Grassland Restoration in the White Carpathian Mts.

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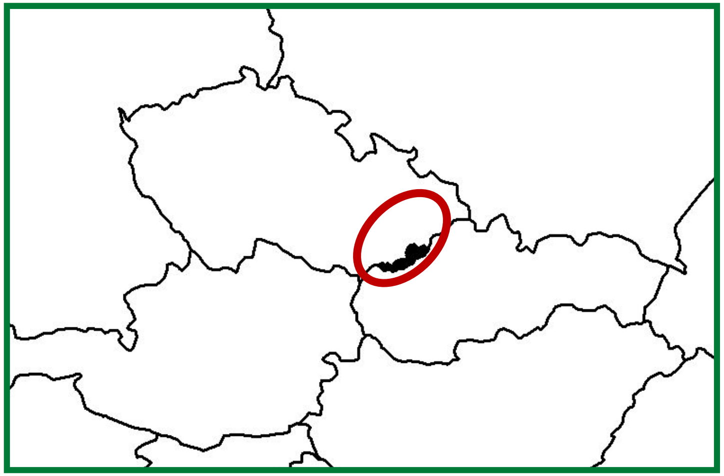
Study area

White Carpathians (Bílé Karpaty)

Protected Landscape Area

Habitat of interest:
Species-rich dry (*Bromion*) grasslands
(over 4,000 ha preserved)



Meadows

Most species-rich communities in the world at small scales

(0.1 / 0.25 / 16 / 25 / 49 m² – Wilson et al. 2012, Chytrý et al. 2015)

Ophrys holoserica subsp. *holubyana*

Traunsteinera globosa

Also called „orchid meadows“

Meadows

Long history
probably continuity from early Holocene forest-steppe

Veratrum nigrum

Pedicularis exaltata

Veronica spuria subsp. *foliosa*

Former management

1950–1989

Thousands of hectares ploughed, fertilised or unmanaged

Current management

1. Regular management of preserved grasslands
2. Restoration of grasslands degraded by former fertilisation
3. Resumption of management at abandoned sites
4. Re-creation of grasslands on arable land

