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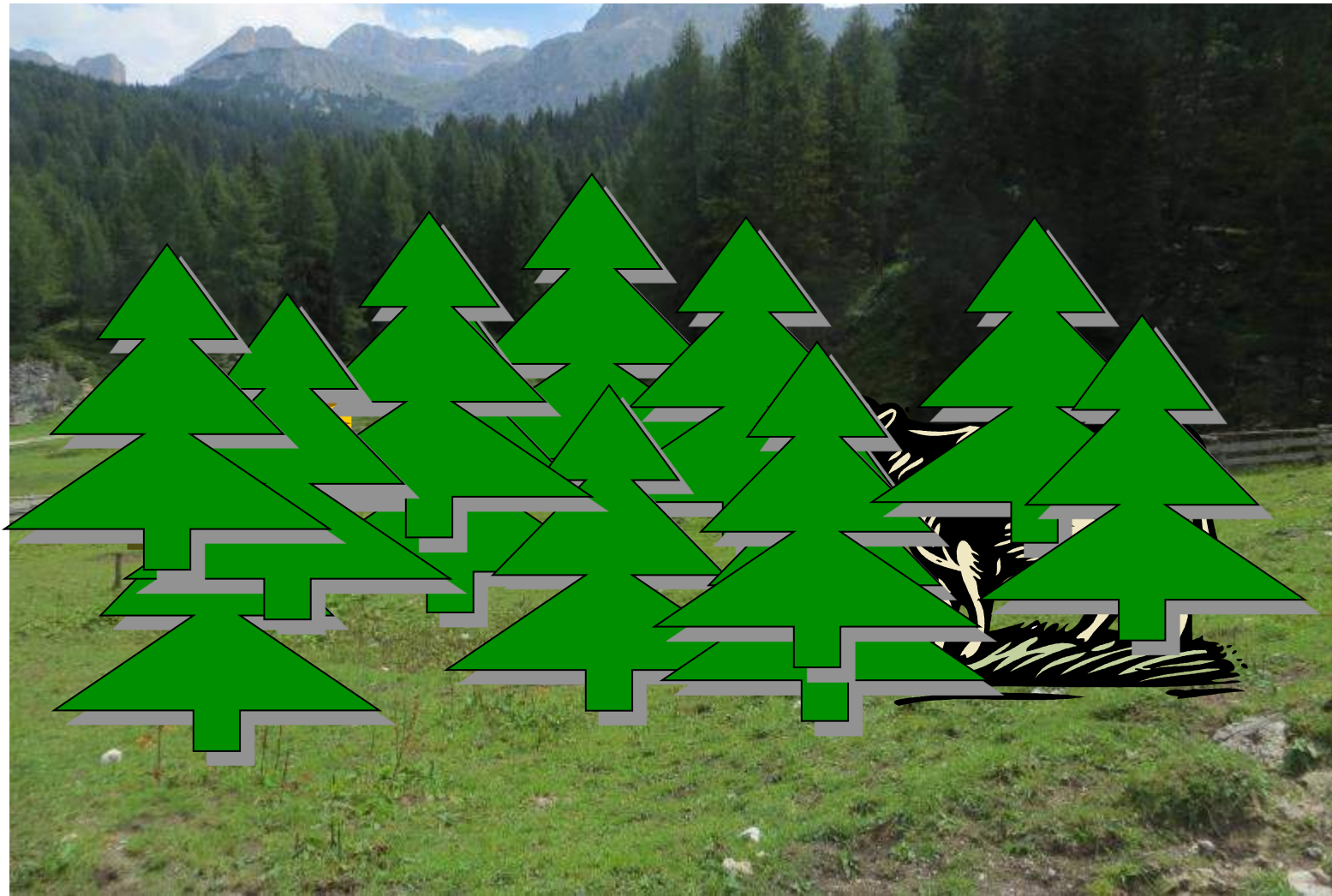
Department of Agronomy Food
Natural resources Animals Environment



Forest succession and botanical composition changes in abandoned Alpine pastures related to rare species and environmental factors

