



ProSeed – Large-scale grassland restoration: the use of establishment windows and high diversity seeding by the knowledge transfer of regional seed propagation to Hungary



Funded by: German Federal Environmental Foundation
(Deutsche Bundesstiftung Umwelt)

Duration: 15 September 2013 until 31 August 2015

FKZ: 31006/33-2

gefördert durch



Deutsche Bundesstiftung Umwelt

www.dbu.de

Project partner

- **Universität Debrecen, Department of Ecology**
(Béla Tóthmérész, Péter Török, Balázs Deák, Orsolya Valkó)
- **Hochschule Anhalt, Department of Nature Conservation and Landscape Planning**
(Sabine Tischew, Anita Kirmer)
- **Saale-Saaten** (Matthias Stolle)
- **Hortobágy National Park Directorate** (István Kapocsi)
- **Salvia Environmental and Nature Protection Association**
(Balázs Deák, Orsolya Valkó)



3 Work Packages

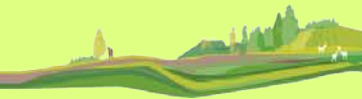


WP1 Establishing seed propagation of wild plants in the Hortobágy National Park

- *presentation Balázs Deák et al.: Seed propagation of characteristic loess grassland species and application of high diversity seed mixtures in nature conservation*
- *presentation Matthias Stolle: An example of wild plant seed production in Central Germany*

WP2 Set-up of a donor site register for species-rich grasslands in the Hortobágy National Park

WP3 Developing of methods for successful grassland restoration in Hungary and Germany



In Hungary, wild plant seeds of local provenance are not available commercially till now.

The project is supporting the **Salvia Environmental and Nature Protection Association** to produce seeds of local provenance for future restoration projects.



Compiling of an information brochure about seed propagation requirements of selected target grassland species:

Woodland sage
Salvia nemorosa L.



Family	Lamiaceae
Flowering period	May – June
Color	lilac
Seed bank type	transient
Red list status	not protected

Stem	
Height	30 – 70 cm
To be completed	

Seed	
Diaspore type	carcerulus
Seed shape	round
Seed length	1.254 mm
Seed width	0.912 mm
Seed thickness	0.25 mm
1000 seed weight	0.867 g



Use in restoration: Can be a good matrix species for all kinds of loess grassland restoration. Besides the relatively low germination rate in laboratory/greenhouse, on field the germination and establishment success is rather good in various site conditions. Very attractive and ornamental species and also important nectare source for pollinators.

Site conditions: Typical species of natural loess grasslands, can be very abundant in loess verges..

Austrian sage
Salvia austriaca Jacq.



Family	Lamiaceae
Flowering period	May – October
Color	pale yellow
Seed bank type	transient
Red list status	not protected

Stem	
Height	60 – 80 cm
To be completed	

Seed	
Diaspore type	carcerulus
Seed shape	round
Seed length	2.12 mm
Seed width	1.544 mm
Seed thickness	1.139 mm
1000 seed weight	1.817 g



Use in restoration: Can be a good matrix species for all kinds of loess grassland restoration. Although typical for natural loess grasslands, it occurs sometimes also in alkali grasslands. Besides the relatively low germination rate in laboratory/greenhouse, germination and establishment success in the field is rather good. Very attractive and ornamental plant, also important nectar source for pollinators.

Site conditions: Typical species of natural loess grasslands and sometimes also occurs in alkali meadows.

Easy to propagate

Germination

No specific requirements
Germination rate 35 %

Cultivation

Initial planting of greenhouse-grown juvenile plants
Planting in autumn recommended

Weed control

To be completed

Harvest

Second year after planting
Ripe seed end of June?
Best option: on-site threshing with small thresher

Yield

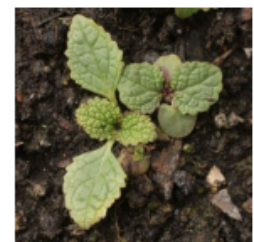
To be completed

Processing/Cleaning

With special machines
By hand

Storage

To be completed





3 Work Packages



- WP1** Establishing seed propagation of wild plants in the Hortobágy National Park
- WP2** Set-up of a donor site register for species-rich grasslands in the Hortobágy National Park
- WP3** Developing of methods for successful grassland restoration in Hungary and Germany

A data base about still existing grasslands can support conservation actions as well as restoration projects (e.g. for collection of basic seed material for propagation). **This data base of potential donor sites for seed harvest will encompass ecological as well as economical data.** For any harvest, the approval of the National Park Administration is mandatory.

