019)
- European Geosciences Union General Assembly (online, 2021)

- Forum Carpaticum Conference (online, 2021)
- 3rd Conference on Community Ecology (online, 2021)
- The Conference of the Czech Botanical Society (Brno, Czech Republic, 2022)
- 6th European Congress for Conservation Biology (Prague, Czech Republic, 2022)
- European Congress for Ecological Restoration (Alicante, Spain, 2022)
- 16th Eurasian Grassland Conference (Tolosa, Spain,2022)

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)
- VIII. Magyar Tájökológiai Konferencia (Kisvárda, 2019)
- Kolozsvári Biológus Napok (online, 2021)
- Az MTA Kolozsvári Akadémiai Bizottság előadássorozata (online, 2021)
- 12. Magyar Ökológus Kongresszus (Vác,2021)
- Kolozsvári Biológus Napok (Kolozsvár, 2022)
- Kvantitatív Ökológiai Szimpózium (Vácrátót, 2022)
- Magyar Természetvédelmi Biológiai Konferencia (Pécs, 2022)

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) at the Eurasian Grassland Conference (Graz, 2019) and 2nd best poster prize (Orsolya Valkó, Island Biology Conference, La Réunion, 2019).

We gave invited talks about the topic of the FK project at the Conference of the Czech Botanical Society (Brno 2022, Balázs Deák), the ecology seminar of the University of South Bohemia (Ceske Budejovice, 2021, Orsolya Valkó) and the seminar series of the HAS Regional Chapter in Kolozsvár (online, Katalin Lukács).

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 FK 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
- Balázs Deák and Orsolya Valkó, together with Zoltán Botta-Dukát and Milan Chytry organized an international conference for PhD students in botany (Poroszló, September 2022). This was a great opportunity for our students to present the results of the FK project to the wide international young researcher community.

2.4 Dissemination and public outreach

- We regularly disseminated news on the project on our scientific blog, both in English and Hungarian https://deak-valko.blogspot.com/ and on the homepage (https://seed-ecology-research-group.webnode.hu/) and facebook site (https://www.facebook.com/SEEDECOLOGY) of our research group.
- We gave interviews at online platforms and several radio channels both in the Hungarian and the international media. We 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, the ecology seminar at the University of South Bohemia,

the environmental management seminar at the Clemson State University, and multiple seminar talks at the Institute of Ecology and Botany, Centre for Ecological Research.

- We participated at the Researchers' Night (Kutatók Éjszakája) in 2020 and 2022, and at the Garden on the Cube (Kert a Köbön) event of the Centre for Ecological Research in 2021 and 2022, and at the International Environmental and Nature Protection Festival at Gödöllő where we disseminated the results of our seed ecological research. The PI also participated in a roundtable talk about 'Migration in nature and culture' at the Kert a Köbön program.

2.5 Continuation of the research, plans for the future

The FK project was a great inspiration for our future studies at the Lendület Seed Ecology Research Group. The results on human-vectored seed dispersal inspired us to continue this research line with a special focus on the spread of invasive alien species in the framework of the National Laboratory on Health Security. Also, we started new studies about similar non-conventional dispersal processes, such as zoochory by small mammals, diploendozoochory, and seed dispersal by vehicles. We have also broadened our research related to road ecology and currently we are working on a questionnaire survey and a field study about roadkill. We also continue our studies related to linear landscape elements and we are working on a dataset about the restoration possibilities of former linear landscape scars on convex and concave landforms.