Meadow restoration

Re-creation of grasslands

Re-creation methods

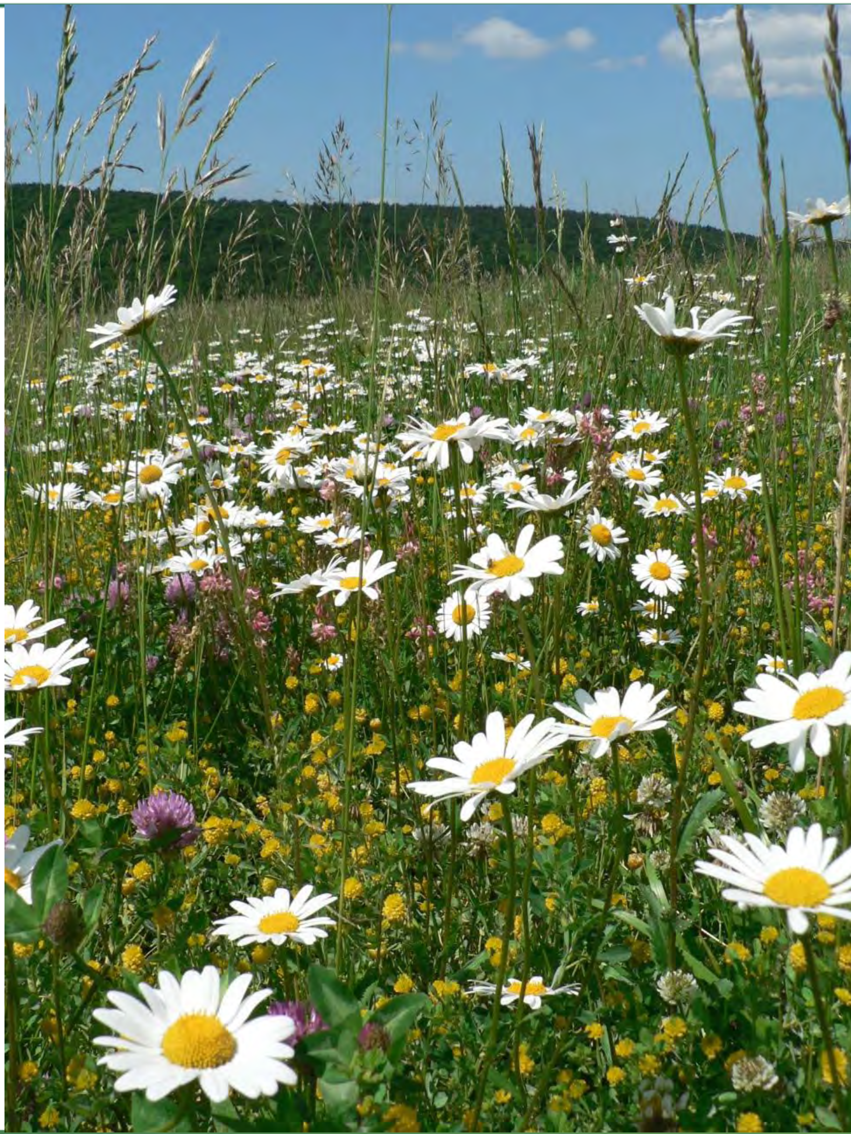
by **spontaneous succession**

with **commercial seed mixtures**

species-poor seed mixture
species-rich seed mixture

with **regional seed mixtures**

green hay
combine harvester
brush harvester
production from seed beds



Spontaneous succession

- **Needs adjacent meadows as seed source**
- **Needs patience**

Prof. Karel Prach

Important tool for ecological restoration

Nová Lhota, 15 years after abandonment

Regional seed mixtures

- More species – higher biodiversity
- Medicinal herbs, legumes
- Higher ecological stability
- Faster colonisation by animals

Composition should respect:

- Phytogeography of species
- Ecological demands of species
- Genetic differences within species

Green hay

Advantages ☺
- low cost method
- short preparation time
- preserves regionality and species richness
- ‘difficult’ species may establish
- no special equipment needed

Disadvantages ☹
- large, local, species rich donor site needed
- timing of harvest difficult
- species composition not guaranteed
- donor sites may be threatened by repeated harvesting

Combine harvester

Advantages ☺

• low cost method
• short preparation time
• preserves regionality and species richness
• ‘difficult’ species may establish
• no special equipment needed
• collects rather clean seed
• less biomass to transport

Disadvantages ☹

• large, local, species rich donor site needed
• limited amount of seed (different ripening times, seed sizes and plant heights)
• problems on slopes and uneven terrain

Brush harvester

Advantages ☺

- similar to Green hay
- less biomass to transport
- harvest several times a year
- hay can still be made

Disadvantages ☹

- large, local, species-rich donor site required
- species composition not guaranteed
- donor sites may be threatened by repeated harvesting

Brush harvester

Production

- Performance = **5** ha/day
  (harvesting for 7 hours)
- Driving speed = 3.8 km/h
- Ratio rough : clean seed = 2 : 1
- Yield of clean dry seed from 1 ha:
  - Vojšice **4.8** kg
  - Zahrady pod Hájem **9.8** kg

Seed beds

Advantages ☺

- standard agricultural techniques
- small plots give plenty of seed
- donor sites can be far away
- seed composition and seed rate under control

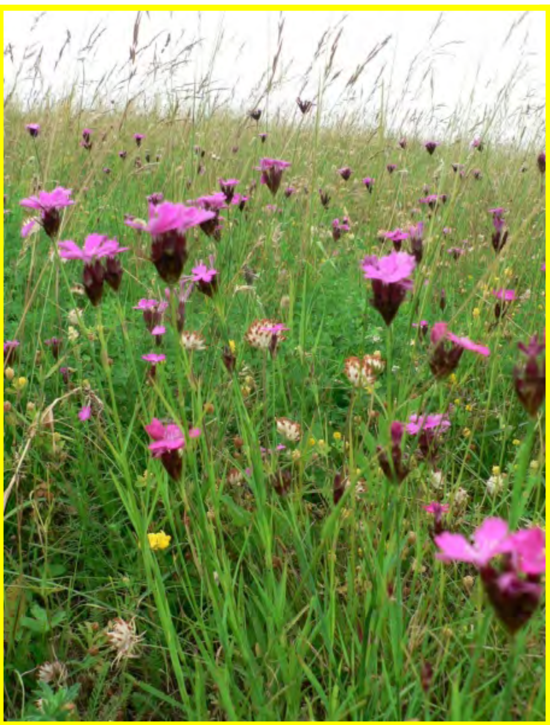
Disadvantages ☹

- higher cost
- more time-consuming
- some species unsuccessful
- knowledge of the biology and ecology of species required
- need to renew gene pool regularly

