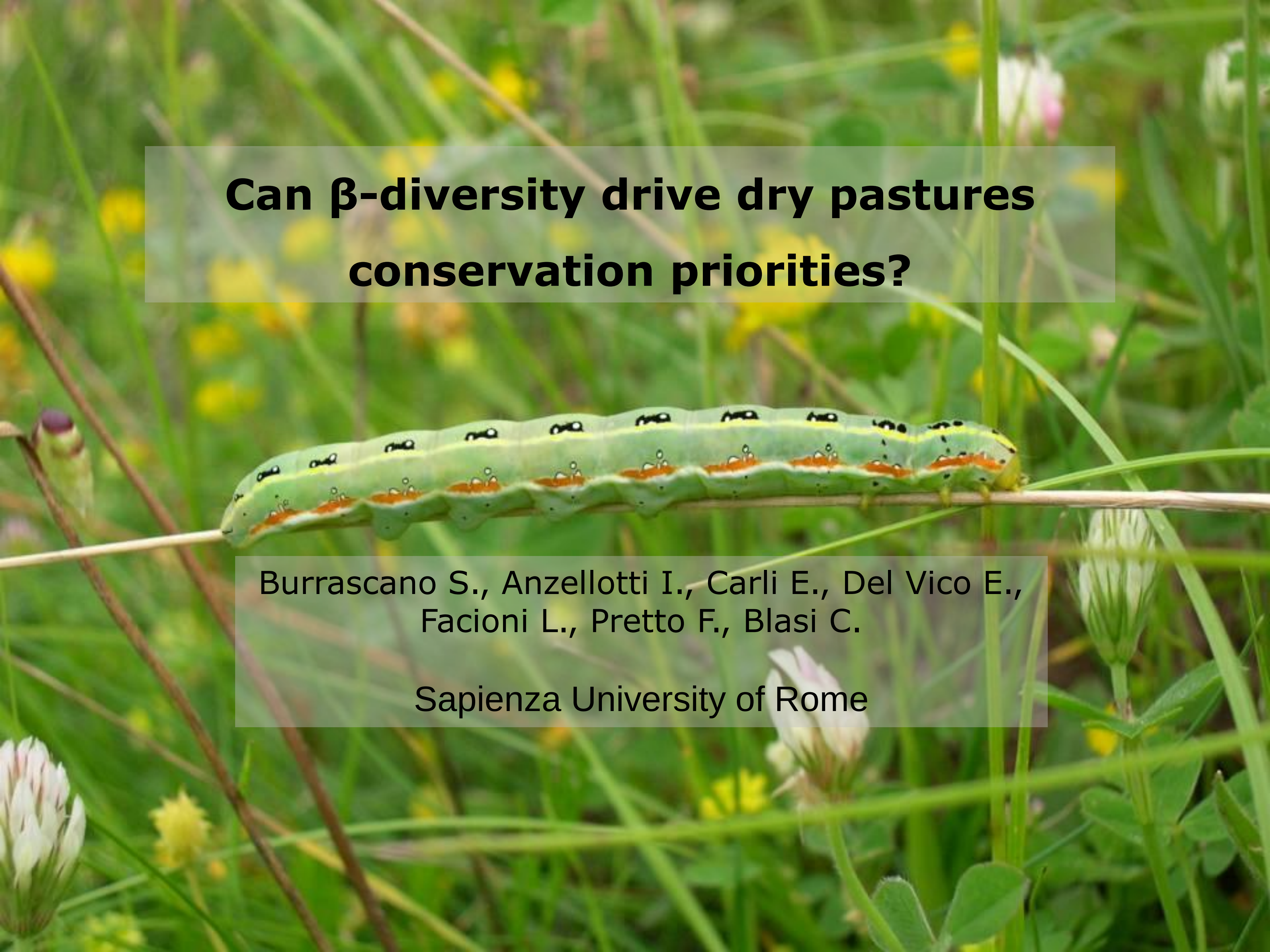

Can β-diversity drive dry pastures conservation priorities?

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Introduction

Open grasslands in the land cover map of Italy, are spread over about 2% of the country (APAT 2005), generally following the main mountain chains.

In the Apennines pasture covered 18% in 1960 and 10% in 2000 (Falcucci et al., 2007).
This reduction follows the general European trend (Pykälä, 2000).