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Introduction



Introduction



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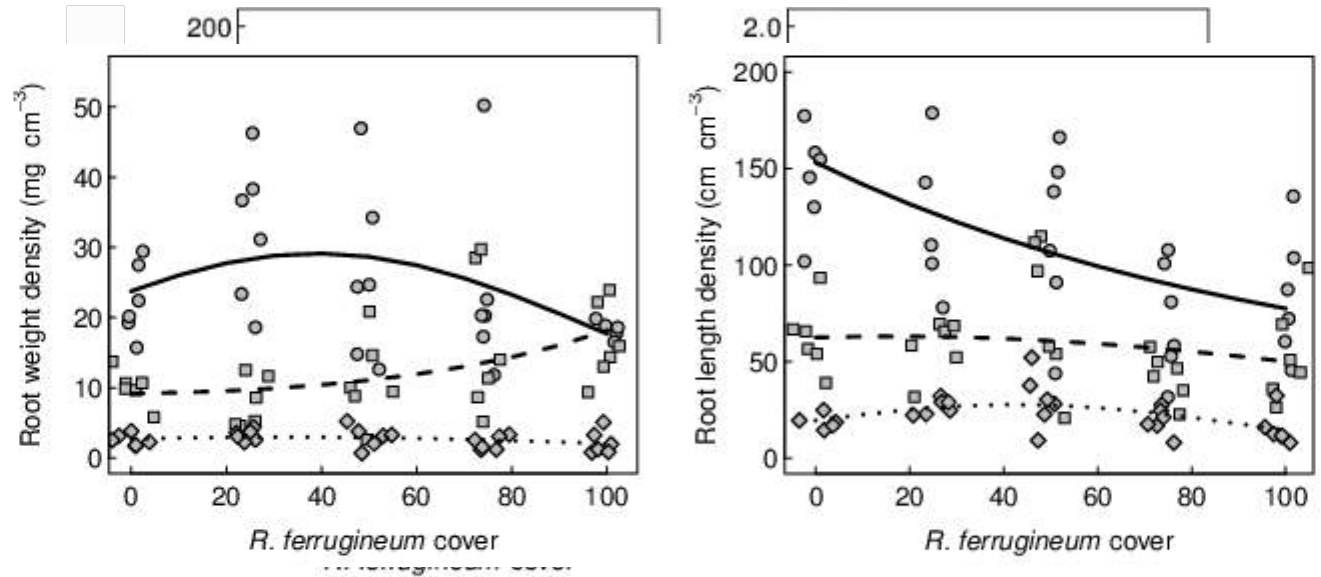
GRASSLANDS DEPLETION → LOSS OF RELATED ECOSYSTEM SERVICES



Introduction (ecosystem services)

- Lower values of organic C are allocated to stable soil aggregates in forests than in grasslands.
- The mass and length density of fine roots (<2 mm) decrease as shrubs progress (*Rhododendron ferrugineum*) into grassland. Fine roots of grasses have high turn-over rates and a positive effect on aggregate stabilization.

