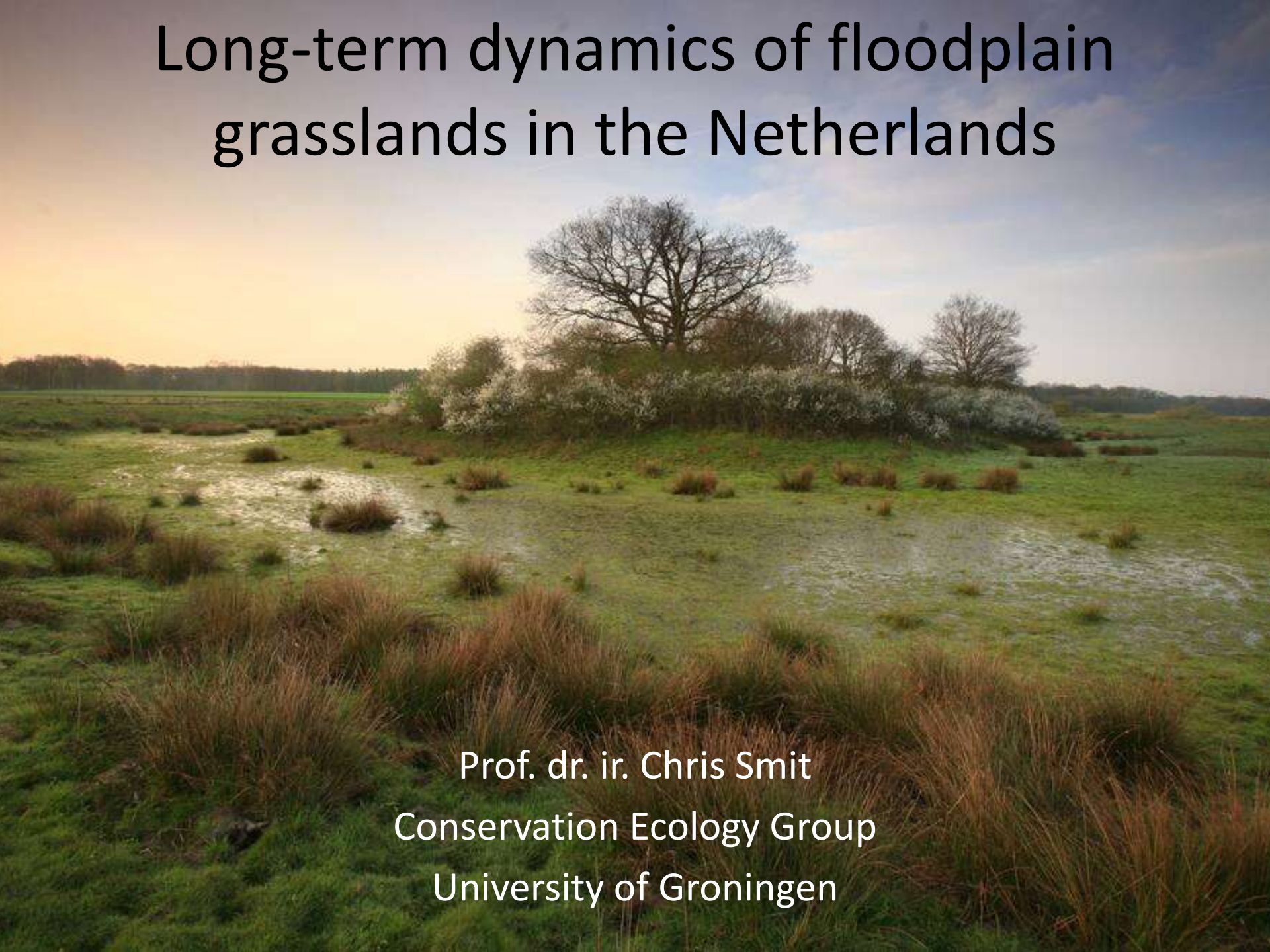
Long-term dynamics of floodplain grasslands in the Netherlands



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Three case studies

- Junner Koeland

- Drentsche Aa

- ‘Large river’ floodplain grasslands

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Floodplain grasslands Junner Koeland

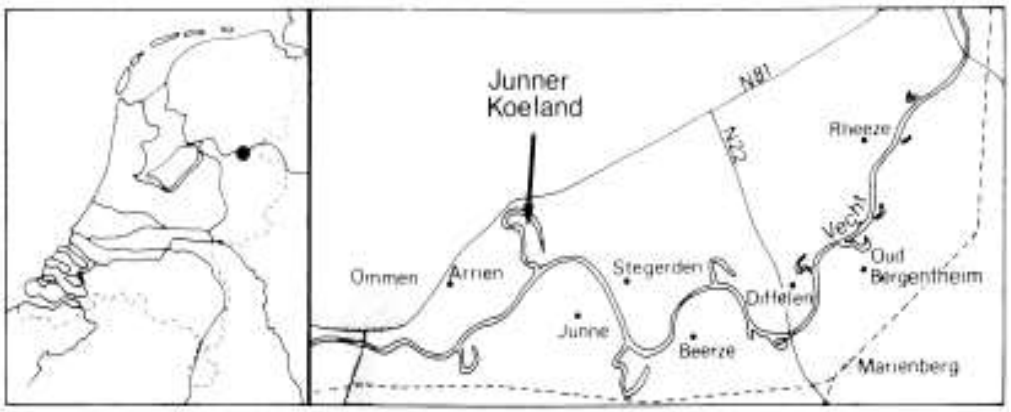

Figure 1.1 Location of Junner Koeland in The Netherlands. The floodplain grassland of Junner Koeland lies within an old oxbow of the river Overijsselse Vecht. From Bokdam (1987).