Introduction

The lack of management often leads to a loss of grassland coverage owing to their succession into scrublands and forests.

The Apennines represent an area of high conservation concern for both plants and animals (Stanisci et al., 2005; Maiorano et al., 2006). In particular high levels of specificity and vulnerability were assessed for Apennine grasslands (Fattorini, 2010).

Conservation priorities aimed at maintaining the highest possible degree of biological diversity in grasslands on the basis of sound scientific methodologies are urgently needed.

Introduction

Different factors have been suggested as major determinants of variation in semi-natural grassland vegetation. The inconsistency among studies may reflect the complexity of the involved gradients and differences in grain and extent of studies (Auestad et al., 2008).

Furthermore, when analysing species composition we should take into account the spatial pattern; in fact it may reflect spatial patterns in environmental variables but also a ‘pure spatial structure’.

Introduction

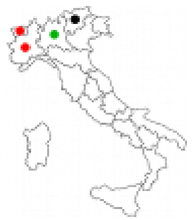
The grasslands included in the group of habitat "*Semi-natural dry grasslands and scrubland facies*" occurring in Italy are:

- 6210 (*) Semi-natural dry grasslands and scrubland facies on calcareous substrates (*Festuco-Brometalia*)(*important orchid sites)

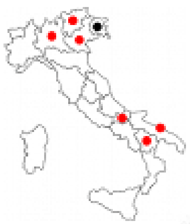
- 6220 * Pseudo-steppe with grasses and annuals of the *Thero-Brachypodietea*

- 6230 * Species-rich *Nardus* grasslands, on siliceous substrates in mountain areas (and submountain areas, in Continental Europe)

- 6240 * Sub-pannonic steppic grasslands



- 62A0 Eastern sub-Mediterranean dry grasslands (*Scorzoneratalia villosae*)



Biondi, Blasi, Burrascano, Casavecchia, Copiz, Del Vico, Galdenzi, Gigante, Lasen, Spampinato, Venanzoni, Zivkovic. Italian interpretation manual of the 92/43/EEC Directive Habitats. Available on-line at: http://vnr.unipg.it/habitat/index.jsp

Introduction

The communities referred to the habitat 6210(*) are mostly of secondary origin and are included in the orders *Brometalia erecti, Festucetalia valesiacae*.

The studied communities are referred to the Apenninic endemic alliance *Phleo ambigui-Bromion erecti* characterized by several southern European orophyte and endemic species.

Biondi, Blasi, Burrascano, Casavecchia, Copiz, Del Vico, Galdenzi, Gigante, Lasen, Spampinato, Venanzoni, Zivkovic. Italian interpretation manual of the 92/43/EEC Directive Habitats. Available on-line at: http://vnr.unipg.it/habitat/index.jsp

Introduction

Aim of this study is:

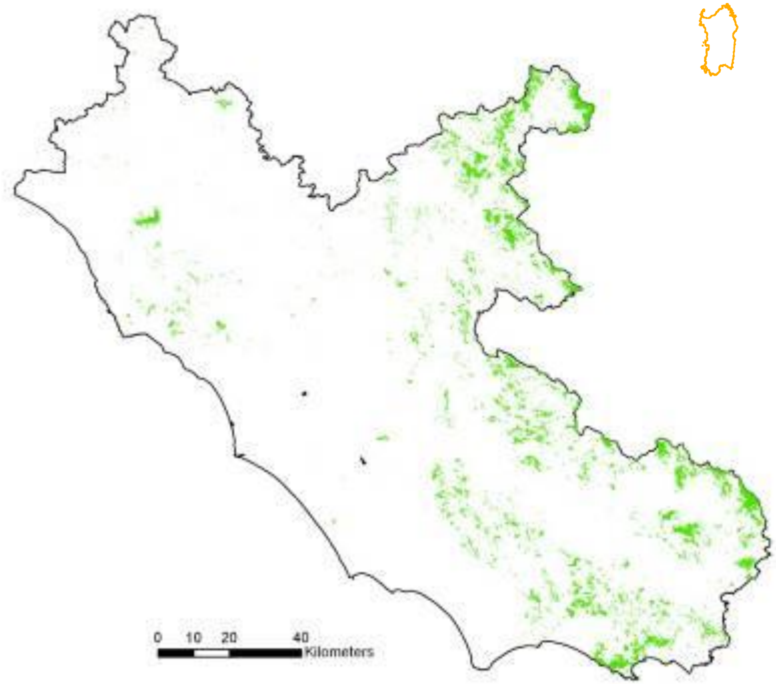
to identify the main drivers of variation in the β-diversity of grasslands referred to Habitat 6210(*) at different spatial scales, through:

- the partition of the variation in β-diversity between spatial and environmental variables,
- the quantification of the relative contribution of individual variables.