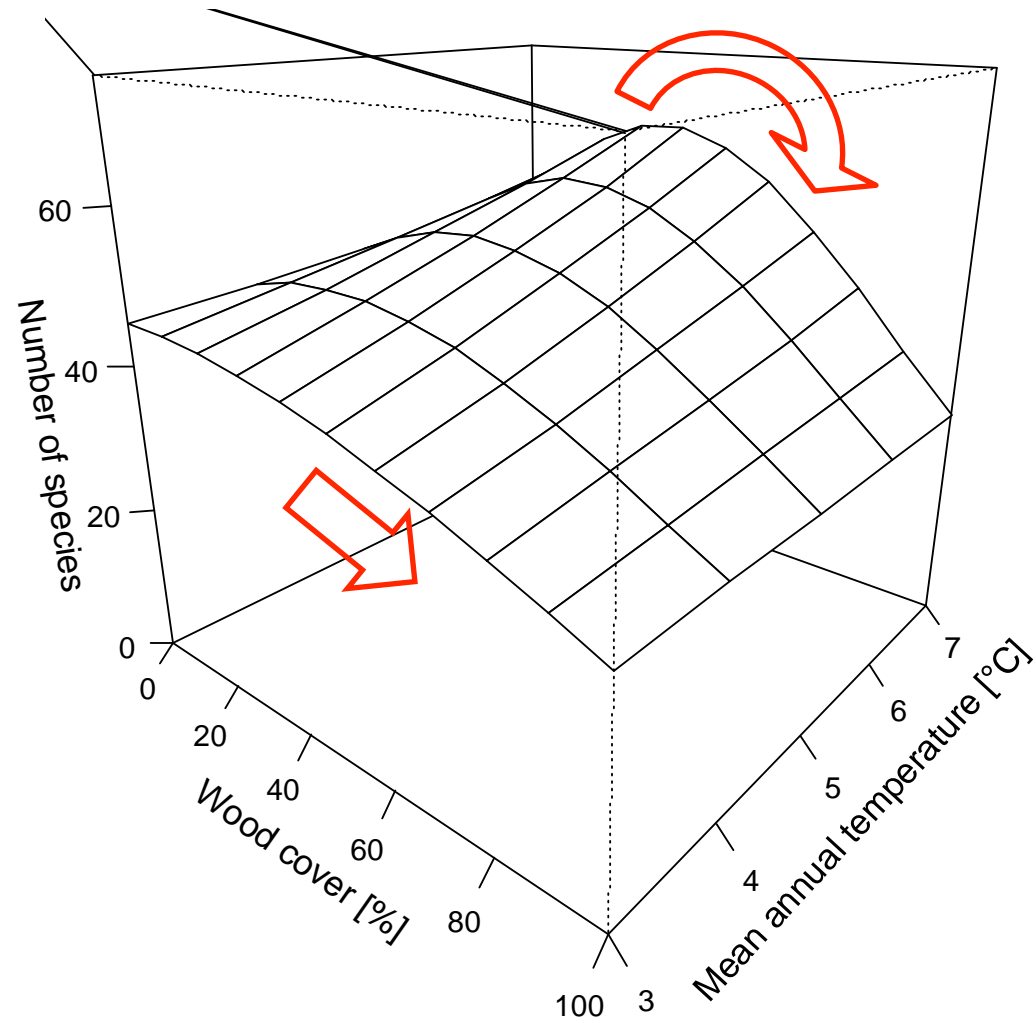
— 0-5 cm
- - - 5-10 cm
..... 10-20 cm



(Plant ecosystems -Pornaro et al., 2016)

Introduction (biodiversity)

Several studies report a decrease in the number of species with increasing forest cover.



(Biological conservation - Pornaro et al., 2013)

Objective

Environmental conditions have direct effects on the vegetation and also affects the dynamics that occur thereafter.

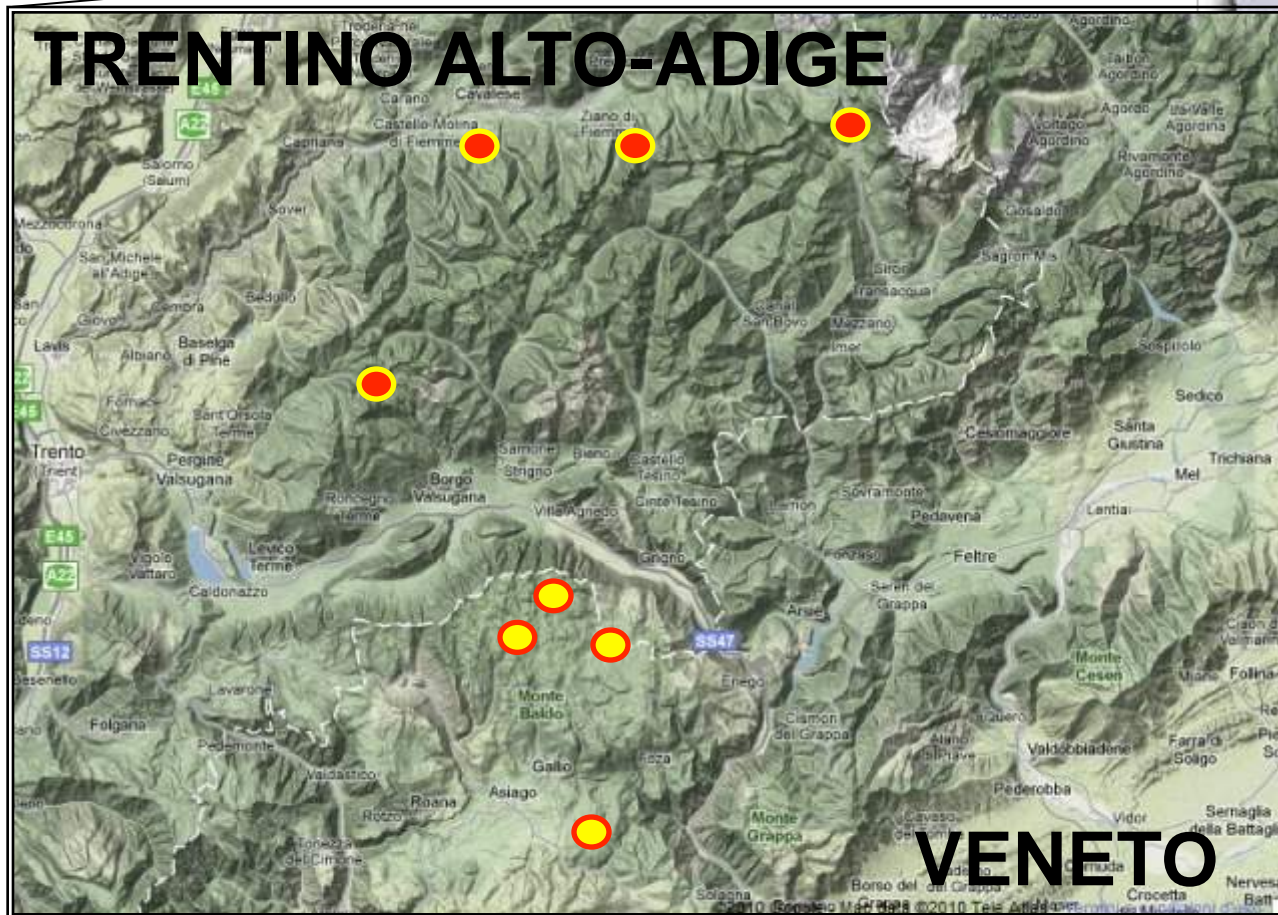
A low percentage of wood cover outcompetes a comparatively larger number of shade-sensitive grassland species and hence species richness decreases with wood cover.