Area Data

Name of the site _____ Location _____

Date of assessment _____ Person in charge _____

Total area size [m²] _____ Harvesting area [%] _____

General remarks _____

Ecological suitability

Proportion/ Amount of characteristic species

☐ High ☐ Moderate ☐ Low

Remarks _____

Amount of problematic species

☐ High ☐ Moderate ☐ Low

Remarks _____

Economical Suitability

Shrub encroachment

☐ None to low (<15%)

Remarks _____

☐ Moderate (15-40%)

☐ High (>40%)

Disturbances

☐ Grass invasion

☐ Ruderalisation

Remarks _____

☐ Shrub encroachment

☐ Land abandonment

☐ Eutrophication


☐ Others



3 Work Packages



- WP1** Establishing seed propagation of wild plants in the Hortobágy National Park
- WP2** Set-up of a donor site register for species-rich grasslands in the Hortobágy National Park
- WP3** Developing of methods for successful grassland restoration in Hungary and Germany

- 
- A horizontal illustration of a landscape with rolling green hills, a small cluster of trees, and a few buildings under a light blue sky.
- ❖ How does the management regime (with/without grazing) influences the establishment of target species and their seed production?
 - ❖ What is the optimal size of establishment windows to built up the diaspore pressure necessary for successful colonisation?
 - *presentation Balázs Deák et al.: Seed propagation of characteristic loess grassland species and application of high diversity seed mixtures in nature conservation*
 - ❖ Are introduced species able to migrate into their surroundings?



Examinations in old restoration sites in Germany: migration of target grassland species



Question: Are introduced species able to migrate into their surroundings?

Methods

Selection of old sites without introduction of target species adjacent to restoration sites with high biodiversity

Relevés with percentage cover of species on permanent plots in sites without target species introduction



Examinations in old restoration sites in Germany: migration of target grassland species



Germany: 2 old restoration trials

	1. mining site Roßbach	2. mining site Profen
Location	11° 54' 05,46" E 51° 14' 27,98" N	12° 09' 07,9" E 51° 08' 22,8" N
Height above sea level	123	162-177
Substrate/soil	Loess	Boulder clay with sand
Mean pH (CaCl ₂)	7,5 ± 0,02	7,6 ± 0,1
P (mg /100 g soil)	0,3 ± 0,2	1,0 ± 0,3
K (mg /100 g soil)	13,3 ± 1,0	5,1 ± 0,9
N _t (%)	0,1 ± 0,01	0,03 ± 0,02
Start of experiment	September 2000	December 2004
No. of target species (only introduced, i.e. not present in the mining site before)	39 forbs 12 grasses	40 forbs 11 grasses

Study sites Germany

1. Central German Lignite Mining District: mining site Roßbach: dry grassland restoration



Complete block design, extension 1.2 ha, 3 variants, 3 repetitions, start: September 2000

- (1) Application of c. 1 kg green hay/m² from Festuco-Brometea & Arrhenatheretea
- (2) sowing of a native seed mixture, 2 g/m², covered with species-poor hay mulch
- (3) untreated control



