Appendix A: SEM Results of main model

Abstract

Appendix A for the MS The Sensitivity of hay meadow species diversity to nitrogen deposition

Introduction

In this appendix the detailed SEM results are provided from applying the main model to the data of the low and medium-altitude hay meadows (EUNIS R2.2) and the data of the mountain hay meadows (R2.3). As measure of species richness either the total species richness or the number of the target species were used. See the section *conceptual model* in the main body of the manuscript for a detailed description of the model. The model is depicted as a causal diagram in the following figure.
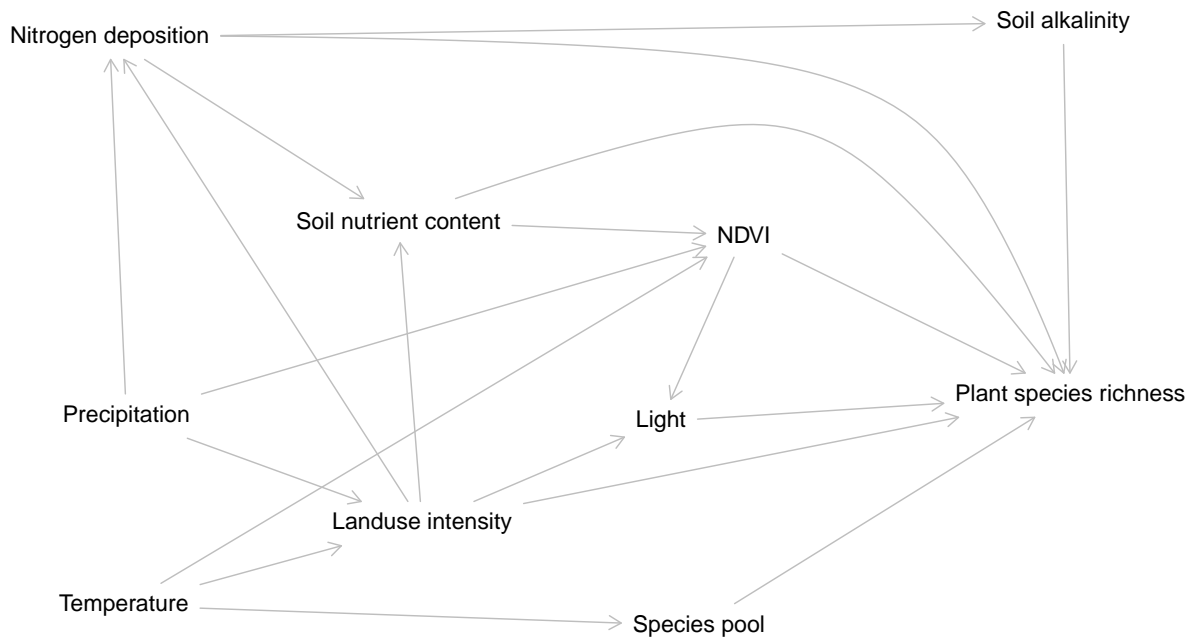

Figure 1: Conceptual model used in the SEM.

Based on this conceptual model the following equations were used to analyse the data:

$$
\begin{aligned}
Plant\ species\ richness = {} & Nitrogen\ deposition + Soil\ alkalinity + Soil\ nutrient\ content + NDVI + \quad (1)\\
& Light + Landuse\ intensity + Species\ pool
\end{aligned}
$$

$$Soil\ alkalinity = Nitrogen\ deposition \quad (2)$$

$$Soil\ nutrient\ content = Nitrogen\ deposition + Landuse\ intensity \quad (3)$$

$$NDVI = Soil\ nutrient\ content + Precipitation + Temperature \quad (4)$$

$$Light = NDVI + Landuse\ intensity \quad (5)$$

$$Nitrogen\ deposition = Precipitation + Landuse\ intensity \quad (6)$$

$$Landuse\ intensity = Temperature + Precipitation \quad (7)$$

$$Species\ pool = Temperature \quad (8)$$

Model Results

The formulas were applied using the R-package `brms` (Bürkner 2021). The results are shown in the following tables.