Further aim was to identify clusters of relevés based on species composition and to characterize them in terms of environmental conditions.

Study area

In Latium land cover types that can be referred to dry grasslands occupy about 5% of the territory.

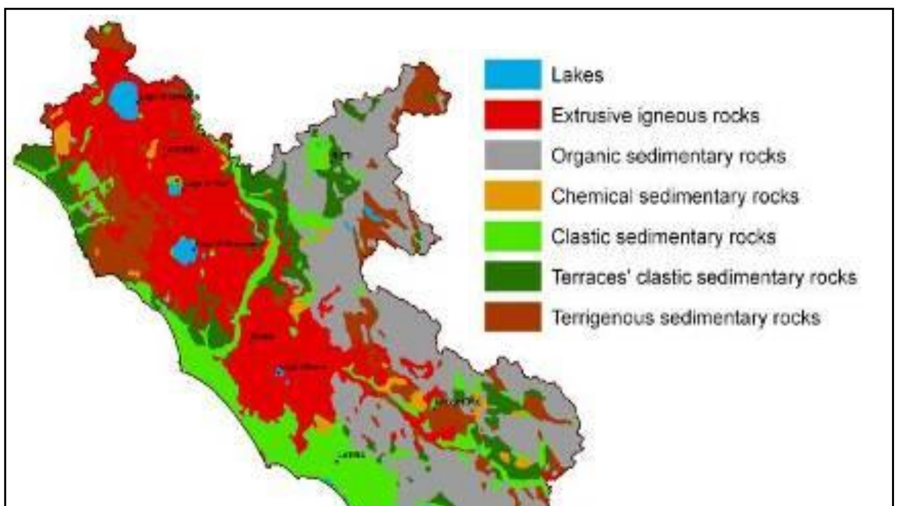


Study area

Latium is characterized by 14 phytoclimatic units included in 3 regions.

The analysed data belong to the temperate and the transitional regions.

Blasi 1994. Fitoclimatologia del Lazio.