Mining site Roßbach: raw soil, loess, start 9/2000

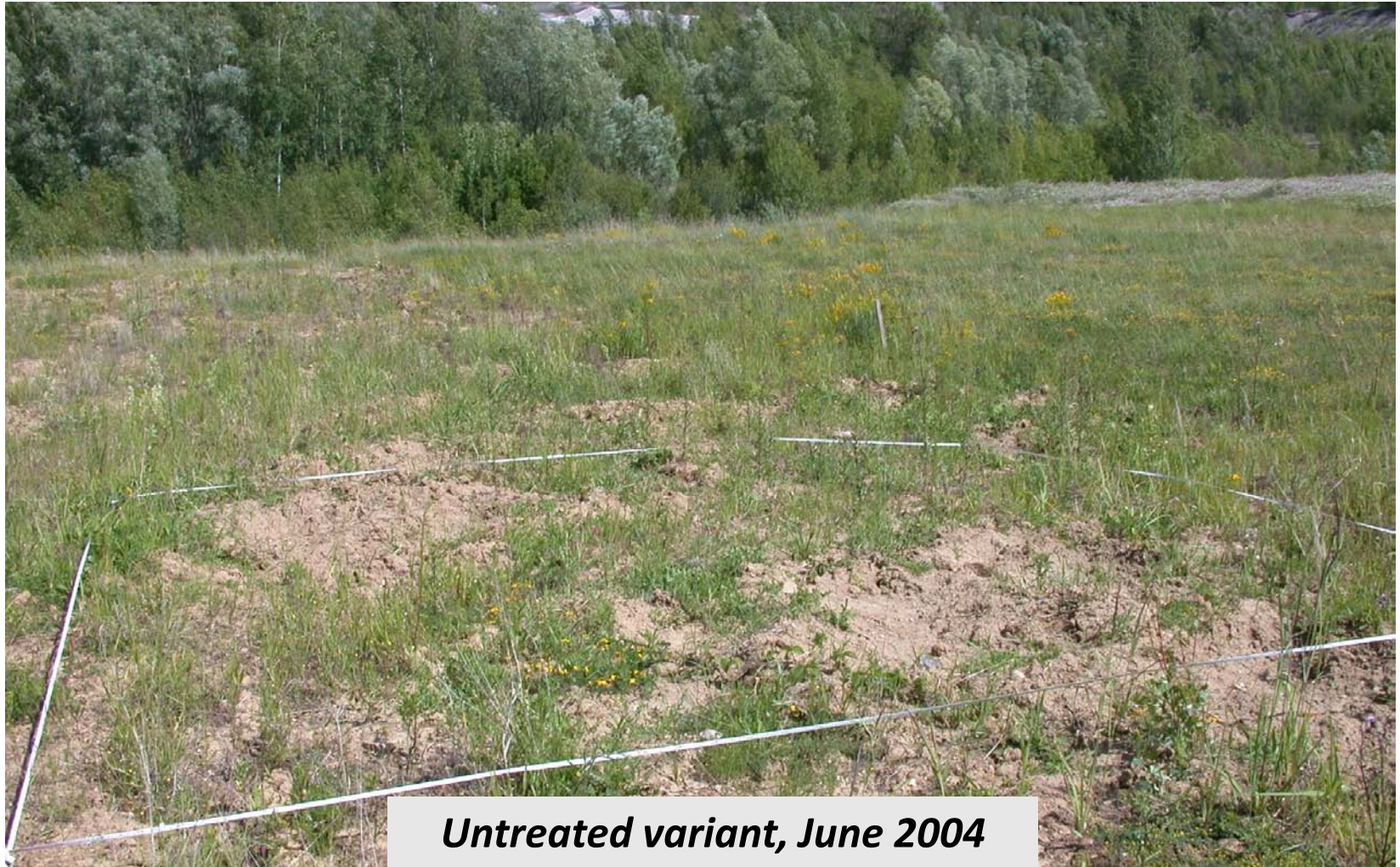


hay transfer

Sowing

Untreated variant, August 2002

Mining site Roßbach: raw soil, loess, start 9/2000



Untreated variant, June 2004



Mining site Roßbach: raw soil, loess, start 9/2000

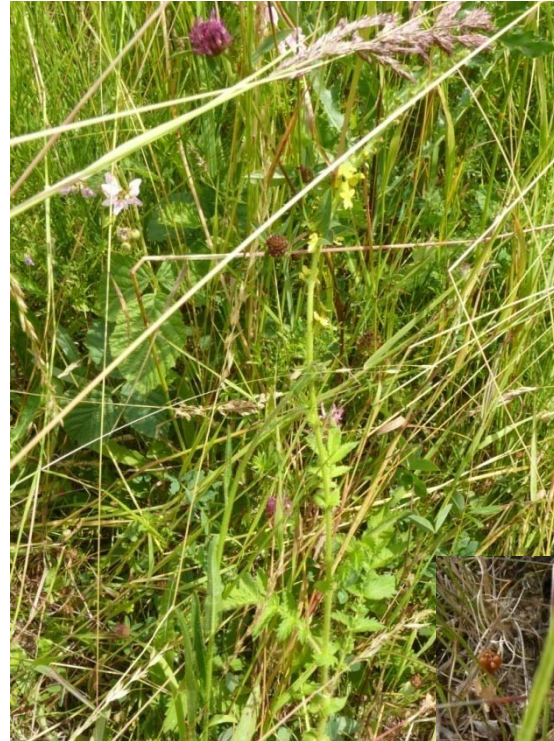


Untreated variant, June 2010

Mining site Roßbach: raw soil, loess, start 9/2000



Untreated variant, June 2014



Agrimonia eupatoria



Lacerta agilis (sand lizard)



