

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

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Management, conservation and restoration of semi-natural grasslands

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## *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 m<sup>2</sup>

(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**

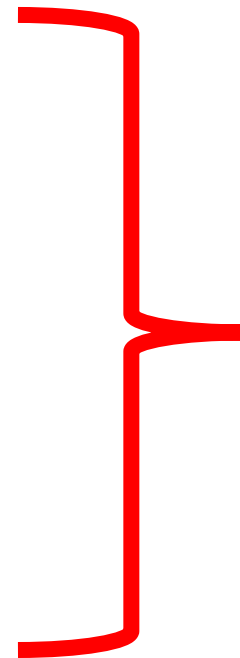
- Austrian law on environmental impact assessment

### **European legislation**

- Fauna-flora-habitats-guideline

### **international agreements**

- UN – Convention on Biological Diversity (CBD 2010)



- conservation of (near) natural habitats
- restoration of degraded habitats
- compensation for habitat degradation

➤ **crucial question: is my restoration project successful???**

## ➤ 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

**practicality depends on a comparison  
with reference vegetation!**

### similarity indices

- Soerensen; Jaccard; FPF1

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### diversity indices

- Shannon; Evenness; Simpson

**do not take species composition into  
account!**

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**

**BORHIDI (1995):** Social behaviour types, the naturalness and relative ecological indicator values of the higher Plants in the Hungarian Flora. *Acta Botanica Hungarica* 39.



# study question

## naturalness indicators (-3 to 6):

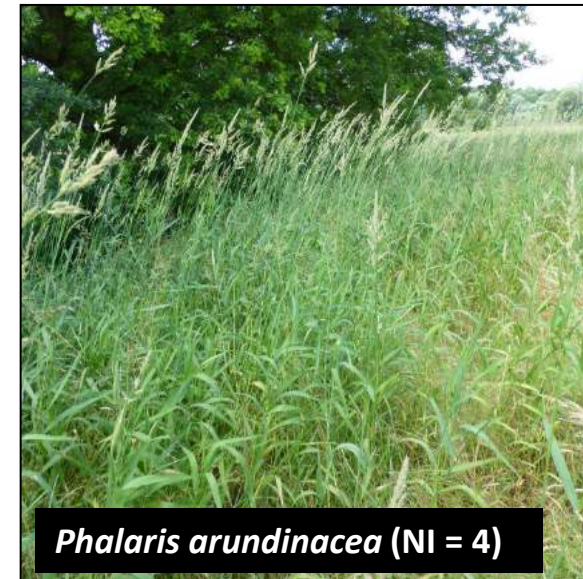
- 6 (plants indicating natural conditions, climax vegetation)
- 4 (typical species of semi-natural grasslands)
- 3 (indicator species of highly degraded habitats, including invasive alien species)



we calculated two indices:

- **Naturalness-Index (NN)**  
(naturalness indicators calculated as unweighted averages per plot)
- **Modified Naturalness-Index ( $SpN \times NN$ )**  
(unweighted averages of naturalness indicators  $\times$  species richness)