Grassland re-creation in practice

„Regrassed“ since 1990: ± 7,000 ha

- by **spontaneous succession** (5%)
- with species-poor **commercial seed mixtures** (88%)
- with species-rich **regional seed mixtures** (7% = 600 ha since 1999)



Regional seed mixture

85–90% grasses

10–15% forbs

(20–25 species)

weight percentage

2 g/m²

Jongepierová I. & Prach K. (2014): Grassland Restoration in the Czech Republic.
In: Kiehl K. et al. (eds): Guidelines for native seed production and grassland restoration

Species composition of mixtures

85–90 % **grasses**
mix from brush harvester

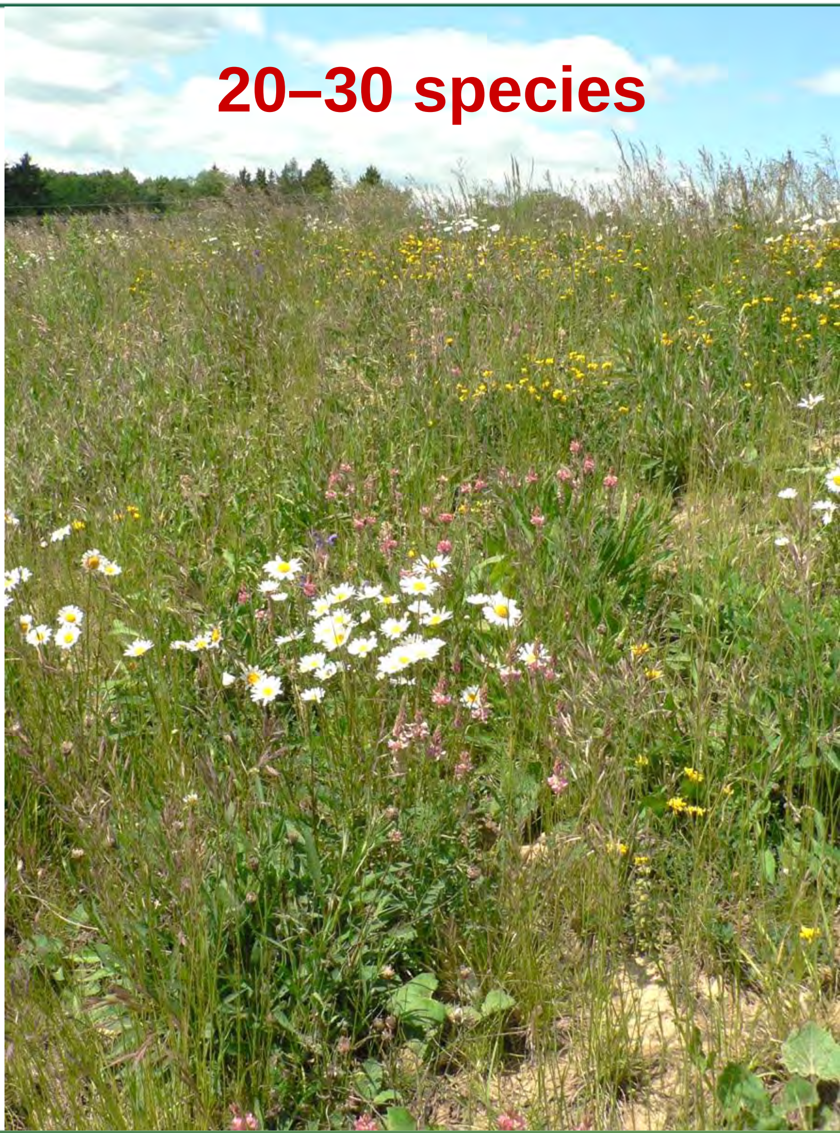
Bromus erectus, Festuca rupicola, Briza media

3–5 % **legumes**

Anthyllis vulneraria, Astragalus cicer, Dorycnium herbaceum, Lathyrus latifolius, Trifolium rubens, Onobrychis viciifolia

7–10 % **herbs**

Betonica officinalis, Campanula glomerata, Centaurea jacea, Centaurea scabiosa, Dianthus carthusianorum, Filipendula vulgaris, Galium verum, Hypericum perforatum, Prunella vulgaris, Salvia pratensis, Salvia verticillata, etc.