Mining site Roßbach: raw soil, loess, start 9/2000

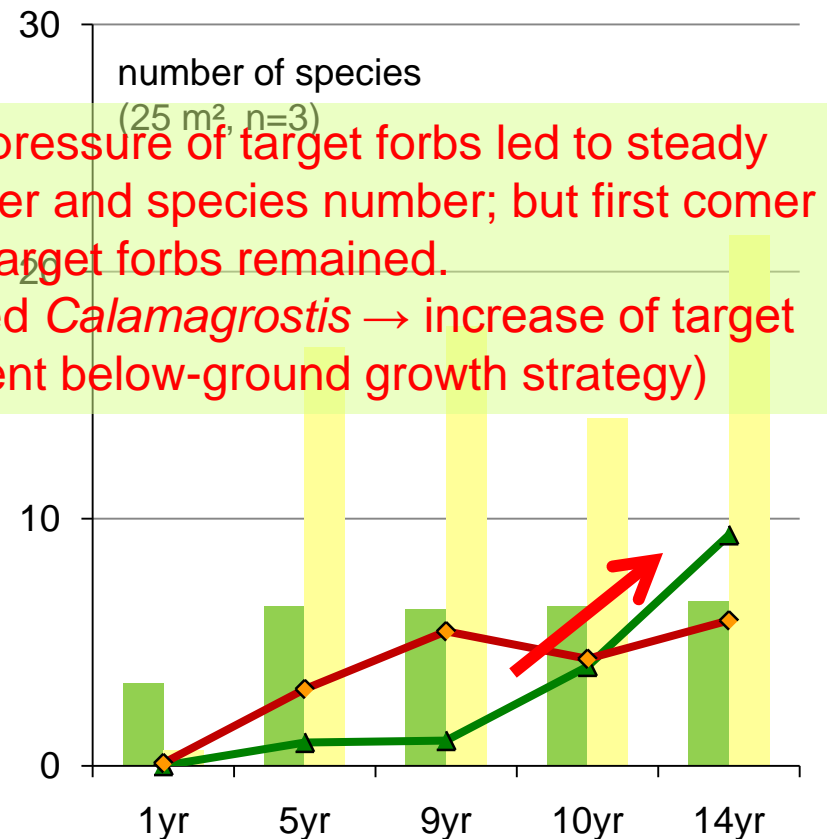
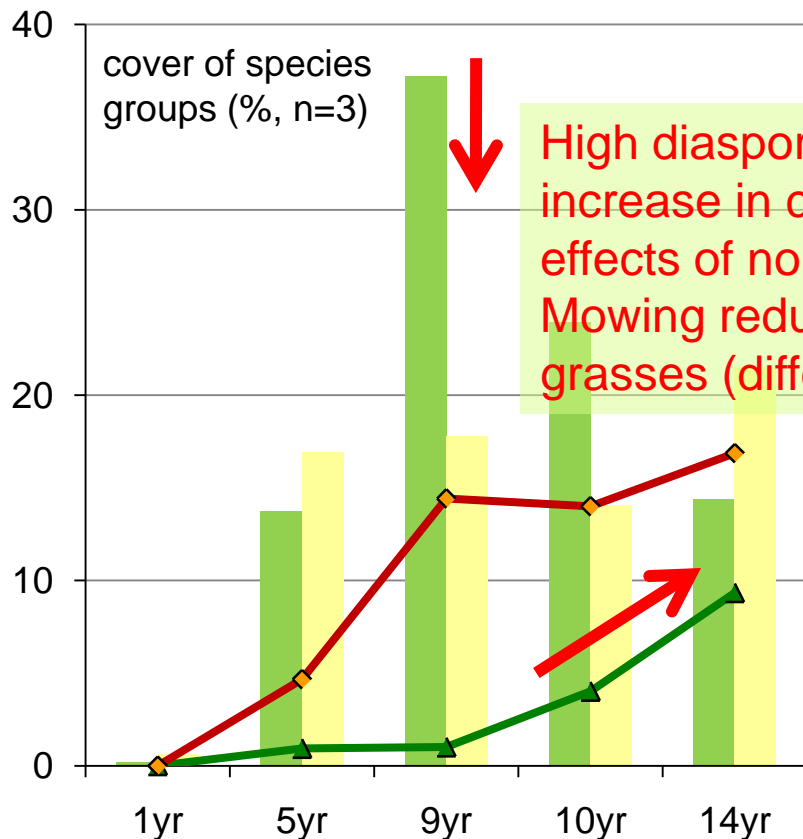