Veronica longifolia


Dianthus deltoides


Mentha pulicum


Thymus pulegioides


Inula britannica


Carex caryoplyllea

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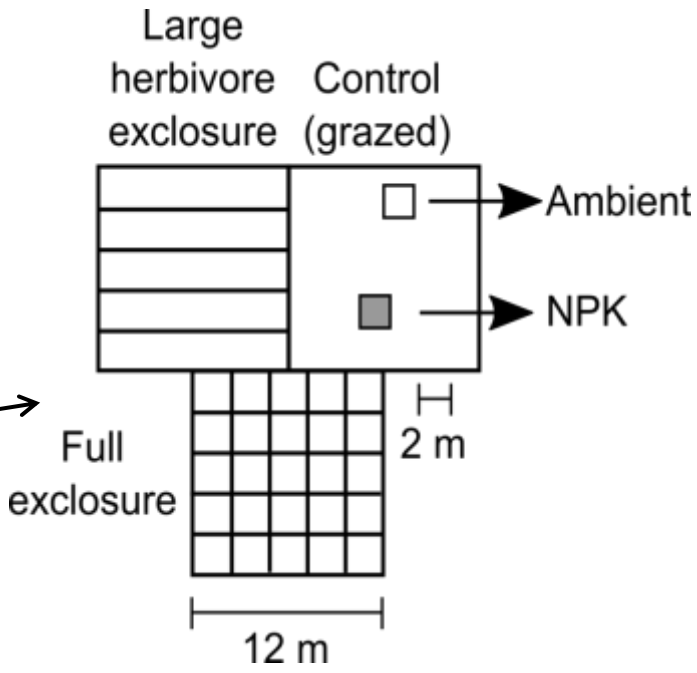
Experimental set-up (1994)



- 5 blocks, 60 plots (2x2m), plant cover (Londo scale)
- 3 grazing treatments (control, cattle+rabbit, rabbit)
- 2 nutrient treatments (+/- NPK)

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Research questions

- Plant community regulated by bottom-up (nutrients) or top-down (herbivory) processes?
- How do these determine relative importance of stochastic and deterministic processes?

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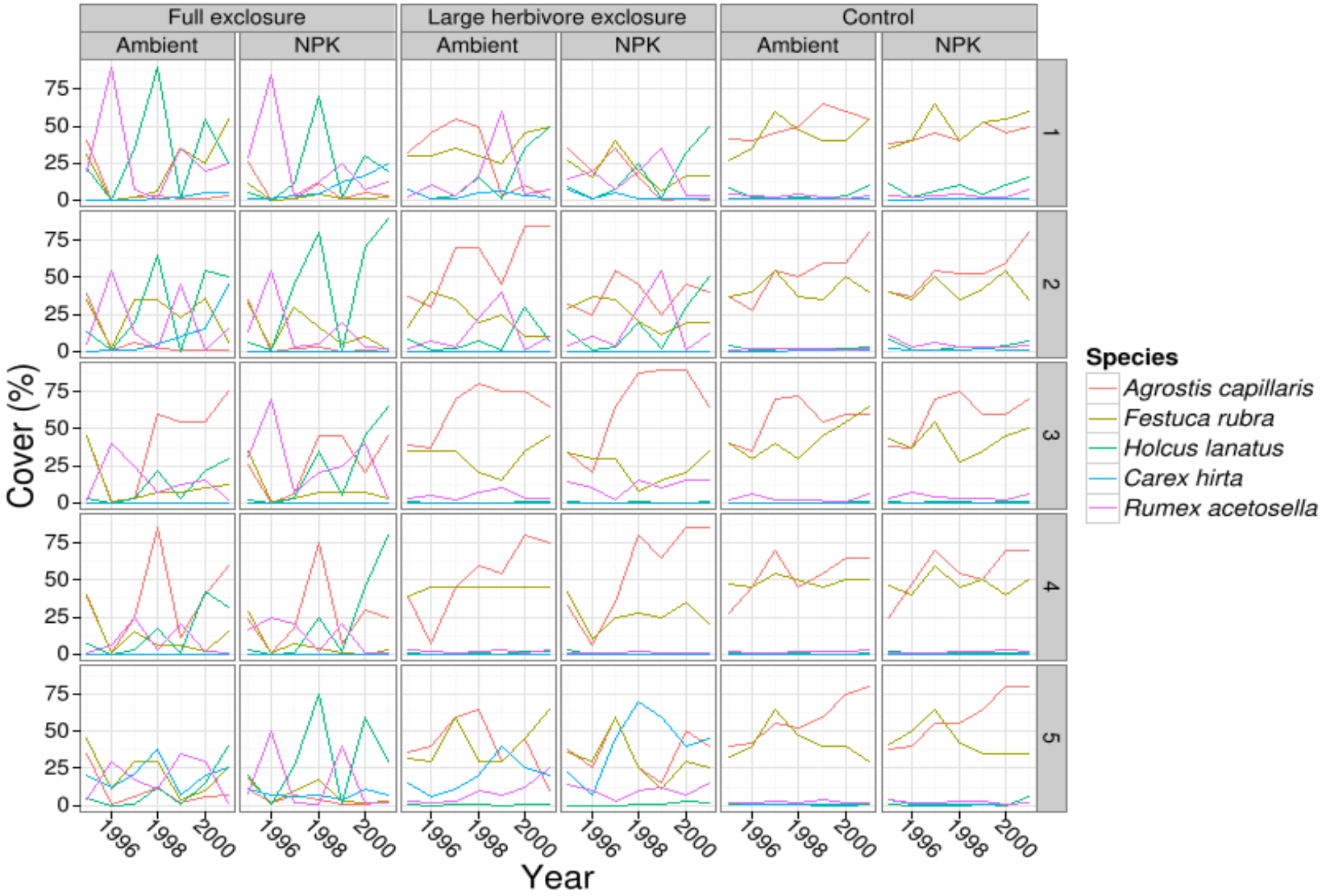
Herbivores stabilize community



Alberti et al 2017 (Ecology)