Sowing

Superficially! Then rolling.

Optimum seed rate 17–20 kg/ha

- Sown with or without a cover crop
- Sowing time: April and May (or autumn)

Management after sowing

Mowing

necessary, especially in early stages for weed control (2x)

- Early cut (June) reduces grasses and encourages herbs.
- Late cut (September) encourages grasses and reduces herbs.

Landscape restoration

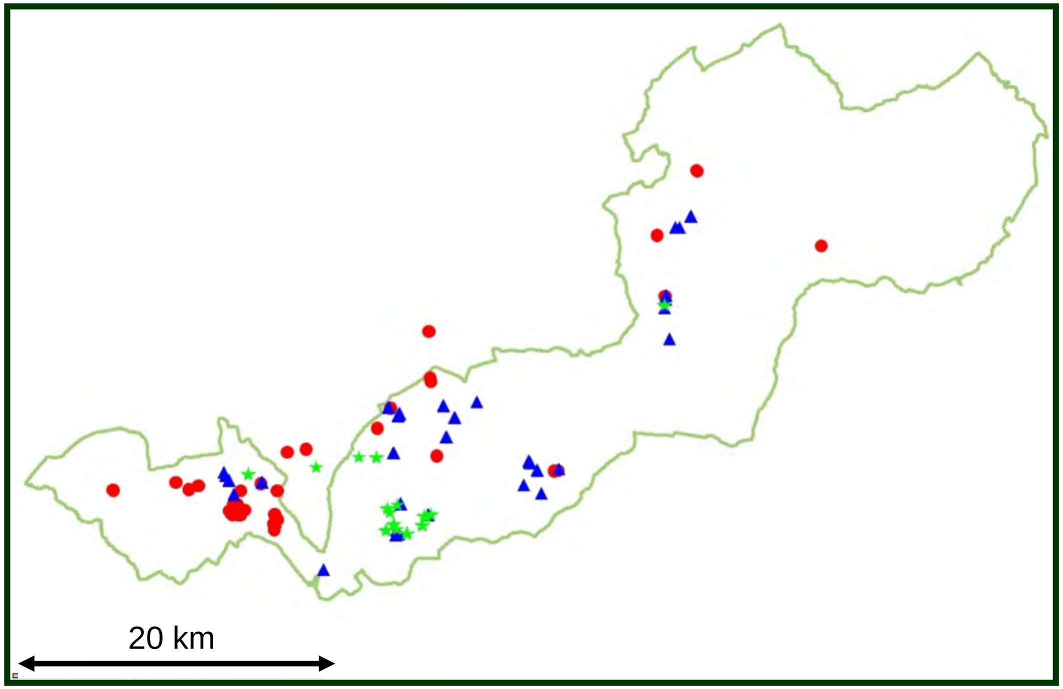