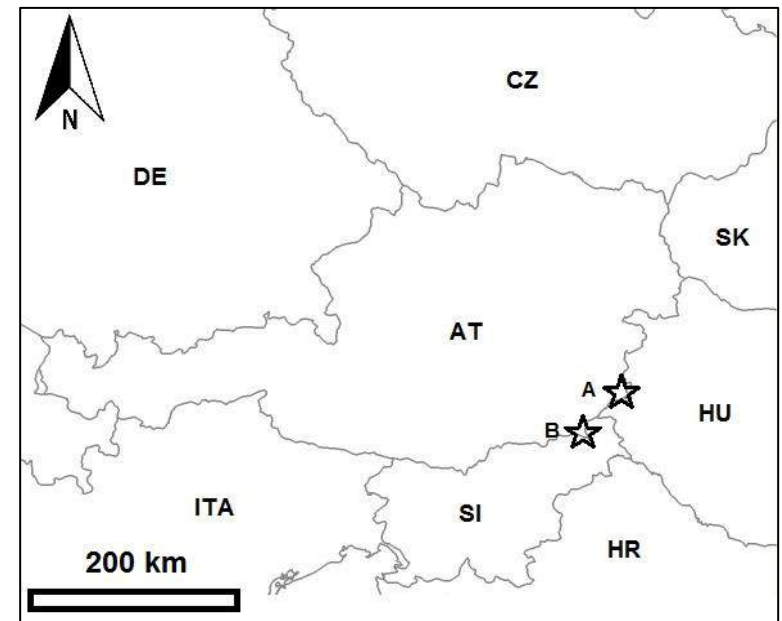
SENGL, MAGNES, WAGNER, WEITENTHALER, ERDÖS & BERG (submitted)