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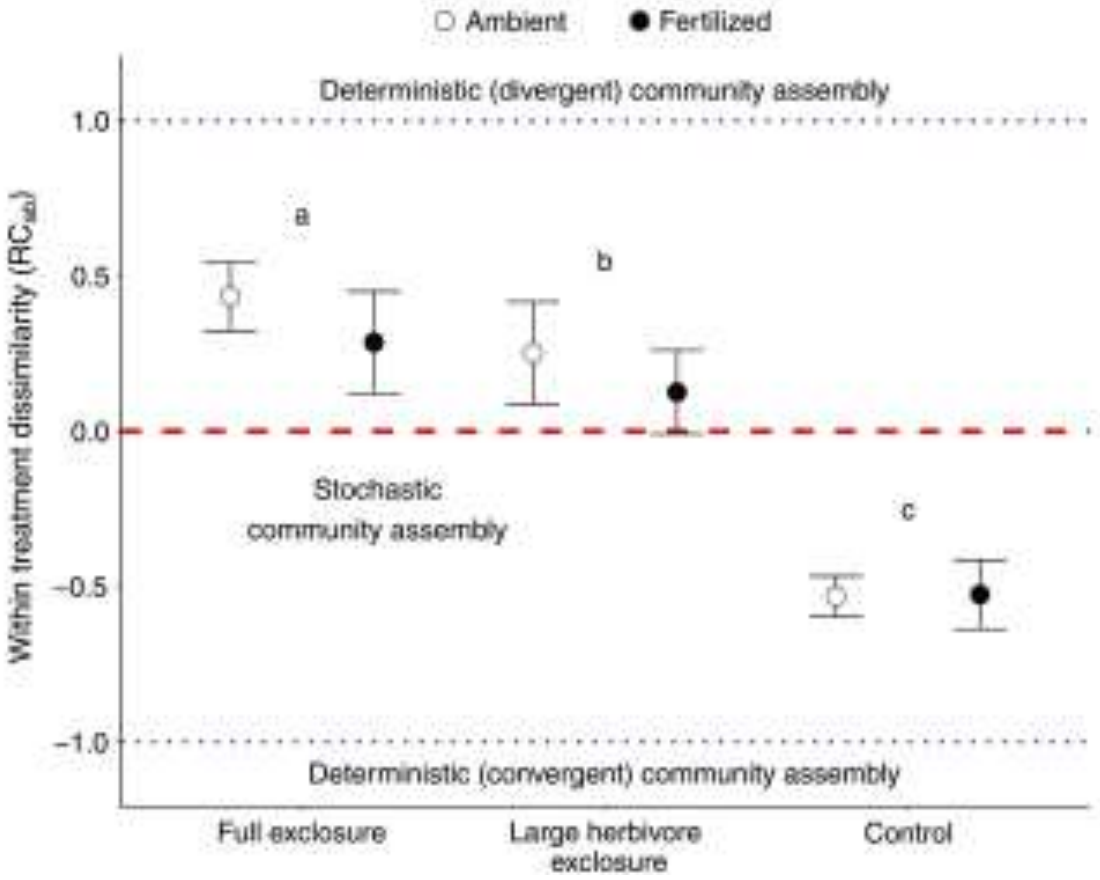
Herbivores promote more deterministic community assembly



Alberti et al 2017 (Ecology)

FIG. 2. Within-treatment dissimilarity (mean ± SE) according to a modified Raup-Crick dissimilarity metric (RC$_{gb}$). This metric ranges from −1 to 1, indicating whether a pair of plots are more dissimilar (approaching 1), as dissimilar (approaching 0), or less dissimilar (approaching −1), than expected by chance. The dashed horizontal gray line denotes a pure stochastic community assembly. Different letters denote significant differences between grazing treatments ($P < 0.05$; note that the P value for the comparison between full and large herbivore exclosures was 0.0575).

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Floodplain meadows Drentsche Aa


Phyteuma spicatum nigrum


Caltha palustris


Menyanthes trifoliata


Crepis paludosa


Dactylorhyza majalis


Carex aquatilis

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Eco-hydrology (brook valley system)

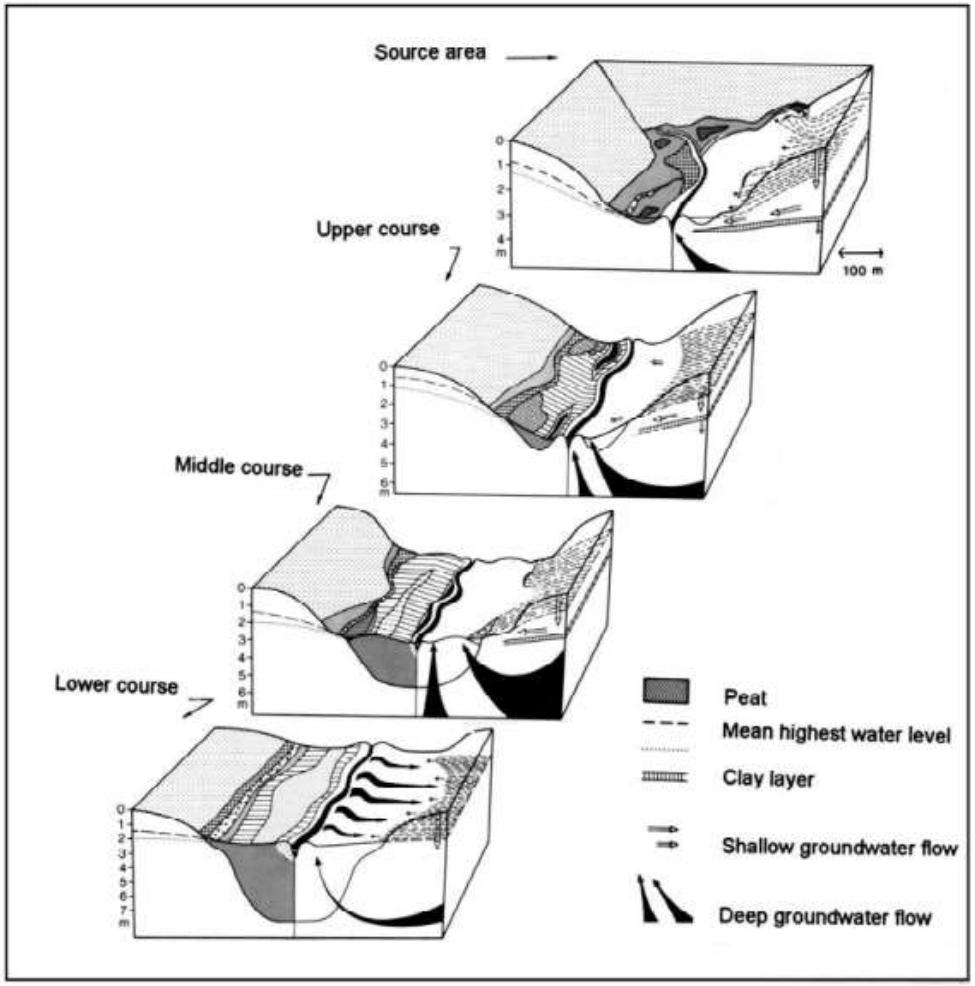

Figure 1. Distribution of fen and hay meadow communities in relation to hydrological conditions in brook valley systems in the Netherlands (adapted from Grootjans, 1980).