Planting of solitary trees

Monitoring

Scientific research at re-created sites

Methods

3 relevés per site, plots 5 x 5 m; 2009–2013



82 regrassed sites

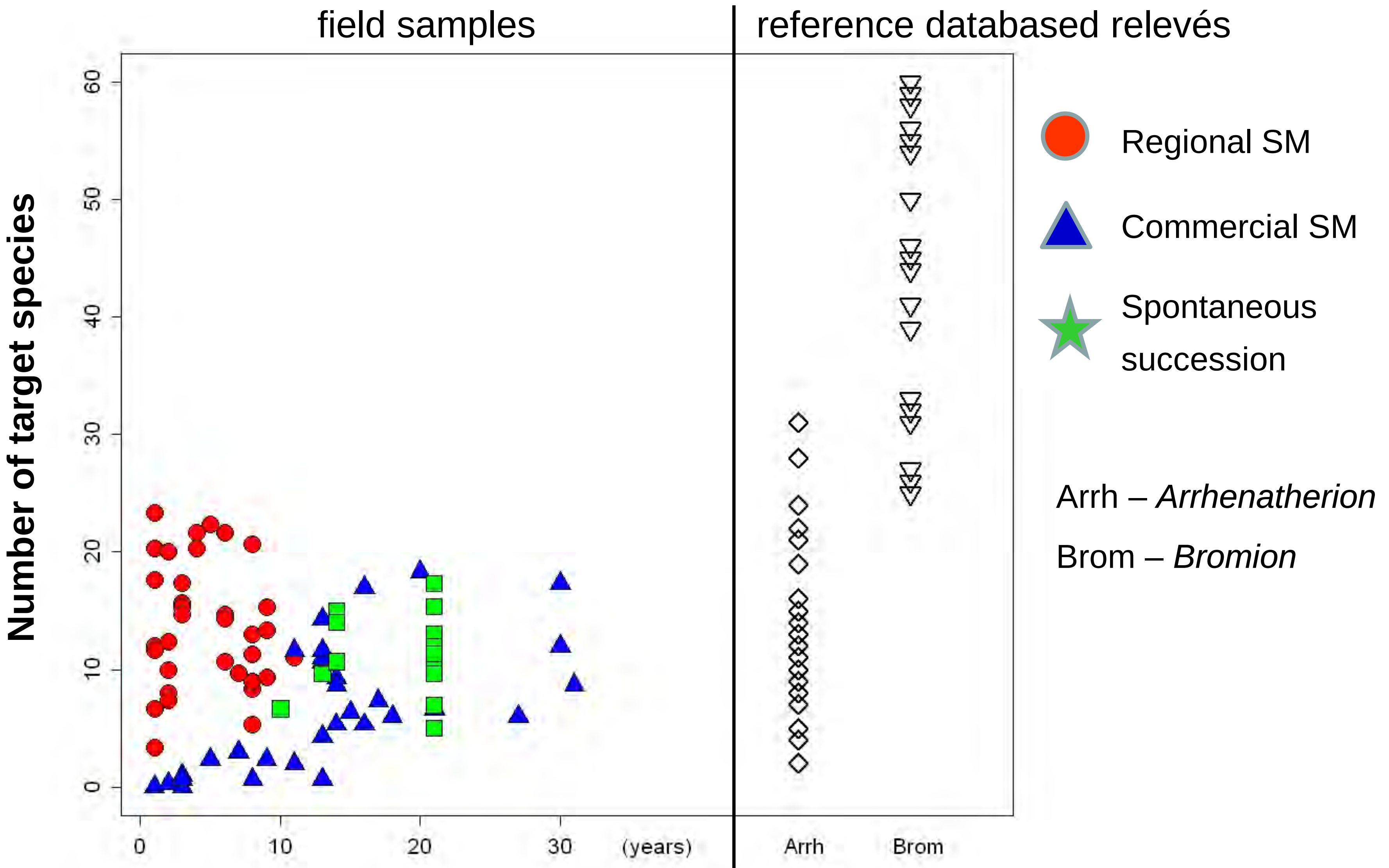
23 permanent grasslands

+ 25 reference relevés
(Czech National Phyto-sociological Database)

●	Regional seed mixture:	35 sites
▲	Commercial seed mixture:	31 sites
★	Spontaneous succession:	16 sites