What about plant composition and changes related to environmental variables?



Materials and methods

This study was carried out on eight sites located in the Eastern Alps of Italy



Materials and methods

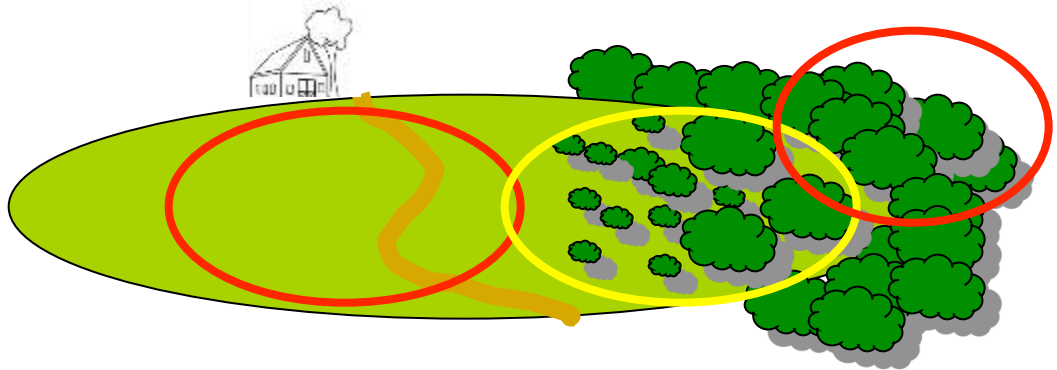
ID site	A	B	C	D	E	F	G	H
Dominant woody species	Fagus sylvatica	Picea abies	Larix decidua	Pinus mugo	Alnus viridis	Picea abies	Larix decidua	Rodhodendron ferrugineum
Substrate	carbonate	carbonate	carbonate	carbonate	silicate	silicate	silicate	silicate
Altitude [m a.s.l.]	1150	1350	1700	1650	1050	1550	1750	1700
Mean annual temperature [°C]	6.68	5.38	3.66	3.48	6.75	4.00	3.51	4.36
Annual precipitation [mm]	1463	1546	1546	1546	800	1050	1050	917
N content [g kg⁻¹]	2.6	6.9	14.3	5.4	4.9	5.3	7.3	7.8
Organic matter [g kg⁻¹]	128.6	212.2	309.5	295.0	156.7	148.7	245.5	226.0
Total number of species	190	147	128	81	141	128	116	106
Red list species	5	4	1	2	4	0	2	0