Grootjans et al 2002 (Hydrobiology)

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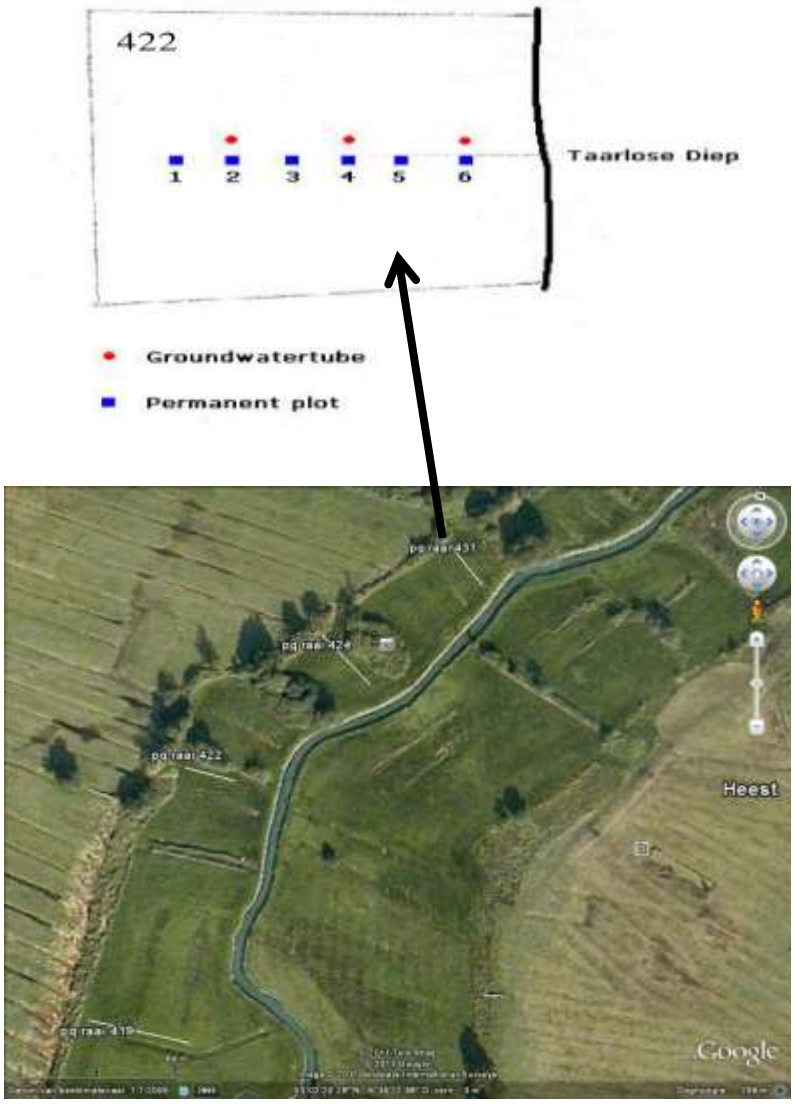
Experimental set-up (1972)

- Fertilization stopped
- 9 transects, 6-10 plots each, in total 79 plots (2x2m)
- Regularly monitored until 2009 (44 years, Londo scale)
- Data on groundwater table (tubes)



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Plant species richness increases

