Conservation and restoration of biodiversity at multiple scales
(A biodiverzitás, ökoszisztéma szolgáltatások és funkciók megőrzése és helyreállítása)
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WP-1 Landscape-scale drivers of grassland biodiversity: Urbanisation and fragmentation

Landscape and habitat filters are major drivers of biodiversity of small habitat islands by influencing stochastic dispersal and extinction events in the metapopulations. We assessed the effects of landscape and habitat filters on the species richness, abundance and trait composition of specialist and generalist species in small habitat islands. Habitat loss and changes in the abiotic environment are seriously affecting urban biodiversity. We investigated the vegetation composition of three urban habitat types, vacant lots, urban parks, and peri-urban grasslands, which are characterised by species typical to semi-natural grasslands and ruderal assemblages in the city of Debrecen (East-Hungary). We used five spatial replicates of each habitat type and five random plots in every site for our analyses. We found that species composition of urban habitat types is considerably affected by the specific disturbances and site histories associated with the certain habitats. The most urbanised habitats, the urban parks harboured the lowest number of species and the lowest Shannon diversity. The ratio of weeds and disturbance-tolerants was the highest in the city centre likely due to the high-intensity trampling and soil disturbances. Plant species of city centre were more drought-tolerant compared to peri-urban grasslands, which is likely due to the increased level of drainage. The ratio of nitrogen-demanding species was lower in urban parks and peri-urban grasslands than in vacant lots, likely due to the high level of recent soil disturbance in this habitat type. The proportion of alien species was high both in vacant lots and peri-urban grasslands, even though their disturbance regimes differed considerably. The proportion of cosmopolitan species was significantly higher in urban parks compared to vacant lots and peri-urban grasslands. The large proportion of alien and cosmopolitan species together with the continuous human disturbance put native species at a competitive disadvantage, and accordingly the proportion of these species was lowest in the city centre.

We studied traits related to functional spatial connectivity and temporal connectivity using model selection techniques. We sampled herbaceous grassland specialist and generalist plants, landscape filters and habitat filters in grassland islands in Hungary. Isolation decreased the abundance of good disperser specialist plants due to the lack of directional vectors transferring seeds between suitable habitat patches. Persistence by clonal reproduction was an

effective strategy in isolated habitat islands. Persistent seed bank did not support the survival of specialist plants in isolated habitats. We found that clonal specialist plants could cope well with increasing woody encroachment due to their high resistance against environmental changes; however, they could not cope with intensive disturbance. Steep slopes proving environmental heterogeneity had an overall positive effect on species richness. Specialist plants were influenced by the interplay of landscape filters influencing their abundance, and habitat filters affecting plant species richness. Landscape filtering by isolation influenced the abundance of specialist plants by regulating seed dispersal. Generalist plants were not affected by landscape filters due to their broad habitat breadth and high propagule availability. Habitat filters sorted species that could establish and persist at a site by influencing micro-site availability and quality.

An especially pronounced effect of fragmentation is the increase of edges. Most edges are anthropogenic in origin, but are distinguishable by their maintaining processes: natural versus anthropogenic interventions like agriculture, urbanization. We invented and tested the history-based edge effect hypothesis: we found that diversity-enhancing properties of edges significantly differed according to their history. Edges maintained by natural processes had significantly higher species richness than their interiors, while edges with continued anthropogenic influence did not. The filter function of edges was also essentially different depending on their history. Preserving and protecting all edges maintained by natural processes, and preventing anthropogenic changes to their structure, composition, and characteristics are key factors to sustain biodiversity.

WP-2 Spatial diversity components of grasslands: Regional and landscape-scale species pool

We identified urban green areas and their connections with the Regional Ecological Network surrounding the city of Debrecen (East-Hungary), and explored the biodiversity potential of the network of these areas. We found that whilst industrial areas, airport and mixed land covered a relatively large area, parks and other functional green spaces had a relatively small extent. However, the green space system of the city is well connected to the Regional Ecological Network. We also surveyed the functional and potential green spaces in the city and in the studied patches of the Regional Ecological Network in and around the city. We found that 65% of the functional green spaces are potentially connected; thus, there is a possibility for species typical to semi-natural open habitats to disperse between the green spaces of the city. Based on the survey of the spontaneous flora and planted ornamentals we found that the ratio of native species was high in the studied urban parks. We found that native species were the most typical in the spontaneous flora of the studied urban parks, although the ratio of archaeophytes and neophytes were also high. Our results suggest that the

studied urban habitats have some biodiversity conservation potential; they mostly harbour species which can cope with the local environmental conditions of the city parks, such as increased temperature, drought and nutrient enrichment.