Sowing variant, June 2013



Green hay variant, June 2013

Mining site Roßbach: raw soil, loess, start 9/2000



High diaspore pressure of target forbs led to steady increase in cover and species number; but first comer effects of non-target forbs remained.
Mowing reduced *Calamagrostis* → increase of target grasses (different below-ground growth strategy)

■ non-target grasses (spontaneous) ■ non-target forbs (spontaneous)
▲ target grasses (introduced) ◆ target forbs (introduced)

Immigration rate:
forbs: 15%
grasses: 85 %

Study sites Germany

2. Central German Lignite Mining District: mining site Profen: grassland restoration



high-diversity sowing variant
after 9 years (July 2013)



Complete block design, extension 1.2 ha, 4 variants, 3 repetitions, start: December 2004

(1) sowing of 3 commercial grass cultivars, 10 g /m²

(2) sowing of 51 native grassland species, 2 g/m²



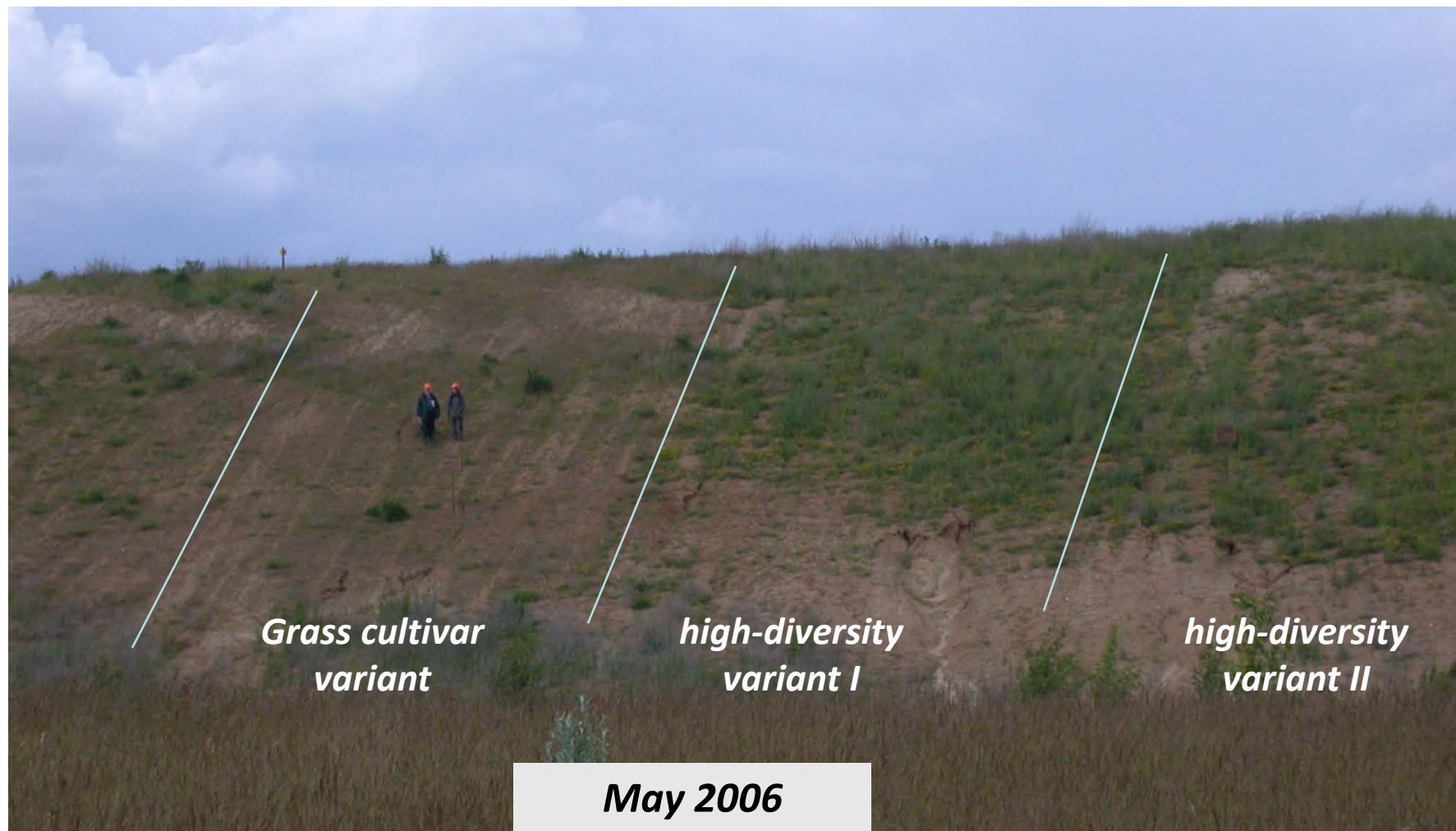
Mining site Profen: grass cultivar matrix, boulder clay/sand, start: 12/2004