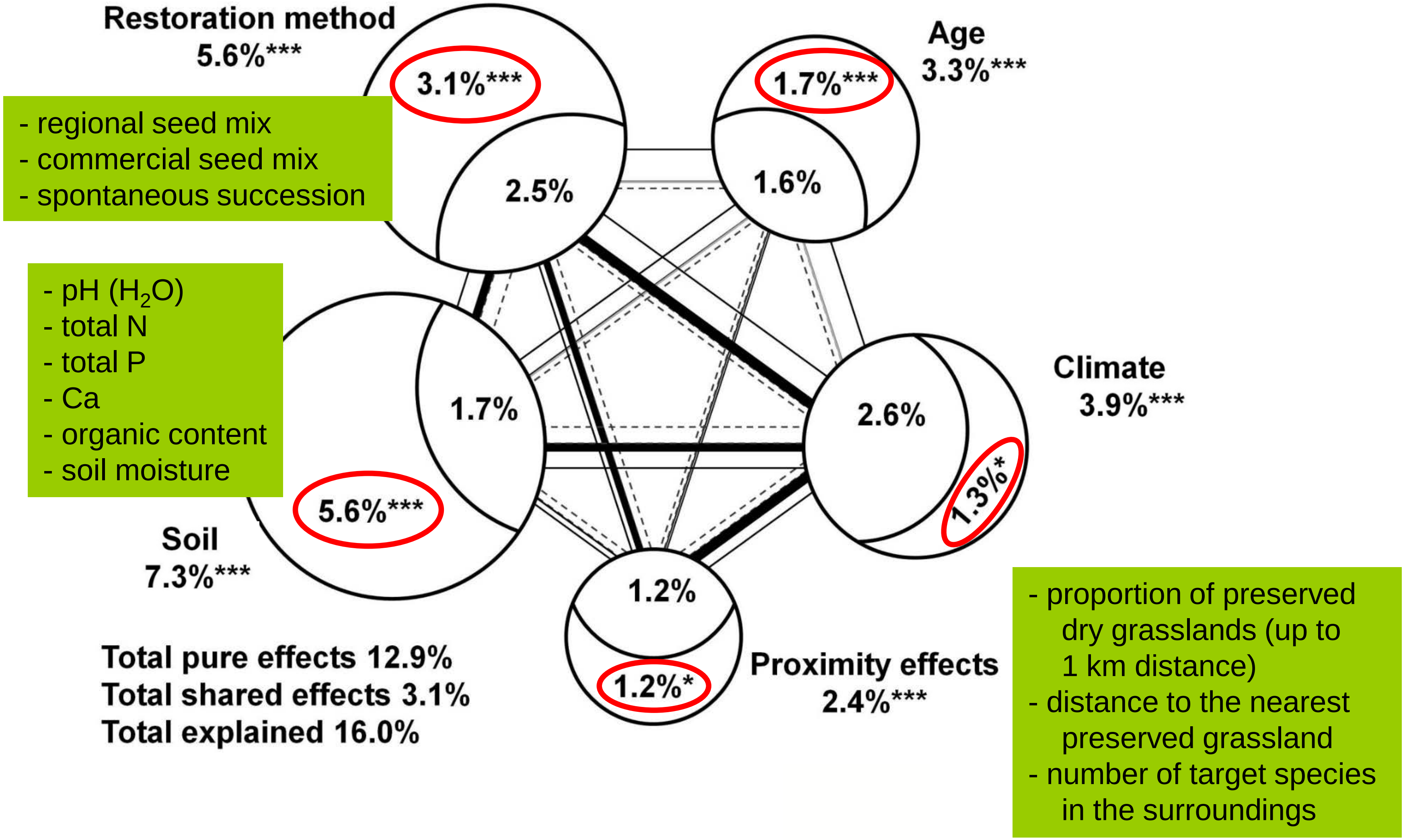
Target species

in total 151 target species, icluding 43 sown ones