Materials and methods

At each study site,

- 30 plots of 10 m x 10 m
and
- 30 plots of 1 x 1 m
were established through a
gradient of wood cover



- Percentage of wood cover, species presence and percentage
- Dissimilarity index and effective diversity
- Generalized linear mixed models (GLMMs) were built to explain observed variation in species diversity depending on wood cover and environmental conditions

Results (Bray index)

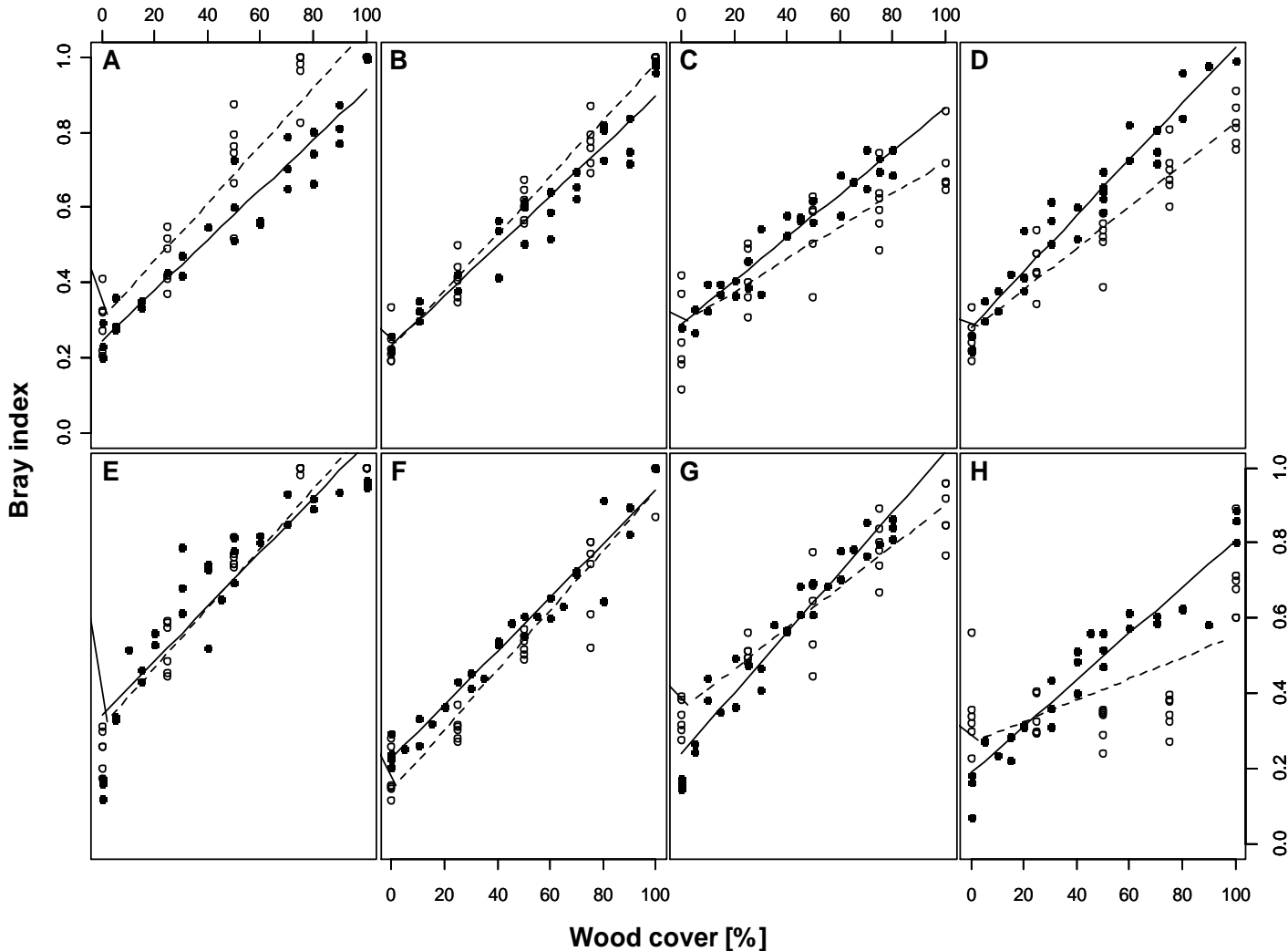
Bray index (0-1):