Grass cultivar variant, July 2005



Mining site Profen: grass cultivar matrix, boulder clay/sand, start: 12/2004





Mining site Profen: grass cultivar matrix, boulder clay/sand, start: 12/2004





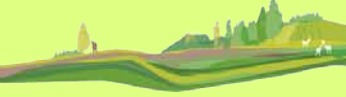
Mining site Profen: grass cultivar matrix, boulder clay/sand, start: 12/2004



Grass cultivar variant, July 2014



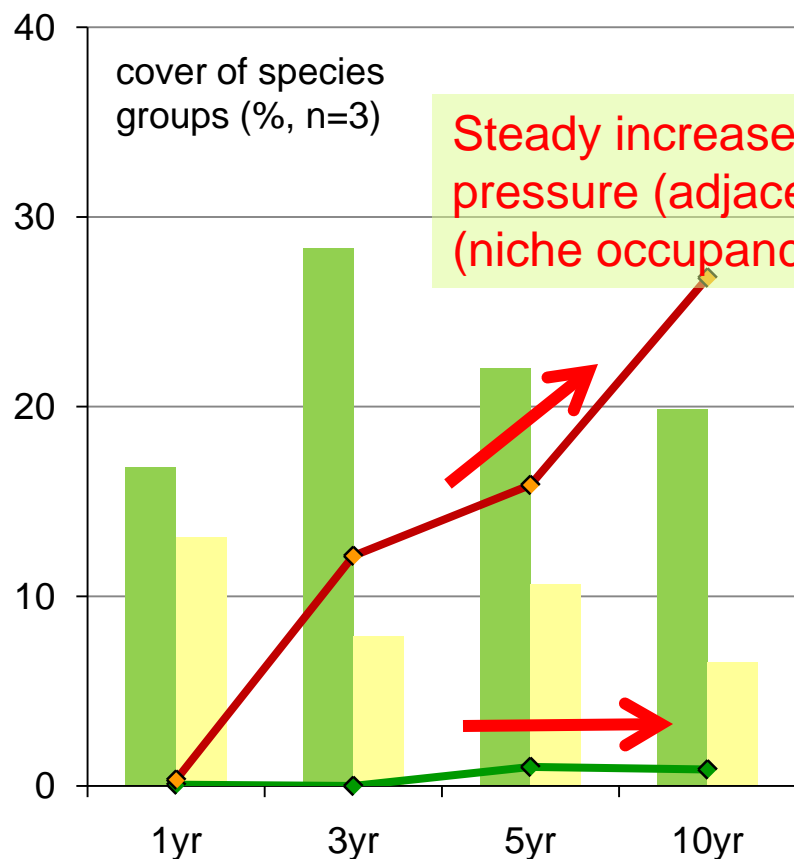
Mining site Profen: grass cultivar matrix, boulder clay/sand, start: 12/2004