**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“

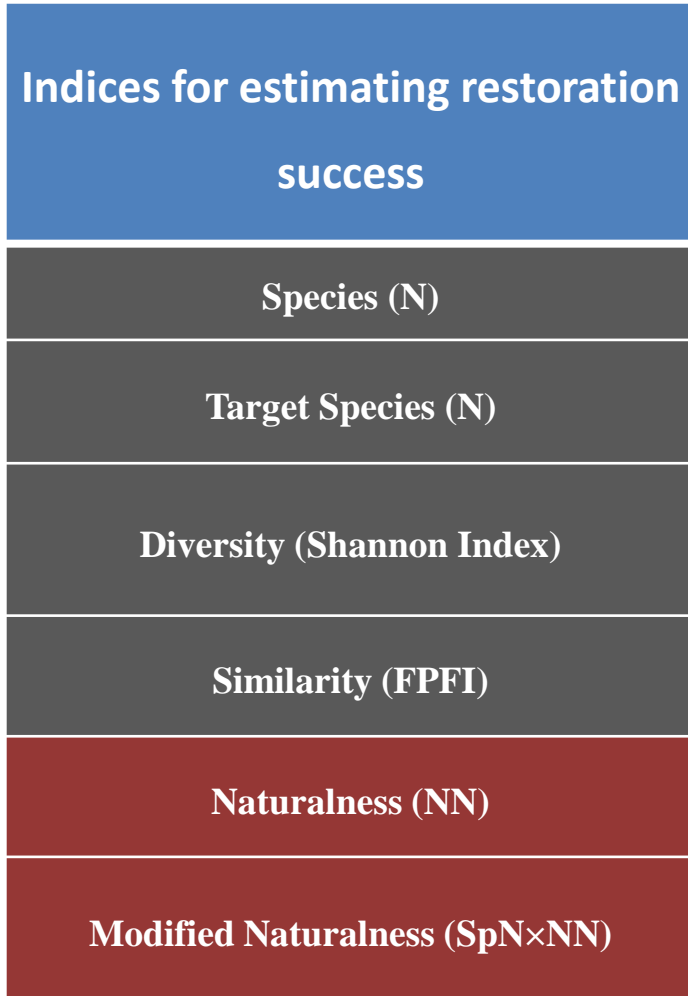
## „hay transfer“

## „2 seeding techniques“



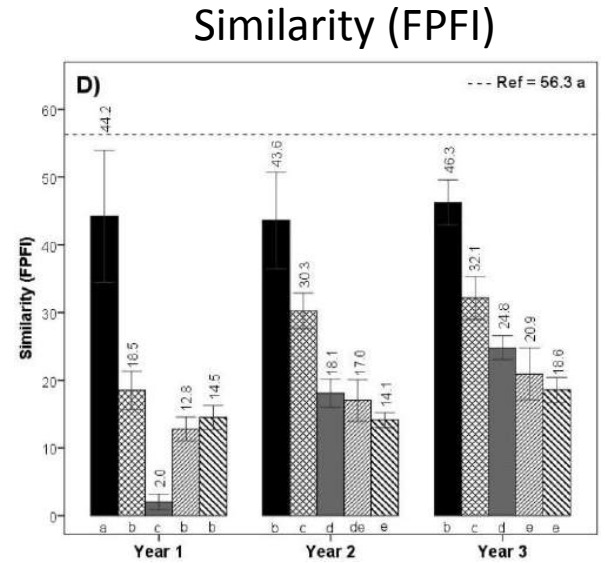
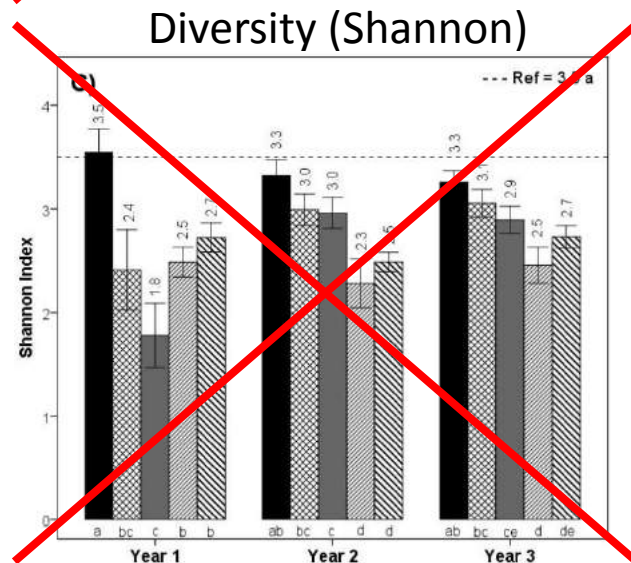
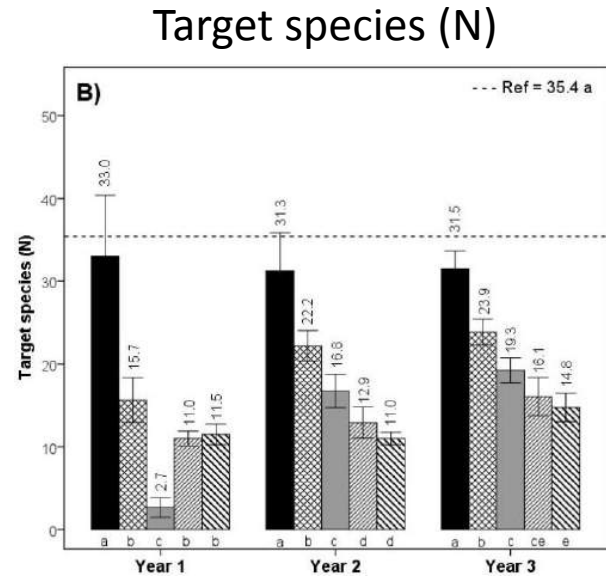
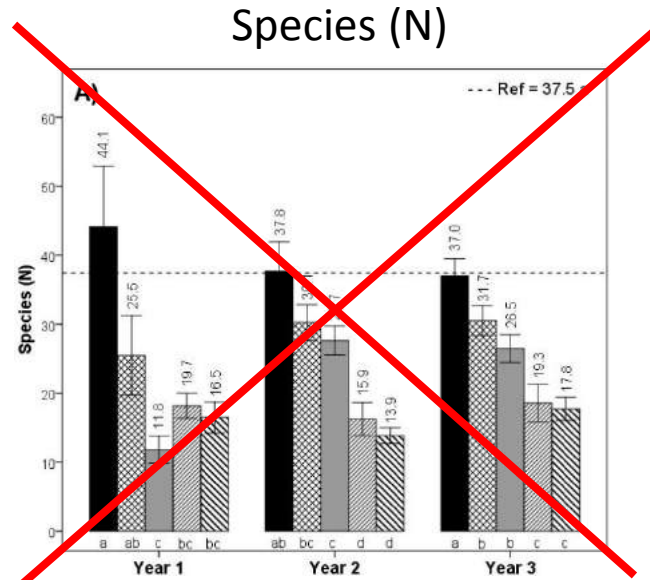