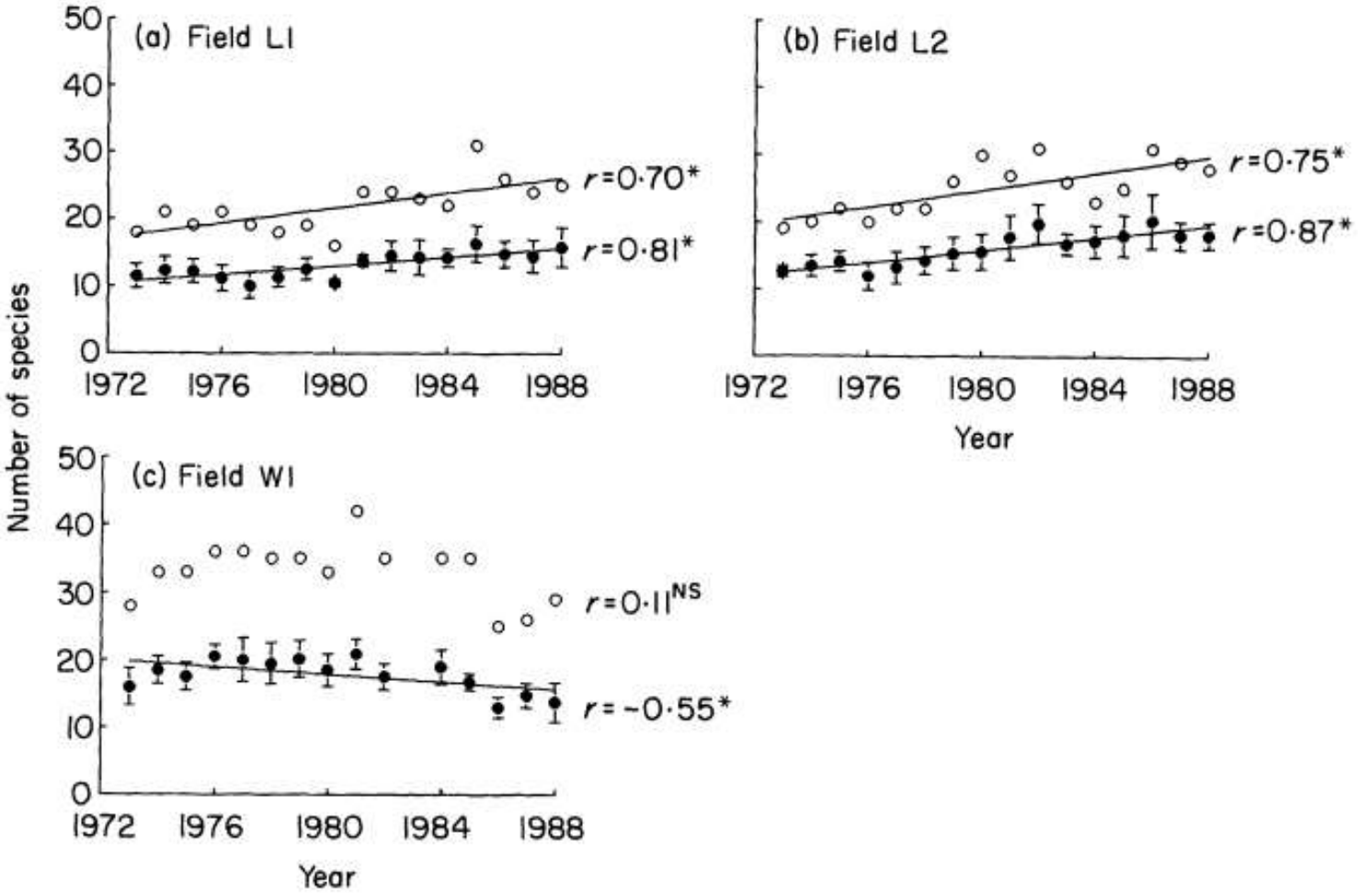

FIG. 3. Changes in species-richness as number of species in July per field (○) and mean number of species per plot (●, with S.D.) for the three hay-fields from Fig. 1 (conventions as in Fig. 1).

Olff & Bakker 1991 (JAPPL)

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Development plant species richness

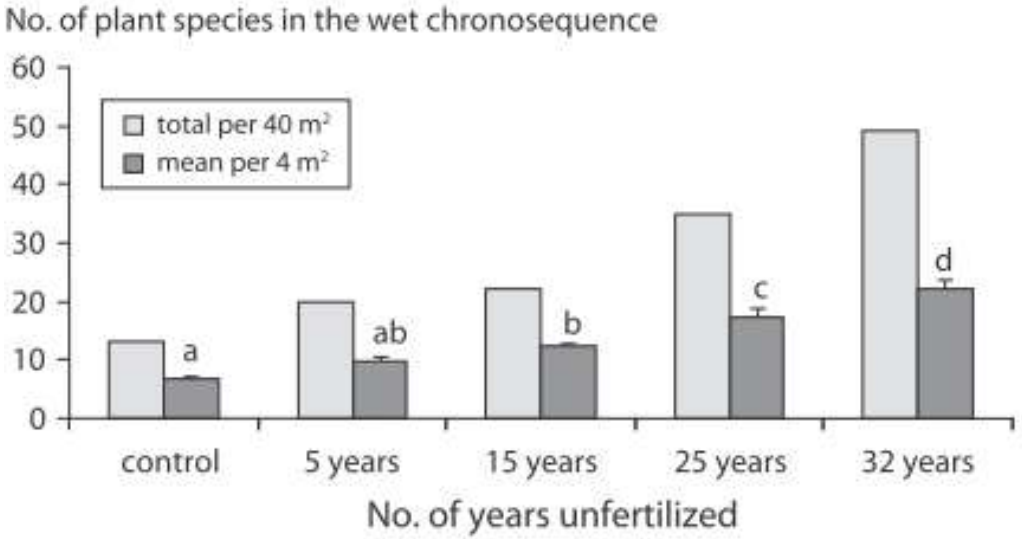
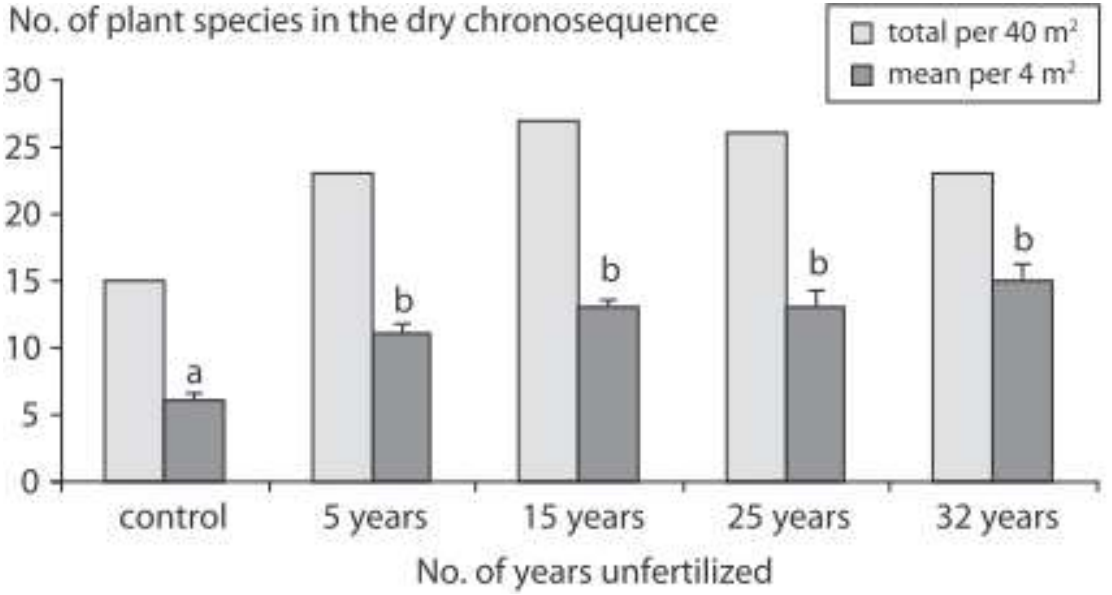


Fig. 2: Total and mean number (+ s.e.) of plant species in each stage of the wet successional series. Different letters refer to statistical differences ($p<0.05$) obtained for each series by a Scheffe-post-hoc test, after a One-way-ANOVA, $p<0.05$.

Fig. 3: Total and mean number (+ s.e.) of plant species in each stage of the dry successional series. Different letters refer to statistical differences ($p<0.05$) obtained for each series by a Scheffe-post-hoc test, after a One-way-ANOVA, $p<0.05$.



