Naturalness indicator values as a tool for estimating success in grassland restoration

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13$^{th}$ Eurasian Grassland Conference
Management, conservation and restoration of semi-natural grasslands
21$^{st}$ Sept. 2016
Semi-natural grassland communities are highly threatened hotspots of biodiversity!

example: *Cirsietum rivularis* Nowinski 1928 in the Lafnitz-valley (SE-Austria)

~ 40 vascular plant species / 16 m²

(Sengl & al. submitted)
Restoration ecology gains priority to compensate for land degradation and stop the decrease of biodiversity.

**provincial legislation**
- Styrian law on nature conservation

**federal legislation**
- Austrian law on environmental impact assessment

**European legislation**
- Fauna-flora-habitats-guideline

**international agreements**
- UN – Convention on Biological Diversity (CBD 2010)

➢ crucial question: is my restoration project successful???
introduction

- measuring restoration success:

  - ordination diagrams
    - DCA; PCA, NMDS

  - species richness
    - (total number of species)
    - number of target species
    - number of protected or Red-List-species

  - similarity indices
    - Soerensen; Jaccard; FPFI

  - diversity indices
    - Shannon; Evenness; Simpson

practicality depends on a comparison with reference vegetation!
do not take species composition into account!
study question

Are naturalness indicators proper alternatives to evaluate restoration success independently from reference sites?

ecological indicators are frequently used to gain information on site parameters:

classical indicators (lt. Ellenberg 1991):

- light (L)
- moisture (F)
- soil nutrient content (N)
- soil reaction (R)
- continentality (K)

naturalness indicators provide information on habitats naturalness or habitat degradation

naturalness indicators (-3 to 6):

6  (plants indicating natural conditions, climax vegetation)
4  (typical species of semi-natural grasslands)
-3 (indicator species of highly degraded habitats, including invasive alien species)

we calculated two indices:

- *Naturalness-Index (NN)*
  (naturalness indicators calculated as unweighted averages per plot)

- *Modified Naturalness-Index (SpN × NN)*
  (unweighted averages of naturalness indicators × species richness)
case study: comparison of various techniques for the restoration of lowland meadows

projekt A: compensation measures for a new motorway

projekt B: compensation in order of land consolidation

Location of study areas A (47°03’N, 16°04’E, 280 m a.s.l) and B (46°43’N, 15°56’E, 230 m a.s.l.) in the South Eastern Alpine Foreland of Austria.
material

„sod transplantation“ „natural colonization“ „hay transfer“ „2 seeding techniques“
methods

- sampling
  - Braun-Blanquet approach
  - several sites per treatment
  - three consecutive years

- several *classical* indices to assess restoration success

- naturalness-based indices to assess restoration success

Indices for estimating restoration success

- Species (N)
- Target Species (N)
- Diversity (Shannon Index)
- Similarity (FPFI)
- Naturalness (NN)
- Modified Naturalness (SpN × NN)

classical indices

- sod transplantation
- hay transfer
- natural colonization
- seeding 'wet meadow' mix
- seeding 'bare soil' mix

Restoration success along a three years chronosequence as a consequence of different restoration methods. Tests for significance: Kruskal-Wallis-H; Mann-Whitney-U.
results

comparison of classical and naturalness-based indices

(1) Naturalness Index

(2) Modified Naturalness Index

Restoration success along a three years chronosequence as a consequence of different restoration methods. Tests for significance: Kruskal-Wallis-H; Mann-Whitney-U.
results

correlation analysis:
naturalness-based indices vs. classical indices

Correlation among indices of restoration success. Numbers indicate Spearman’s correlation coefficient (rs). Significance is indicated by asterisks (*: P < 0.05).

→ the Modified Naturalness Index provides similar information as compared with the number of target species and floristic similarity to reference sites
why to use naturalness indices?
- often reference sites are scarce or not available
- definition of a pool of target species is „artificial“
- restoration sites may differ from reference sites in abiotic site condition

advantages:
- independent of predefined targets
- robust against differences in abiotic conditions
- naturalness considers arable weeds and alien species

disadvantages:
- weakens the need for state-of-the-art restoration?!
- does not consider aspects of species conservation?!
conclusions

- so,…

- if available, reference sites should be considered, but if they are not, naturalness indicators provide valuable alternatives!

- naturalness scores need to be defined & adjusted for biogeographic regions

- naturalness indicators should be combined with species-richness

- typical SpN×NN scores should be defined for several vegetation types
## Acknowledgement

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