Grassland restoration and management to increase landscape biodiversity

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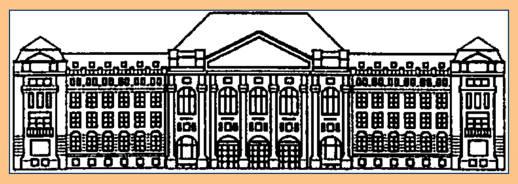


Introduction

• Grassland restoration is one of the most frequent land use change on cropland abandoned due to climate change and intensification (**1**).

• Most studies of grassland restoration typically focus on one taxon at small spatial scales (**2-4**) or several taxa at large (continental) scales (**5-6**).

• Relatively few studies have explored the links between grassland restoration and landscape-level biodiversity (**7-9**).

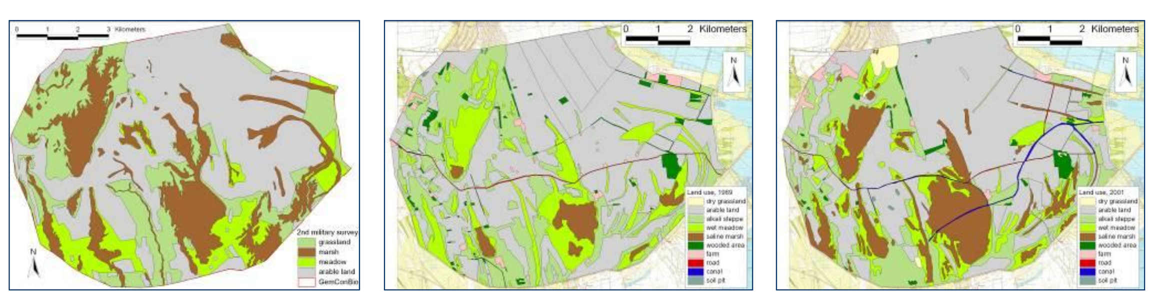
Aim and background

We study the impact of grassland restoration and management on species diversity of multiple taxa at the landscape scale.

Hypothesis 1:
Restoration increases the diversity of plants and arthropods characteristic to natural habitats.

Hypothesis 2:
Low-diversity seed mixtures lead to more open niches, different successional pathways and higher biodiversity.

Our study system is the Egyek-Pusztakócs area (Hortobágy National Park, E-Hungary), one of the largest (> 4000 ha) and oldest habitat restoration projects in Europe.
• Marsh restoration took place between 1976 and 1996.
• The current (2004-08) phase focuses on the restoration and management of grasslands.



Land use in 1866, 1969, and 2001. Grey – cropland, pale green – alkali steppe, bright green – meadow, dark green – wooded area, brown – marsh.

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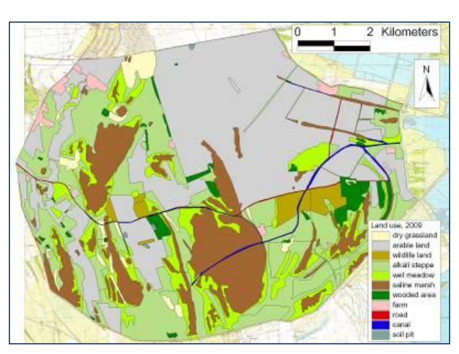

Land use after the current phase of restoration (2009)

Methods

Grassland restoration on **500 ha** in 2005-2007:
- target habitats: Pannonic alkali grasslands and marshes, Pannonic loess steppes (priority habitats in EU)
- **previous crop**: **wheat** or **alfalfa**
- low-diversity **seed mixtures**: **alkali**: 2 grasses, **loess**: 3 grasses

Monitoring of changes:
- repeated measures design (different starting years)
- space-for-time design (same-year comparisons)
- taxa: flowering plants, arthropods (grasshoppers Orthoptera, ground beetles Carabidae, spiders Araneae, and others)