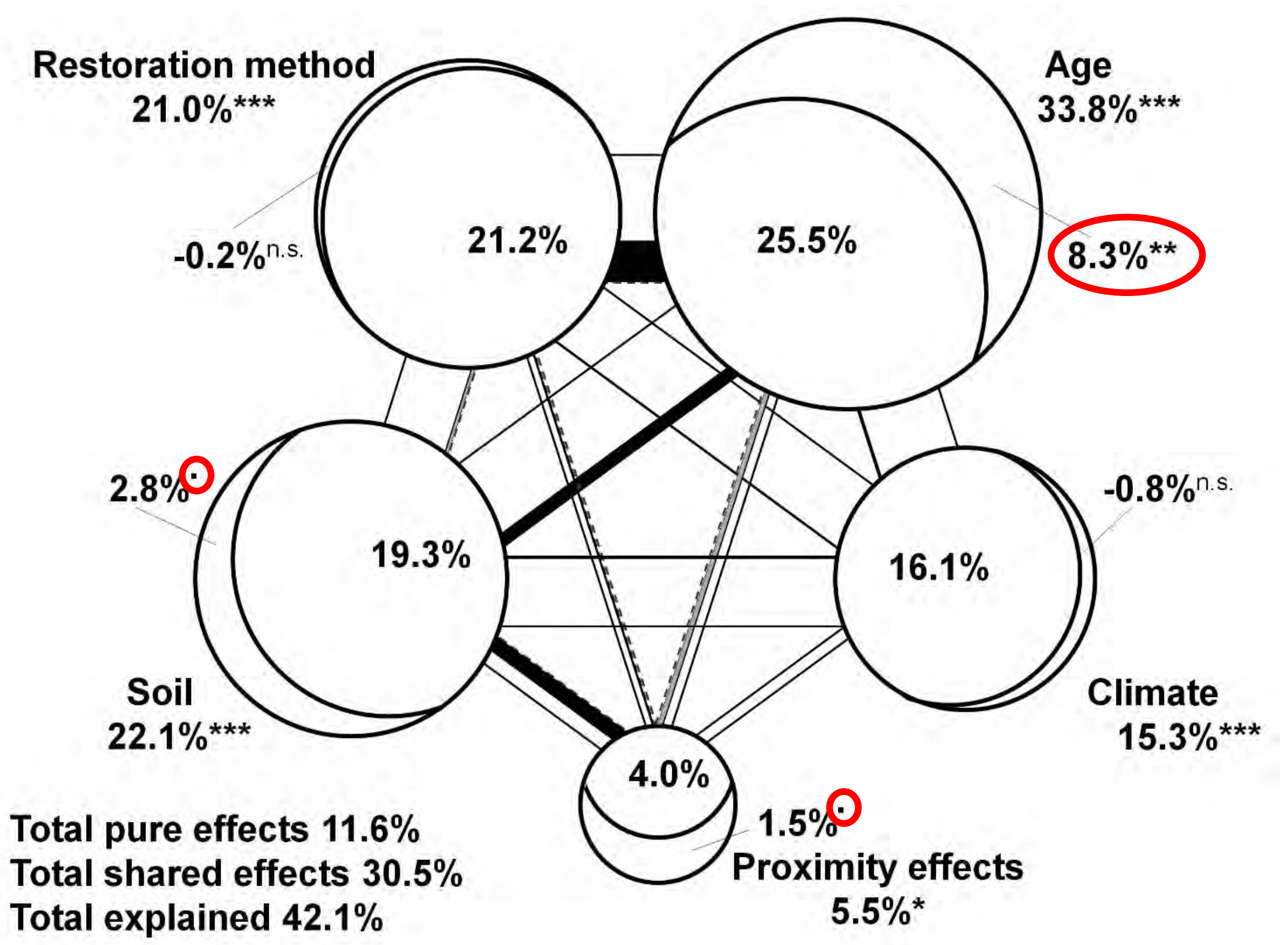
Sites restored in various ways | permanent grasslands