Bekker et al 2006 (Osna Naturw Mitt)

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Changes in bird community

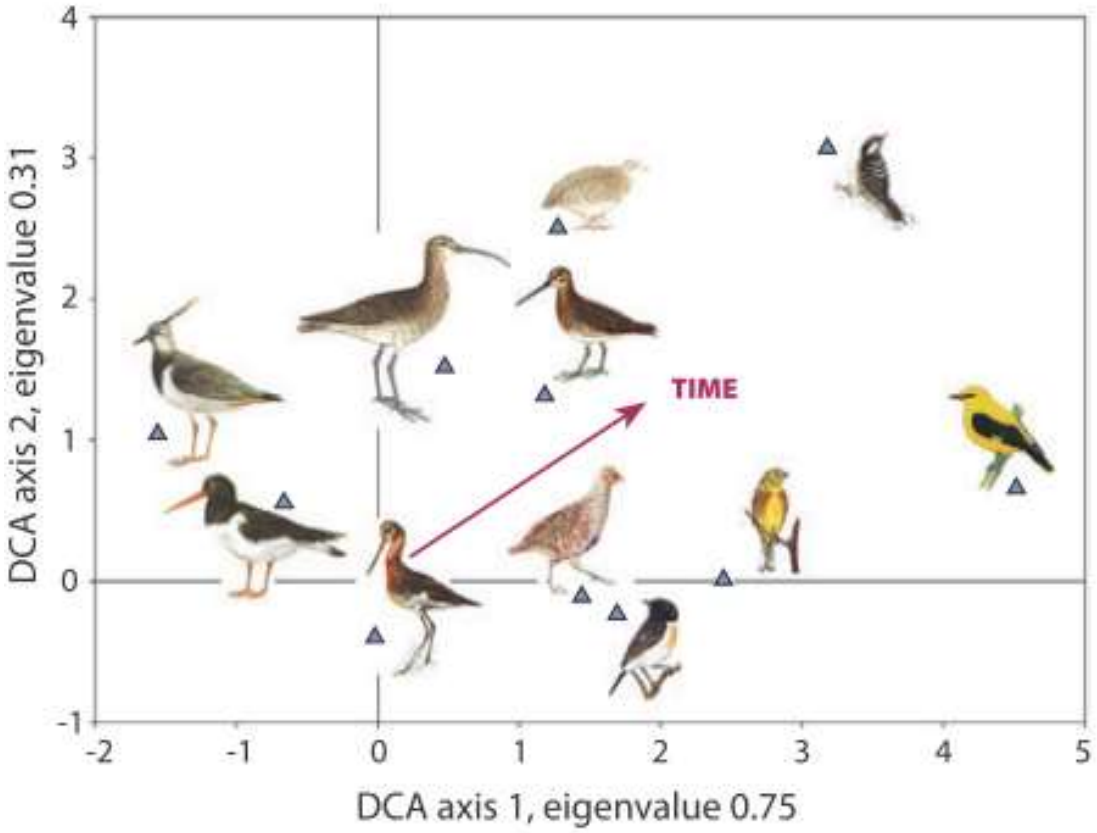

Fig. 7: The first two DCA-axes depicting the change in species composition of the breeding birds in the Anloërdiepje brook valley during 32 years of succession (arrow indicates the factor Time). Species involved in the analyses (from left to right) Lapwing, Oystercatcher, Black-tailed Godwit, Curlew, Snipe, Partridge, Quail, Stonechat, Yellowhammer, Lesser spotted Woodpecker and Golden Oriole.

Bekker et al 2006 (Osna Naturw Mitt)

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Current challenges Drentsche Aa

- Management changed since 2009 (budget cut)
- Rewetting, less & infrequent mowing
- This season:
  - Re-survey all plots
  - Get management data (what happened where)
  - Test for community composition changes

Taarlo, April 2017

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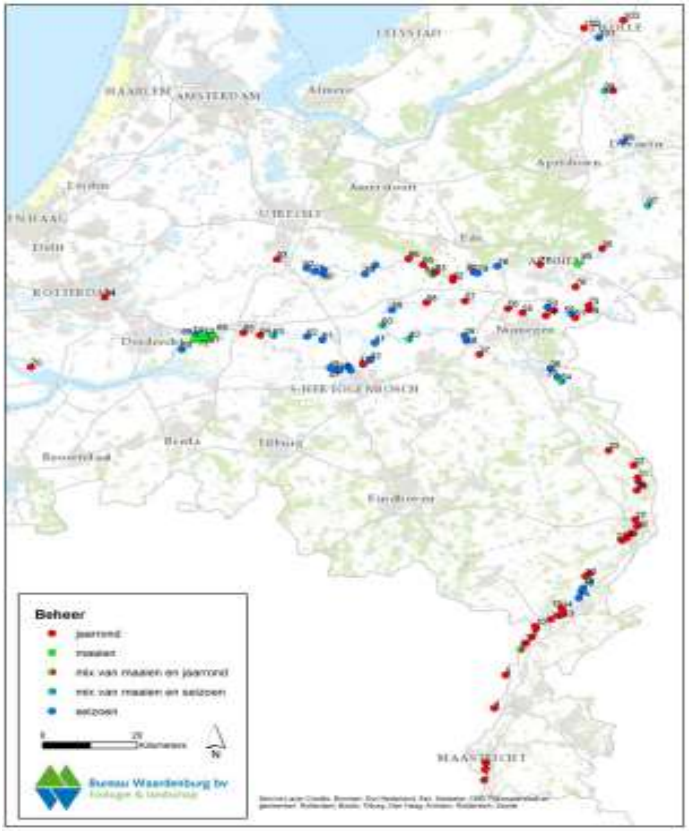
Floodplain grasslands large rivers




Limosella aquatica


Knautia arvensis


Inula britannica


Silene baccifera


Mentha pulicum


Peucedanum carvifolia

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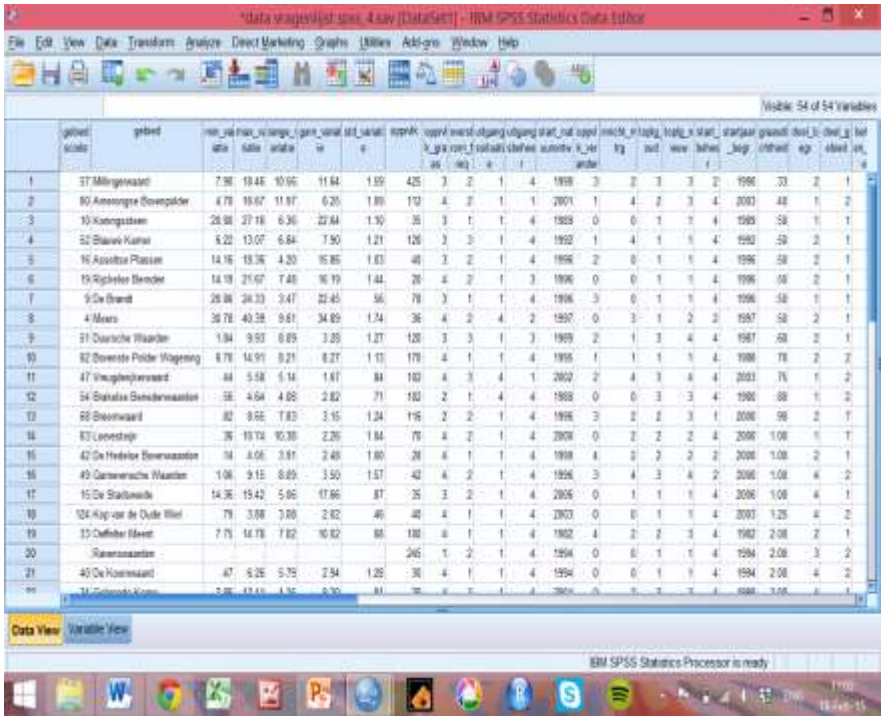
Challenge: safety vs. diversity