References

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Results - *plants*

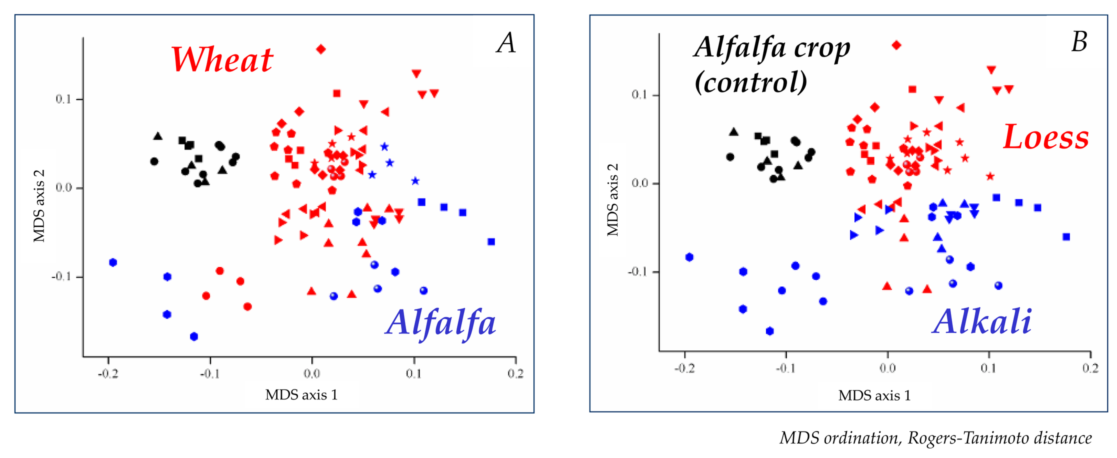

Fig. 1. *In Year 1, plant community composition differed both by (A) previous crop and (B) seed mixture*

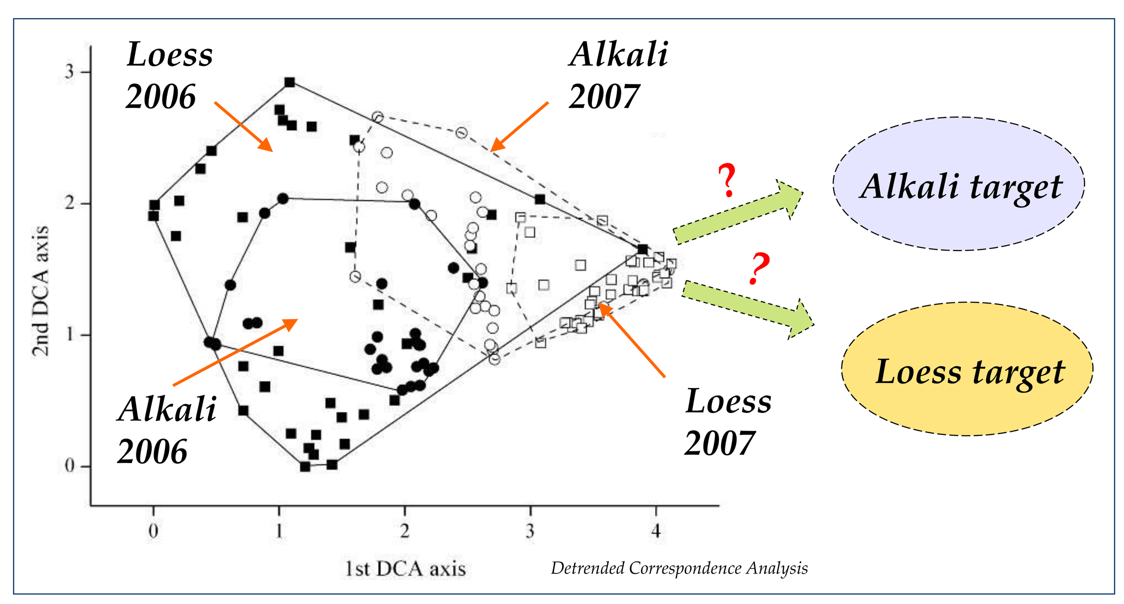

Fig. 2. *From Year 1 to Year 2, overall plant species composition changed and differences by seed mixture remained*

Table 1. *Changes in species composition from Year 1 to Year 2*

	Alkali		Loess	
	2006	**2007**	**2006**	**2007**
Species richness (SR)	65	44	74	51
SR of 'natural' species	9 ± 2.2	34 ± 5.3	11 ± 3.2	19 ± 4.1
Annuals, %	65 ± 4.5	17 ± 5.2	83 ± 3.4	7 ± 1.3
Dicot phytomass, gm^{-2}	1020.2	54.2	989.0	6.4

Summary - Plants

• Weed community composition in Year 1 differed by previous crop and seed mixture (**Fig. 1**), likely due to differences in soil seed bank.