0 = all species are shared

1 = no shared species

— 100 m²

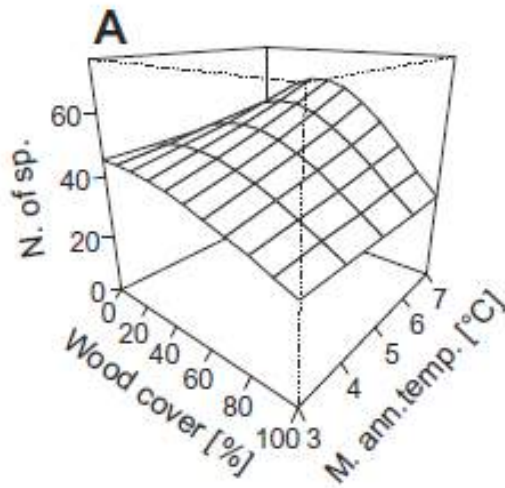
- - - 1 m²



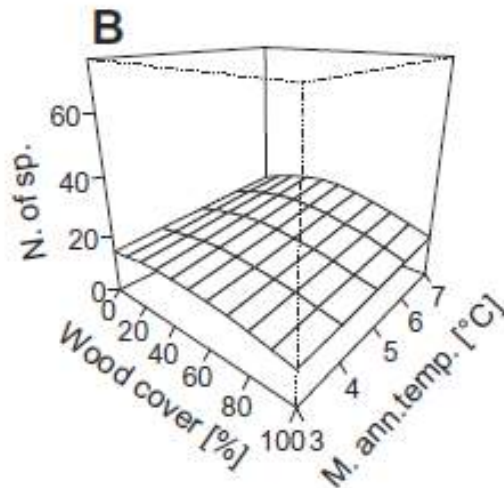
Results (effective diversity)

$$\hat{D}^q = \left(\sum_{i=1}^n p_i^q \right)^{1/(1-q)}$$

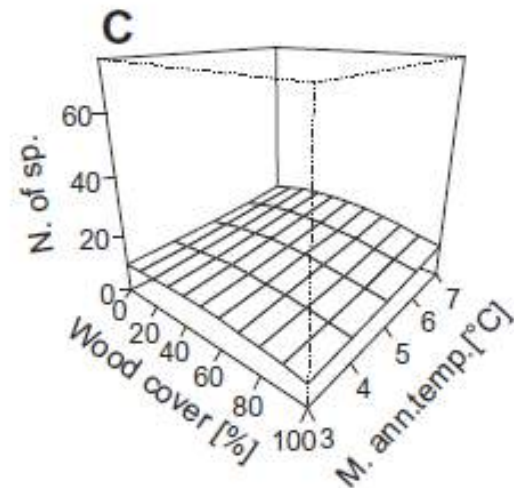
- Increasing the order q means a successive down-weighting of the species with low abundance



$q=0$



$q=1$



$q=2$

Results (red-listed species)

Species	Mean annual temperature	Wood cover
<i>Aristolochia rotunda</i> L.	High	Intermediate
<i>Vicia oroboides</i> Wulfen	High	Intermediate
<i>Cicuta virosa</i> L.	High	Low to intermediate
<i>Daphne cneorum</i> L.	Low to high	Low to Intermediate
<i>Euphorbia carniolica</i> Jacq.	high	Intermediate
<i>Laserpitium prutenicum</i> L.	High	Intermediate
<i>Stellaria longifolia</i> Muhl.	High	Low to intermediate
<i>Gentiana cruciata</i> L.	Low	Low
<i>Juncus articulatus</i> L.	Low	Low
<i>Orobanche gracilis</i> Sm.	Low	Low
<i>Stachys alopecuros</i> (L.) Bentham	Low to high	Low to intermediate



Warmer sites had more red-listed species in comparison with others



Higher % of wood cover = less red-listed species



Conclusion

- Mean annual temperature is the most relevant environmental driver
- Sites with higher mean annual temperature are the most vulnerable to loss of species by forest succession
- Management strategies which maintain a low percentage of shrubs or trees on pastures should be promoted for preserving biodiversity and landscape