- Question:
  - Can grazing be used as management tool to achieve goals for both nature conservation and flood defense?
- Project approach:
  - What are the main drivers for changes in biological diversity in floodplain grasslands?
- Data:
  - Abiotic variables: soil type, flooding frequency, topography
  - Management variables: grazing regime, intensity, land-use history
  - Biotic variables: changes in vegetation type, plant & butterfly diversity (1996 – 2008)



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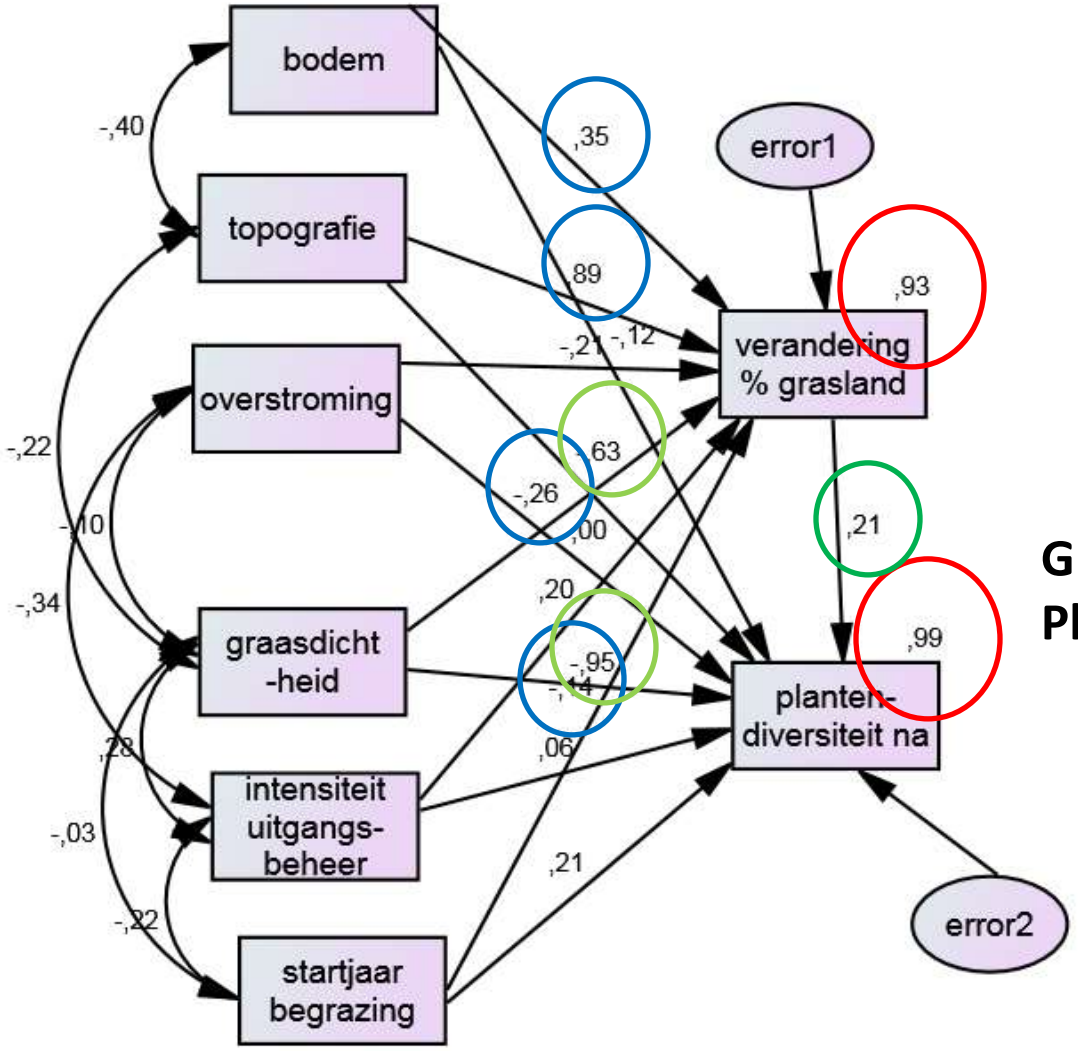
Structural Equation Models: grassland area– plant diversity



Chi-square = 12,158 (df = 8)
P = 0,144
R^2 grassland = 0,933
R^2 plantdiv = 0,986

Grassland area: abiotics > grazing
Plant diversity: abiotics ~ grazing

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Main drivers changes in diversity?

Table 0.1 Summary of the SEM analysis per control variable. Positive impact on the change in surface area:: + = >0 – 0.25; ++ = 0.26 – 0.50; +++ = 0.51 – 1.00. Negative impact: - = <0 - -0.25; -- = -0.26 – -0.50; --- = -0.51 - -1.00. No impact = 0. The larger the value, the larger the impact. Soil: 1 > 90% clay, 2 = 75% clay (25% sand), 3= 50%/50%, 4 = 25% clay, 75 sand en 5 > 90% sand, topography = topographic heterogeneity = variation in height (cm), flooding = flooding frequency, grazing intensity = N/ha/yr, intensity initial management = 1 very extensive – 4 very intensive, start grazing = starting year.

control variabele	surface area				plant diversity			
	grass	roughs	shrubs	forest	grass	roughs	shrubs	forest
soil	++	++		-	-	0		+
topography	+++	-	+++		- - -	- - -	+++	
flooding	-	+	++		0	-	+	
grazing density	- -	-		+++	- - -	- - -		- - -
int. management	+	++	++	- - -	+	+	-	+
start grazing	-	+	++	-	+	+	+	+