• Marked changes in species composition occurred from Year 1 to Year 2 (**Fig. 2**), with total species richness decreasing (**Table 1**).

• Most changes were due to the increase of 'natural' species, either from the seed bank or through colonization, and to the decrease of annual dicot weeds (**Table 1**).

Restored grassland in Year 1 (2006)

Restored grassland in Year 2

Native grassland (restoration target)

Results - *arthropods*

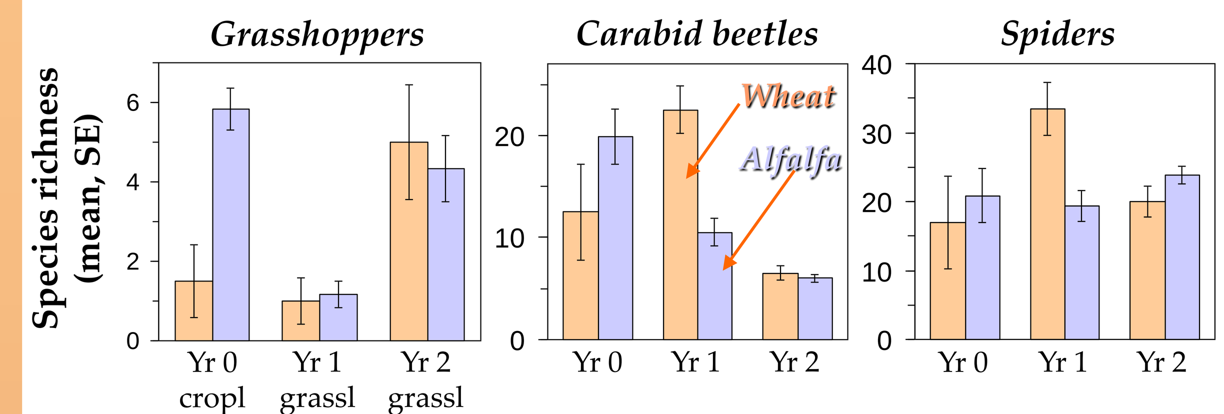

Fig. 3. *Species richness fluctuated per arthropod group among years. Diversity differences between crops in Year 0 disappeared by Year 2.*

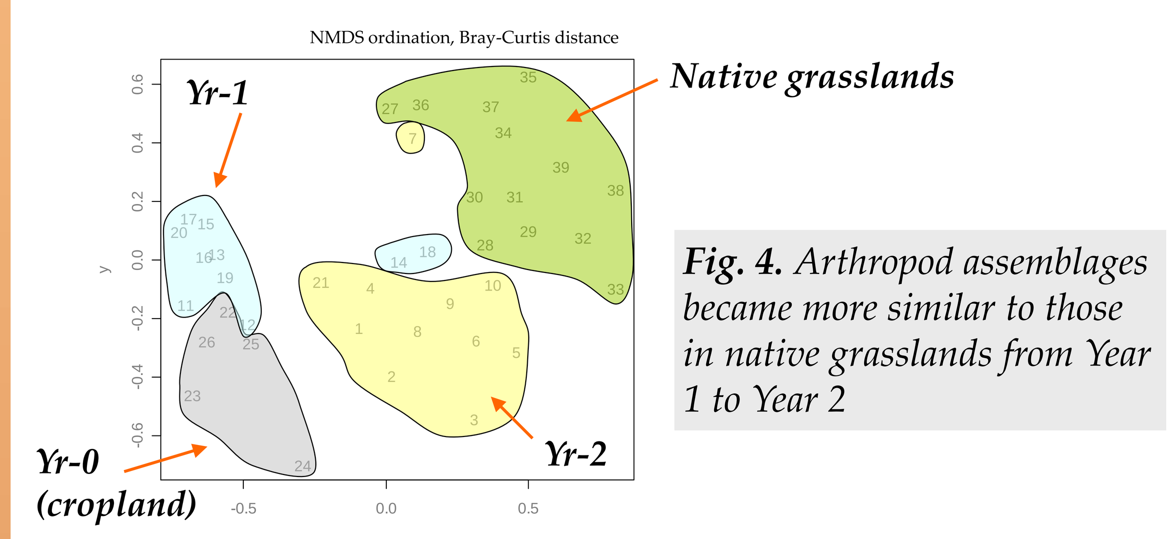

Fig. 4. *Arthropod assemblages became more similar to those in native grasslands from Year 1 to Year 2*