We tested three hypotheses studying the effect of several local and landscape-level factors on spider assemblages of sandy grassland fragments: (i) species richness decreases with grazing intensity; (ii) species richness increasing with fragment size; (iii) the higher isolation of fragments results in decreasing species richness. We found that species richness of spiders did not depend on the grazing intensity, but there were changes in species composition and abundance of species among the variously grazed fragments. We found that only the fragment size was a significant predictor of the diversity of specialist spiders, since the number of these species increased significantly with fragment size. Out of the four investigated landscape-level factors only the isolation was a significant predictor influencing spider diversity. The total number of species, the number of generalist species and the number of hunting species increased significantly with the isolation of fragments. Our results suggest that both local and landscape-level factors are important drivers in maintaining spider diversity in sandy grasslands. Therefore, these factors should be considered simultaneously during the restoration and/or management of grasslands.

WP-3 Effect of local management and landscape complexity on biodiversity

Herbivores and their predators are affected by changes in land-use and habitat fragmentation. Past studies of tri-trophic herbivore communities have found that increasing land-use intensity leads to declines in community stability. In this study we considered how landscape configuration and composition affected habitat networks and parasitoid food webs under moderate but increasing land use. We used gall wasp communities as models to test the effects of landscape change on multi-species hierarchical communities of plants and animals. We investigated characteristics of networks formed by rose bushes and quantitative webs of rose gall parasitoids along a gradient of land-use intensity. We found that link density and compartmentalisation of rose bush networks, and local extinction within parasitoid webs increased with increasing landscape homogenization. Because these network and web characteristics are linked with resilience, our results suggest that stability of these communities can increase as landscapes become less complex. This is an intriguing aspect of landscape homogenisation effects on biological communities that contrasts with most expectations and the majority of the relevant literature, where decreasing community stability is usually associated with landscape homogenization.

Habitat loss and fragmentation causes a decline in insect populations. Odonata (both dragonflies and damselflies) are especially threatened by the destruction of both aquatic and

terrestrial environment. In a two years study along East-European lowland watercourses both aquatic and terrestrial environment were studied to reveal the importance of local and landscape-scale variables to Odonata through increasing spatial sampling scales. Our findings emphasized the importance of terrestrial environment on Odonata both on local and landscape scales. Local variables influence damselflies, while dragonflies are more sensitive to landscape variables. Damselfly's diversity decreased with increasing macrovegetation cover, while dragonfly's diversity decreased with the increasing degree of land use intensification, but increased with the length of watercourses. It is thus vital to stress the importance of partial watercourse clearing, and moderate maintenance of traditional farm management based on small parcel farming near watercourses to maintain diverse and healthy Odonata assemblages.

WP-4 Temporal patterns of grassland biodiversity: Succession and restoration

Grassland restoration is usually an expensive action, especially the technical reclamation. Relying on spontaneous succession (after the establishment of a species-poor grassland) makes the procedure cheaper than an active restoration action. Sowing of grass seed mixtures is a feasible and cost-effective method for landscape-scale grassland restoration. Sowing only grasses usually leads to species-poor and dense grass sward, where the establishment of target forbs is hampered both by microsite limitation, and propagule limitation. To overcome these limitations and increase the diversity of species-poor sown grasslands we developed a novel method by creating establishment gaps. We used tillage to open gaps in dense grass sward of six species-poor sown grasslands in the Great Hungarian Plain. We sowed high-diversity seed mixtures of native species into all gaps. Our results indicated that most of the sown species were able to establish permanently in the establishment gaps. The total cover and the cover of perennial sown species increased independently of gap size. Meanwhile the cover of short-lived sown species decreased during the consecutive years. There was only a moderate level of weed abundance in the gaps, and weed cover decreased over the years. The sown target species started to colonize the species-poor grasslands surrounding the establishment gaps within five years.

Although spontaneous succession (sometimes it means we are doing nothing as restoration action) is a nice buzzword. But in restored grassland scrub encroachment is frequently a real threat without post-restoration management. We studied the effect of native woody encroachment on grassland biodiversity in grassland fragments by analysing the vegetation composition of grasslands subjected to increasing levels of encroachment. We studied both ancient and restored grasslands in South-Eastern part of Transdanubia, Hungary. The percentage cover of trees, shrubs and herbaceous vegetation were recorded. The effects of woody encroachment and grassland age on diversity, total species richness of the herb layer, and richness of dry-grassland species were analysed. We found that woody encroachment

affected the total richness of the herb layer and the species richness of dry-grassland species. For most of the listed variables, lowest values were found for the highest woody encroachment groups. Grassland age affected the species richness of the herb layer and that of dry-grassland species; lower values were detected in restored grasslands. Species composition and richness displayed a relatively high resistance to moderate woody encroachment; the highest decrease in diversity was detected at a high level of woody encroachment. We conclude that low to moderate woody encroachment cannot be simplistically regarded as degradation. Results suggest that moderately encroached loess grasslands can be easily restored by the suppression of woody species, as their species pool still contains many dry-grassland species targeted for restoration.

Publications

There were published 60 papers in international (impacted) journals, during the 4 years of the project, and addition 15 papers during the extra year.

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