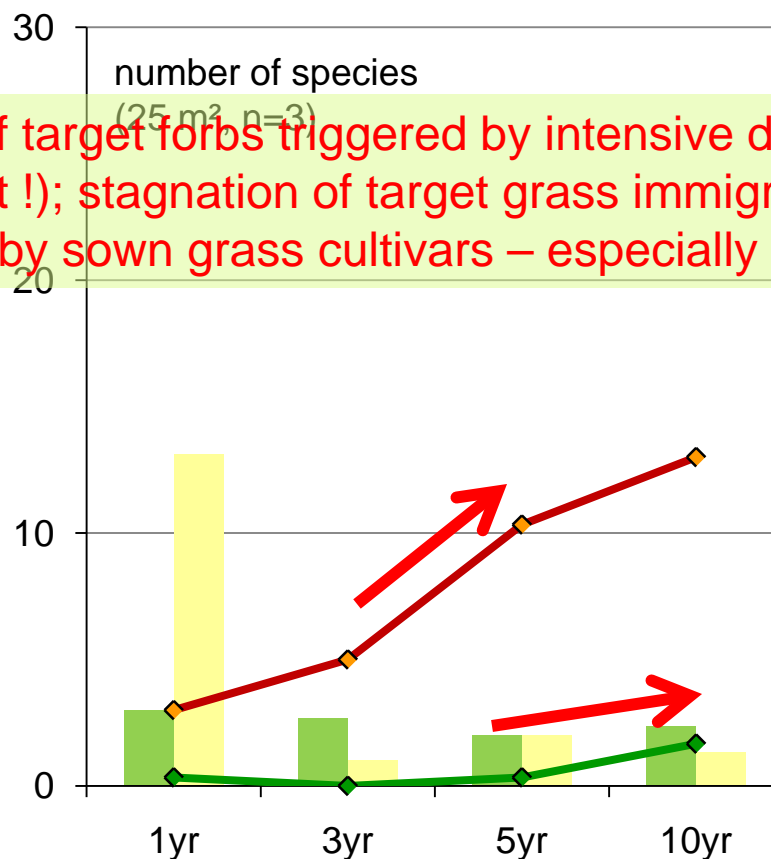
High-diversity variant, July 2013



Mining site Profen: grass cultivar matrix, boulder clay/sand, start: 12/2004



Steady increase of target forbs triggered by intensive diaspore pressure (adjacent !); stagnation of target grass immigration (niche occupancy by sown grass cultivars – especially roots)



■ sown grass cultivars
◆ target grasses (introduced)

■ non-target forbs (spontaneous)
◆ target forbs (introduced)

Immigration rate:
forbs: 33 %
grasses: 15 %



Are introduced species able to migrate into their surroundings?



YES, when seed sources are available: high diaspore pressure leads to a steady increase of the abundance of target species on bare soil sites and on grassy sites with bare soil patches. *Festuca* cultivars hamper establishment of ruderal forbs

BUT:

in a **matrix of *Festuca* cultivars** the establishment and spread of target grasses was delayed due to high competition in the root zone; when target forbs are close by, their number and cover are increasing with ongoing time

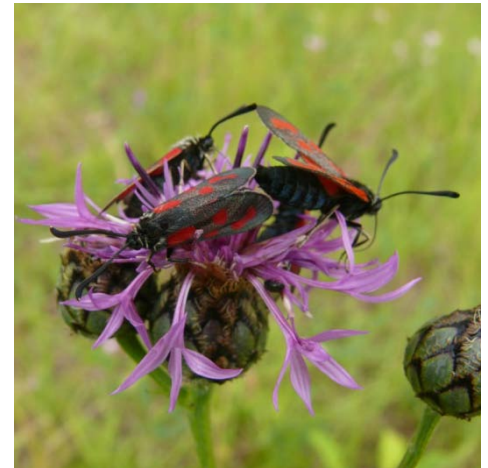
Dense *Calamagrostis epigejos* stands also hamper the establishment of target grasses. If cover of *Calamagrostis* can be decreased by mowing, target grasses can increase in number and cover (in contrast to *Festuca*, competition of *Calamagrostis* is higher above-ground than below-ground)

On bare soil sites, ruderal forbs seem to hamper the establishment of target forbs, most probably due to first comer effects



Conclusions

- on isolated sites – especially when grasses are already present, the spontaneous immigration of target species will be low
- therefore, introduction of native target species, e.g. in so-called establishment windows, is recommended
- species can be introduced with different methods, e.g. sowing, hay transfer, ...
(see Kiehl et al. 2010 *Basic and Applied Ecology* 11:285-299)
- to facilitate the establishment of introduced target species, destruction of the grass sward is recommended



Thank you for your attention!
Questions?