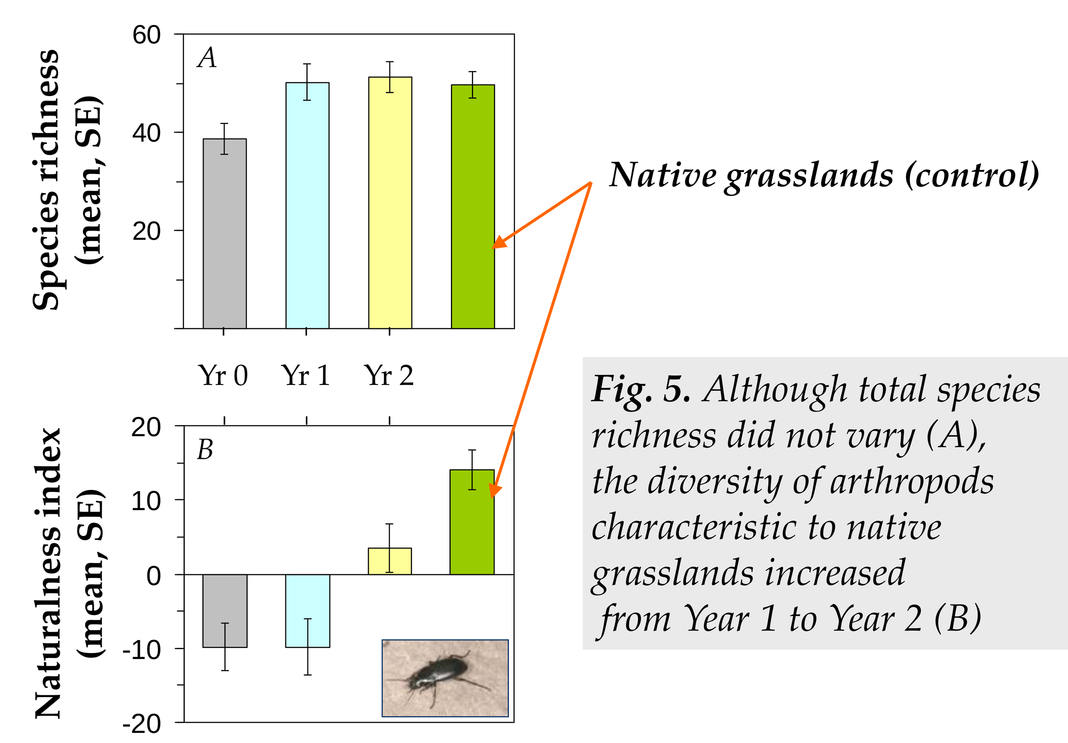

Fig. 5. *Although total species richness did not vary (A), the diversity of arthropods characteristic to native grasslands increased from Year 1 to Year 2 (B)*

Summary - Arthropods

• Taxon species richness fluctuated between years (**Fig. 3**). In Year 1, a few generalist species dominated, and assemblages did not differ by seed mixture (*not shown*).

• Differences in species richness by previous crop in Year 1 disappeared by Year 2 (**Fig. 3**).

• Total species richness did not change (**Fig. 5A**), while assemblages became more 'natural' by Year 2 (**Fig. 4**) due to the colonization of 'natural' species (**Fig. 5B**).

Conclusions

Year 2 was an important turning point in restoration because

• the diversity of 'natural' plants increased,

• new plant communities differed in species composition,

• the diversity of 'natural' arthropods increased.

Hypothesis 1 - supported
• grassland restoration on croplands increased diversity of plants and animals characteristic to target native grasslands

Hypothesis 2 - supported
• low-diversity seeding led to different successional pathways depending on previous history (via soil seed bank) and seed mixture (via colonization).