General vegetation pattern



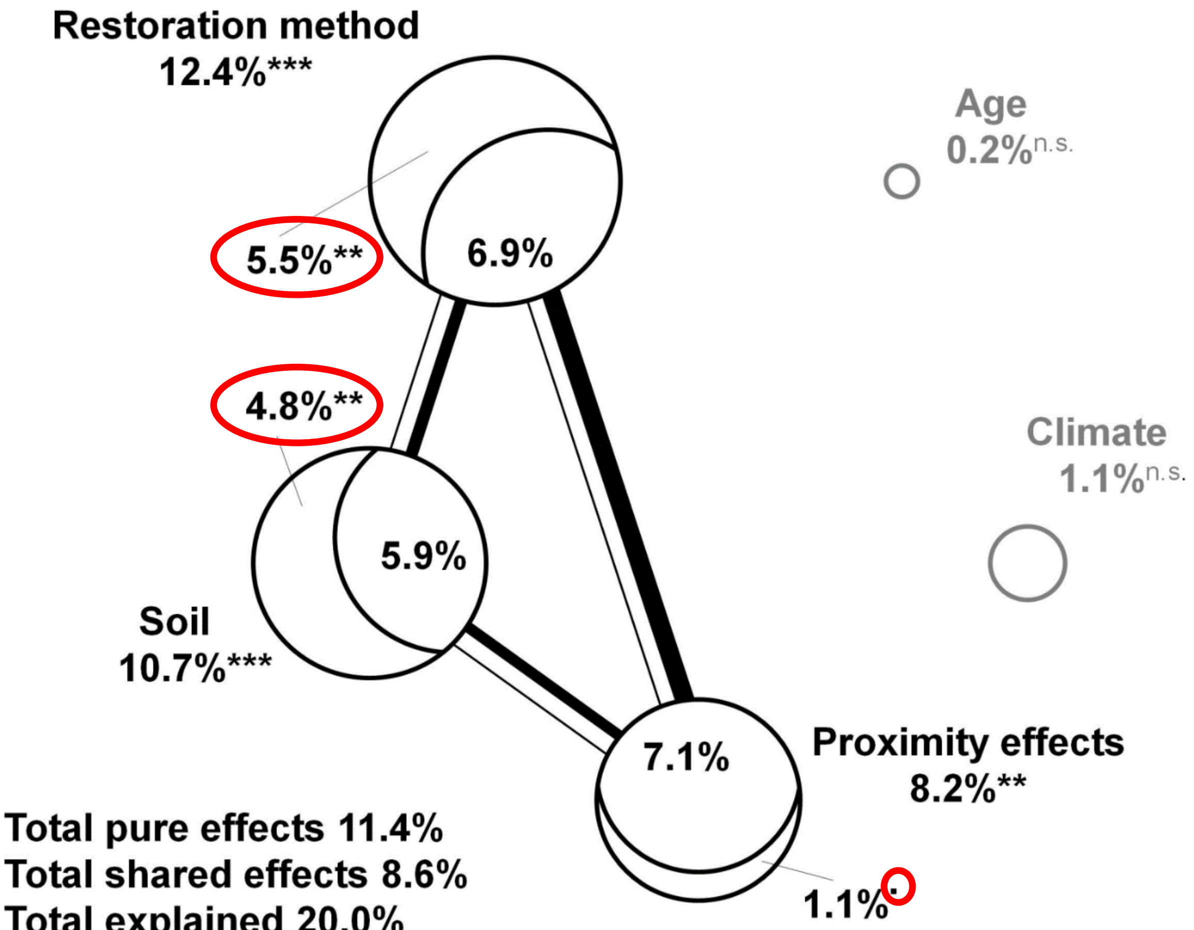
Variation partitioning (CCA)

Number of spontaneously colonizing target species



Deviance partitioning (GLM, Poisson distribution)

Similarity to permanent meadows
(Bray-Curtis similarity)



Total pure effects 11.4%
Total shared effects 8.6%
Total explained 20.0%

Deviance partitioning (GLM, Gamma distribution)

Conclusions

- Using regional seed mixtures is the best method regarding similarity to target grasslands (some target species are sown).
- Spontaneous colonisation is effective in the close vicinity of reference sites, but slower; dominant effect on the colonisation by unsown target species has **time** (in all grassland re-creation methods).
- In grassland restoration projects, **soil characteristics** are the most important factors impacting general vegetation pattern, at the same time having effect also on the restoration success (similarity to reference meadows and, marginally, number of colonising target species).
- **Landscape context (proximity effects)** has rather smaller effect, however should be also taken into account.

Colonisation of animals

at 17 sites (regional seed mix 4, commercial seed mix 4, spontaneous succession 4, permanent grassland 5)

Auchenorrhyncha (87 species)
Heteroptera (96 species)
Phytophagous beetles (175 species)

α-diversity of re-created meadows similar to permanent ones, but with different species.

rare xerothermic species

Neophilaenus infumatus

Lepidoptera (76 species) – poor communities, need more time and more structured vegetation (shrubs, trees).

Zygaena viciae

Turquoise Blue population

Anthyllis vulneraria

Polyommatus dorylas

References

- **Jongepierová et al. 2007** (Biological Conservation)
- **Mitchley et al. 2012** (Applied Vegetation Science)
- **Prach et al. 2013** (Restoration Ecology)
- **Johanedisová et al. 2014** (Grass and Forage Science)
- **Prach et al. 2014** (Agriculture, Ecosystems and Environment)
- **Prach et al**. **2015** (Applied Vegetation Science)
- **Mudrák et al. 2018** (Restoration Ecology)
- **Albert et al. 2018 (**Agriculture, Ecosystems and Environment)

Acknowledgements

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