- sampling
  - Braun-Blanquet approach
  - several sites per treatment
  - three consecutive years
- several **„classical“** indices to assess restoration success
- **naturalness-based indices** to assess restoration success



# results

classical indices



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

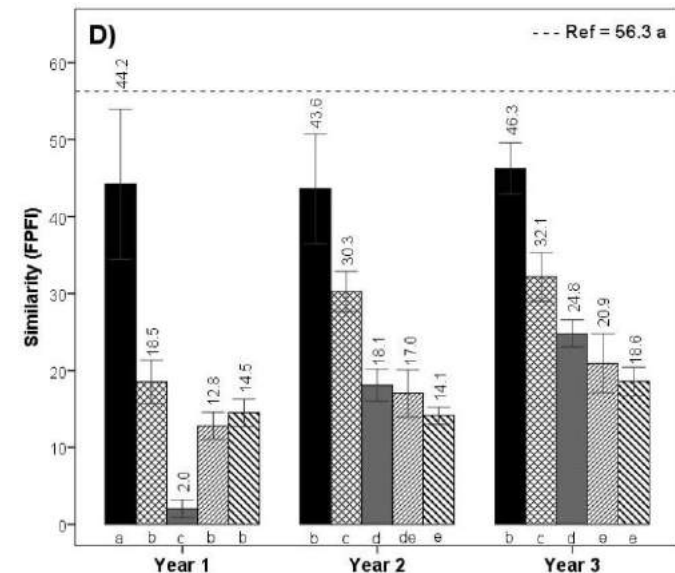
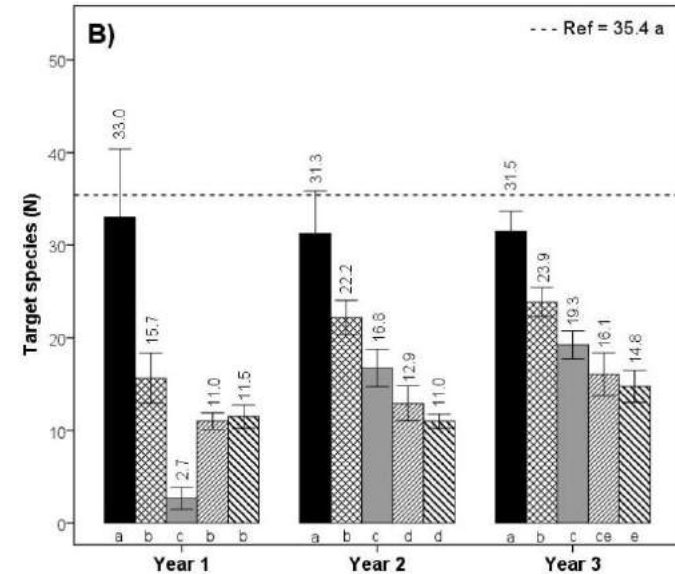
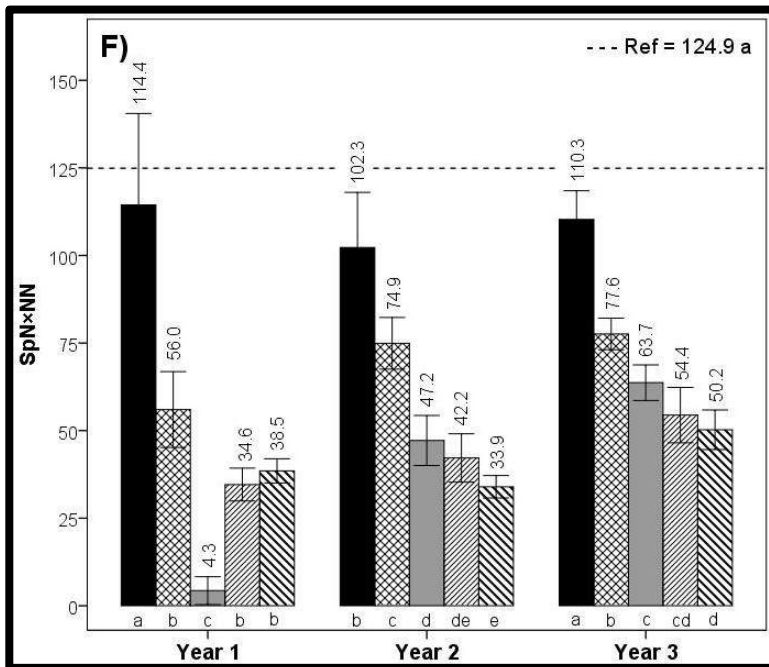
Restoration success along a three years chronosequence as a consequence of different restoration methods. Tests for significance: Kruskal-Wallis-H; Mann-Whitney-U.