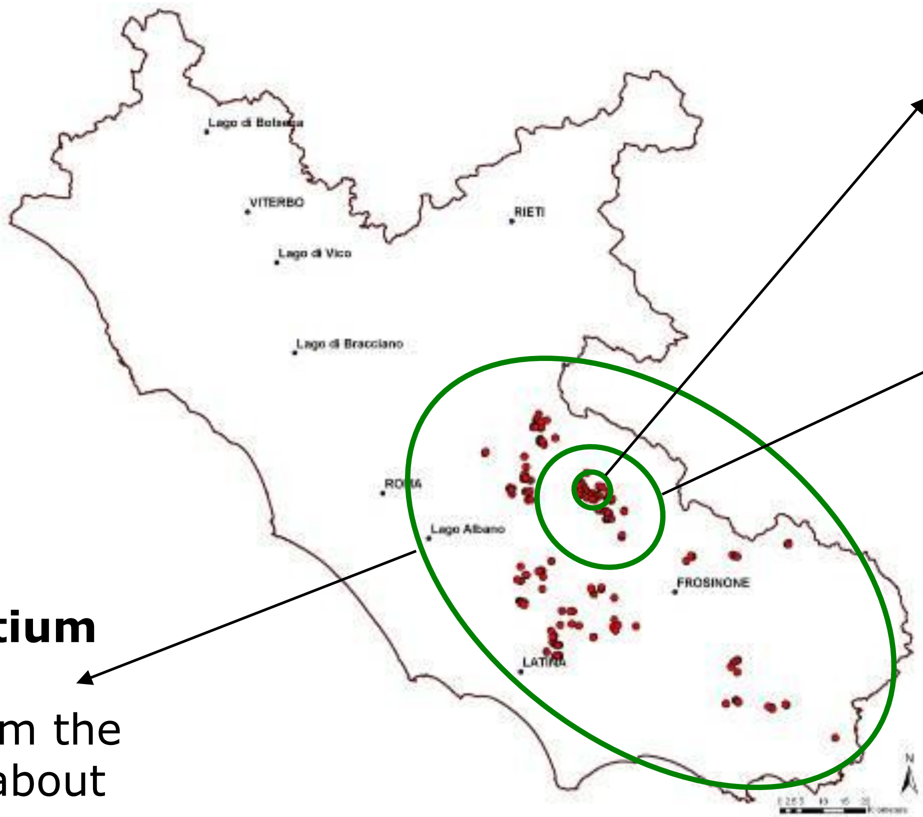
Lithologic map

Data

We performed 207 phytosociological relevés in southern Latium on calcareous substrata.

We considered 3 nested extents and randomly resampled the relevés for the two broader extents through a procedure aimed at avoiding local oversampling.

Mt. Scalambra
46 relevés about
42 km²



Ernici chain
49 relevés
resampled from
a broader set
about 520 km²

Southern Latium
52 relevés
resampled from the
total dataset about
5600 km²

Data

Each relevé is associated with spatial coordinates and environmental data:

Site characteristics

- Slope (°)
- Aspect
- Rocks (%)
- Stones (%)

Environmental data		Southern Lazio	Ernici Range	Mount Scalambra
Altitude (m)	range	80 → 1315	495 → 1411	720 → 1417
	mean ± st. dev.	693 ± 285	1010 ± 214	1063.26 ± 233.44
North-South (sin°)	range	-1 → 1	-1 → 1	-0.93 → 0.93
	mean ± st. dev.	-0.03 ± 0.69	-0.03 ± 0.50	-0.19 ± 0.55
East-West (cos°)	range	-1 → 1	-1 → 1	-1 → 1
	mean ± st. dev.	-0.26 ± 0.68	-0.70 ± 0.50	-0.66 ± 0.48
Slope (°)	range	0 → 40	0 → 35	4 → 40
	mean ± st. dev.	21.15 ± 9.10	20.63 ± 8.63	17.63 ± 8.71
Stone (%)	range	5 → 70	0 → 55	4 → 80
	mean ± st. dev.	25.76 ± 16.66	24.67 ± 13.47	27.80 ± 20.20
Rock (%)	range	0 → 50	0 → 40	0 → 55
	mean ± st. dev.	16.75 ± 11.93	12.87 ± 9.03	14.98 ± 13.18
Annual rainfall (mm)	range	1269.5 → 1518.5	1402.5 → 1518.5	1402.5 → 1518.5
	mean ± st. dev.	1383 ± 77.38	1459.31 ± 58.58	1445.37 ± 56.61
Min. Temp. (C°)	range	-2.1 → 4.4	-2.1 → 0.7	-2.1 → 0.7
	mean ± st. dev.	0.34 ± 2.01	-0.72 ± 1.41	-1.06 ± 1.37
Spatial distances	range	5.8 → 89704	42.8 → 42043	28 → 8867
	mean ± st. dev.	38771 ± 24252	17140 ± 11961	3024 ± 2079

Climate

- Minimum temperature
- Annual rainfall

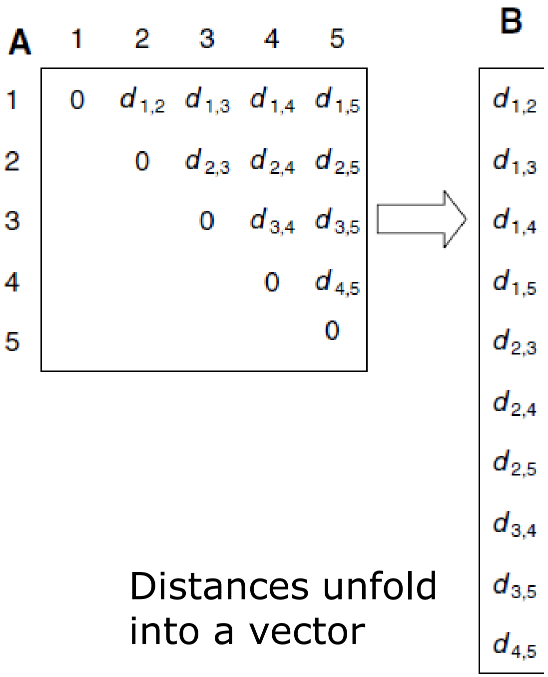
Data analysis

We performed a multiple regression on distance matrices (MRM) as proposed in Lichstein (2007)

It is a multiple regression of a response matrix on any number of explanatory matrices.