Table 1: SEM Results from applyig the structural equation model for the **total species richness** applied to the to the data of the **low and medium-altitude hay meadows** (EUNIS R2.2).

Equation	Response	Predictor	Coefficient	2.5%-Quantile	97.5%-Quantile
(1)	Plant species richness	Nitrogen deposition	-0.09	-0.19	0.01
(1)	Plant species richness	Soil alkalinity	0.52	0.33	0.69
(1)	Plant species richness	Soil nutrient content	-0.27	-0.35	-0.19
(1)	Plant species richness	NDVI	0.03	0.00	0.06
(1)	Plant species richness	Light	-0.18	-0.31	-0.04
(1)	Plant species richness	Landuse intensity	0.07	-0.22	0.35
(1)	Plant species richness	Species pool	0.00	-0.02	0.02
(4)	NDVI	Soil nutrient content	-0.17	-0.45	0.12
(4)	NDVI	Precipitation	1.65	1.08	2.24
(4)	NDVI	Temperature	-3.19	-5.14	-1.23
(5)	Light	NDVI	-0.05	-0.07	-0.03
(5)	Light	Landuse intensity	-0.19	-0.38	0.00
(2)	Soil alkalinity	Nitrogen deposition	-0.17	-0.23	-0.12
(3)	Soil nutrient content	Nitrogen deposition	0.20	0.08	0.32
(3)	Soil nutrient content	Landuse intensity	1.52	1.20	1.84
(6)	Nitrogen deposition	Precipitation	0.57	0.43	0.72
(6)	Nitrogen deposition	Landuse intensity	0.66	0.41	0.91
(7)	Landuse intensity	Temperature	0.06	-0.14	0.26
(7)	Landuse intensity	Precipitation	-0.07	-0.13	-0.01
(8)	Species pool	Temperature	-3.65	-6.60	-0.83

Table 2: SEM Results from applyig the structural equation model for the **numer of target species** applied to the to the data of the **low and medium-altitude hay meadows** (EUNIS R2.2).

Equation	Response	Predictor	Coefficient	2.5%- Quantile	97.5%- Quantile
(1)	Plant species richness	Nitrogen deposition	0.13	-0.10	0.38
(1)	Plant species richness	Soil alkalinity	2.84	2.45	3.24
(1)	Plant species richness	Soil nutrient content	-0.64	-0.82	-0.46
(1)	Plant species richness	NDVI	0.03	-0.03	0.09
(1)	Plant species richness	Light	0.88	0.55	1.20
(1)	Plant species richness	Landuse intensity	-0.16	-0.75	0.46
(1)	Plant species richness	Species pool	-0.02	-0.06	0.02
(4)	NDVI	Soil nutrient content	-0.17	-0.46	0.12
(4)	NDVI	Precipitation	1.65	1.04	2.27
(4)	NDVI	Temperature	-3.18	-5.13	-1.24
(5)	Light	NDVI	-0.05	-0.07	-0.03
(5)	Light	Landuse intensity	-0.19	-0.38	0.01
(2)	Soil alkalinity	Nitrogen deposition	-0.17	-0.23	-0.12
(3)	Soil nutrient content	Nitrogen deposition	0.20	0.09	0.32
(3)	Soil nutrient content	Landuse intensity	1.52	1.21	1.83
(6)	Nitrogen deposition	Precipitation	0.57	0.43	0.72
(6)	Nitrogen deposition	Landuse intensity	0.65	0.40	0.90
(7)	Landuse intensity	Temperature	0.06	-0.14	0.25
(7)	Landuse intensity	Precipitation	-0.07	-0.13	-0.01
(8)	Species pool	Temperature	-3.64	-6.44	-0.86

Table 3: SEM Results from applyig the structural equation model for the **total species richness** applied to the to the data of the **lmountain altitude hay meadows** (EUNIS R2.3).