Strong interplay abiotics and grazing management for diversity:

- Indirect effects (vegetation structure)
- Direct effects (diversity)
- Focus on management only insufficient for reaching goals

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Funding & Support:
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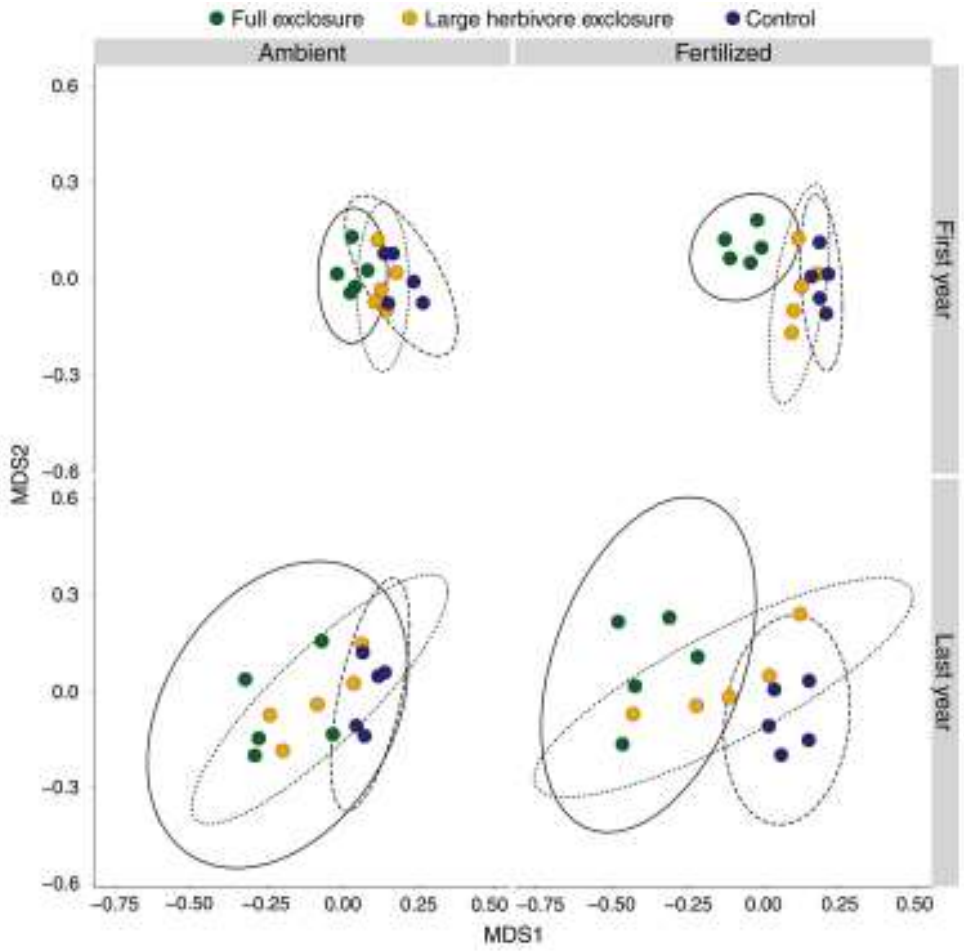

FIG. 1. Nonmetric multidimensional scaling (NMDS) ordination plot of community assemblages in two-dimensional space. Each point represents the species composition in a given replicate, and the distance between any two points represents the difference between those two community assemblages according to the Bray-Curtis dissimilarity index based on fourth-root-transformed data. Lines represent the confidence ellipse at the 0.95 level. The larger the ellipse of a given treatment, the greater variability of that treatment.

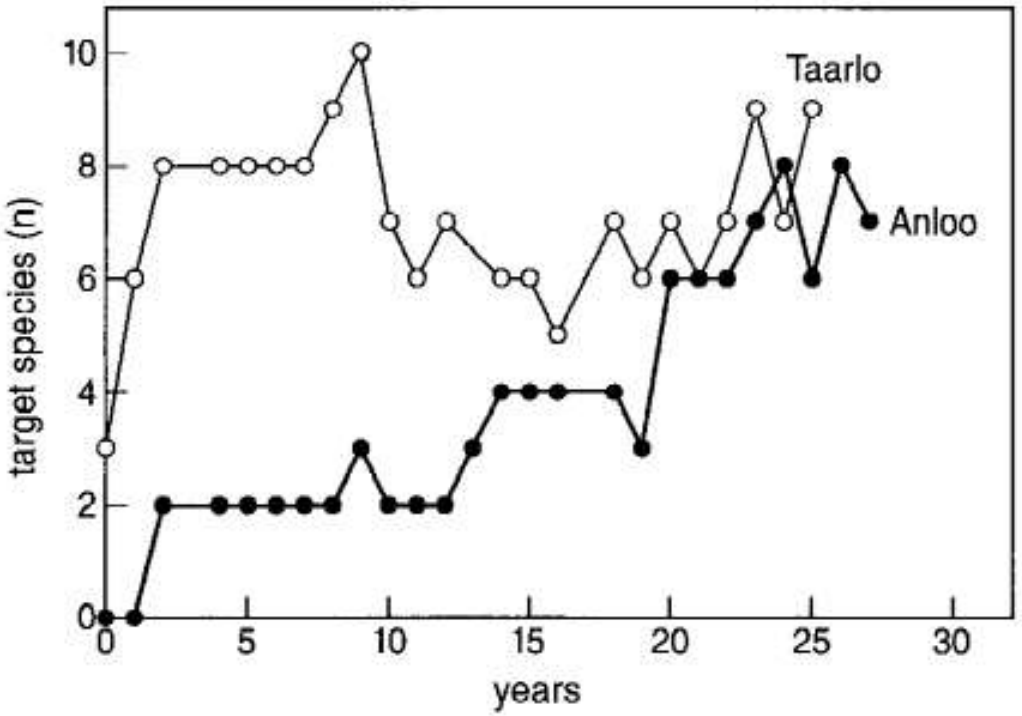

Figure 7. Increase of target species monitored in three permanent plots during 25 years in two brook valley meadows in the Drentse Aa area. The meadow near the village of Taarlo was fertilised only little before abandonment followed by restoration management, while the meadow near Anloo had been fertilised for several decades before a mowing regime without fertilisation was installed.

Grootjans et al 2002 (Hydrobiology)