Each matrix contains distances between all pair-wise combinations of sample units.

Dissimilarity semimatrix



Narcissus poeticus

R package ecodist

Data analysis

An advantage of using dissimilarity matrices is the possibility of relating different types of data.

In fact we calculated:

- Goodman-Kruskall distances among relevés based on Braun-Blanquet abundance/dominance species values,
- Euclidean distances based on the spatial coordinates of the relevés and on environmental variables (climatic variables and site characteristics).

Data analysis

For each extent we run the following analyses

Response matrix	Explanatory matrices
Species abundances based distances	Geographical distances Climatic variables based distances Site characteristics based distances
Species abundances based distances	Geographical distances
Species abundances based distances	Climatic variables based distances Site characteristics based distances

Orchis sambucina

Data analysis

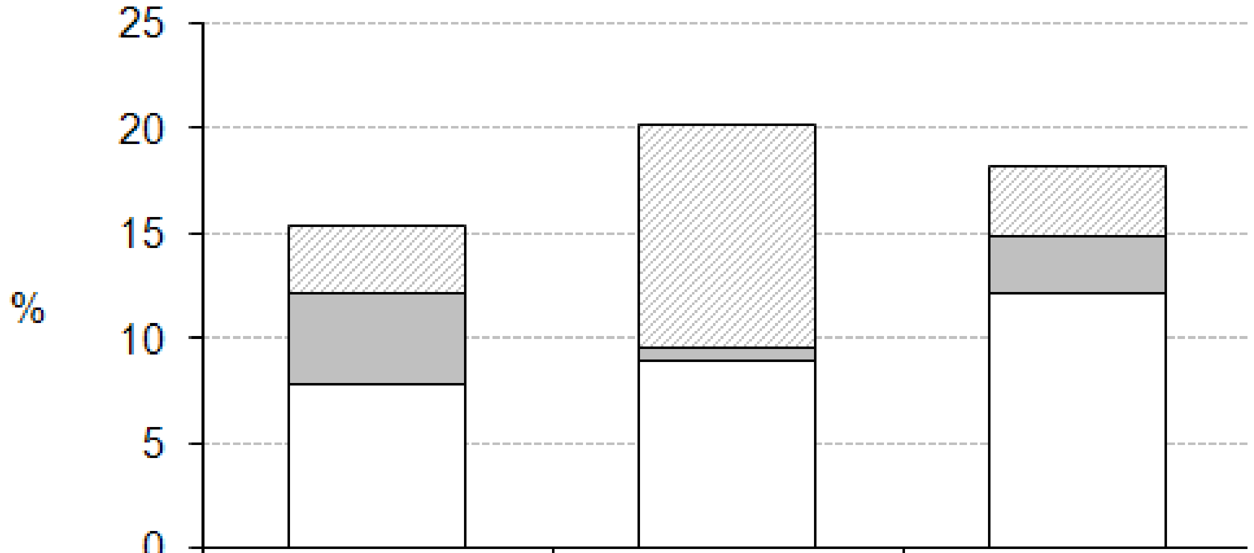
Diverse species assemblages within the context of the broadest extent dataset (southern Latium) were defined through distance-based Multivariate Regression Trees (MRT, De'ath, 2002).

We used the same dissimilarity matrix as response and the environmental variables as explanatory.

R package mvpart

Gagea villosa

Results



	Southern Lazio	Ernici range	Mount Scalambra
space	3,32	10,66	3,35
shared	4,32	0,64	2,75
environment	7,81	8,98	12,13

Histogram showing the variation partitioning derived from the Multiple Regression on distance Matrices analyses.

Space indicates the variation explained by the geographical distances, environment the one explained by environmental variables, shared is the portion of variance explained by these two sets of variables jointly.