# results

comparison of classical and naturalness-based indices

(1) Naturalness Index

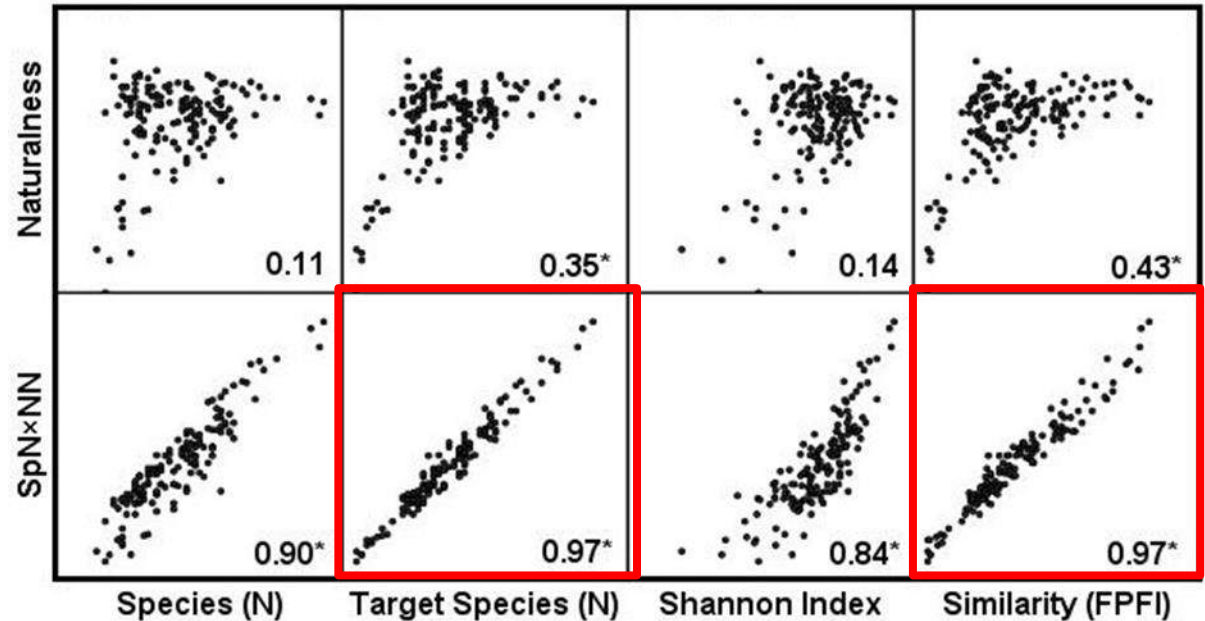
(2) Modified Naturalness Index



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

## 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?!

## ❖ 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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