Equation	Response	Predictor	Coefficient	2.5%-Quantile	97.5%-Quantile
(1)	Plant species richness	Nitrogen deposition	-0.21	-0.29	-0.13
(1)	Plant species richness	Soil alkalinity	0.36	0.27	0.45
(1)	Plant species richness	Soil nutrient content	-0.17	-0.25	-0.09
(1)	Plant species richness	NDVI	0.06	0.04	0.08
(1)	Plant species richness	Light	-0.32	-0.41	-0.23
(1)	Plant species richness	Landuse intensity	-0.32	-0.43	-0.21
(1)	Plant species richness	Species pool	0.00	-0.01	0.01
(4)	NDVI	Soil nutrient content	0.36	0.14	0.58
(4)	NDVI	Precipitation	1.09	0.88	1.30
(4)	NDVI	Temperature	0.50	0.14	0.84
(5)	Light	NDVI	-0.08	-0.10	-0.06
(5)	Light	Landuse intensity	0.11	0.04	0.18
(2)	Soil alkalinity	Nitrogen deposition	-0.15	-0.19	-0.10
(3)	Soil nutrient content	Nitrogen deposition	0.39	0.32	0.46
(3)	Soil nutrient content	Landuse intensity	0.71	0.61	0.80
(6)	Nitrogen deposition	Precipitation	0.45	0.38	0.52
(6)	Nitrogen deposition	Landuse intensity	0.95	0.87	1.04
(7)	Landuse intensity	Temperature	0.85	0.79	0.91
(7)	Landuse intensity	Precipitation	-0.16	-0.21	-0.12
(8)	Species pool	Temperature	2.06	1.10	3.02

Table 4: SEM Results from applyig the structural equation model for the **numer of target species** applied to the to the data of the **mountain altitude hay meadows** (EUNIS R2.3).

Equation	Response	Predictor	Coefficient	2.5%-Quantile	97.5%-Quantile
(1)	Plant species richness	Nitrogen deposition	-0.61	-0.78	-0.43
(1)	Plant species richness	Soil alkalinity	0.98	0.78	1.18
(1)	Plant species richness	Soil nutrient content	-0.37	-0.54	-0.20
(1)	Plant species richness	NDVI	0.08	0.04	0.13
(1)	Plant species richness	Light	-0.24	-0.43	-0.04
(1)	Plant species richness	Landuse intensity	-0.72	-0.94	-0.50
(1)	Plant species richness	Species pool	0.01	0.00	0.03
(4)	NDVI	Soil nutrient content	0.36	0.14	0.59
(4)	NDVI	Precipitation	1.09	0.88	1.30
(4)	NDVI	Temperature	0.50	0.15	0.85
(5)	Light	NDVI	-0.08	-0.10	-0.06
(5)	Light	Landuse intensity	0.11	0.04	0.18
(2)	Soil alkalinity	Nitrogen deposition	-0.15	-0.19	-0.10
(3)	Soil nutrient content	Nitrogen deposition	0.39	0.32	0.46
(3)	Soil nutrient content	Landuse intensity	0.71	0.61	0.80
(6)	Nitrogen deposition	Precipitation	0.45	0.38	0.52
(6)	Nitrogen deposition	Landuse intensity	0.95	0.87	1.05
(7)	Landuse intensity	Temperature	0.85	0.79	0.90
(7)	Landuse intensity	Precipitation	-0.16	-0.20	-0.12
(8)	Species pool	Temperature	2.05	1.07	3.00

References

Bürkner, Paul-Christian. 2021. "Bayesian Item Response Modeling in R with brms and Stan." *Journal of Statistical Software* 100 (5): 1–54. https://doi.org/10.18637/jss.v100.i05.