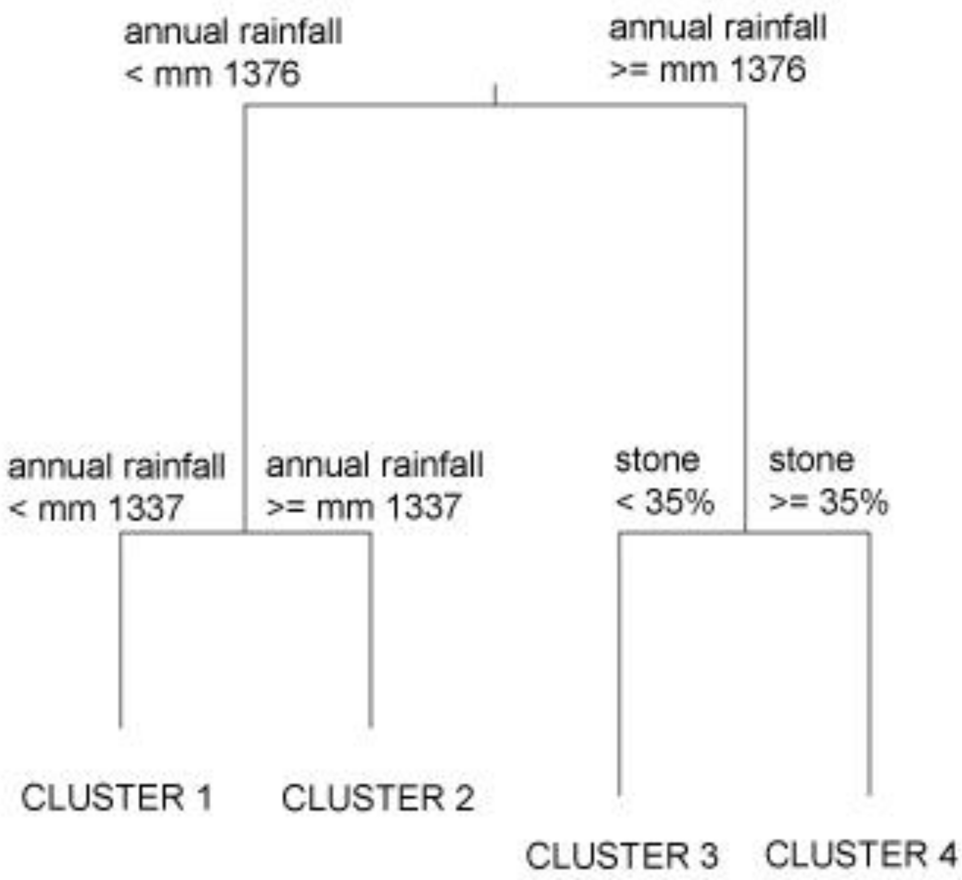
Results

β-coefficients and p-values of the explanatory variables used in the Multiple Regression on distance Matrices analysis

Explanatory variables	Southern Latium		Ernici range		Mount Scalambra	
	β	p	β	p	β	p
N/S gradient	0,0459	0,2380	0,0266	0,5842	0,0729	0,0627
E/W gradient	0,0924	0,0553	0,1037	0,0983	-0,0256	0,5777
Slope	-0,0680	0,2043	-0,0379	0,4326	-0,0619	0,101
Stones (%)	**0,1284**	0,0193	**0,1202**	0,0076	**0,1085**	0,0125
Rocks (%)	-0,0056	0,9130	0,0484	0,2694	0,0059	0,8865
Annual rainfall	**0,2199**	0,0012	-0,3663	0,4262	**-0,4419**	0,0136
Annual minimum temperature	-0,0006	0,9913	0,6292	0,1419	**0,7989**	0,0002
spatial distances	**0,2142**	0,0001	**0,3328**	0,0001	**0,1891**	0,0008
Total model	**0,1545**	0,0001	**0,2028**	0,0001	**0,1823**	0,0002

β-coefficients and p-values of the explanatory variables used in the Multiple Regression on distance Matrices analysis

Results



Regression Tree built using the dissimilarity matrix based on species abundances in the southern Lazio relevés as response and the environmental variables as explanatory.

Conclusions

Both spatial and environmental variables should be taken into account when selecting areas that need to be prioritized in management planning at all the scales considered in this study.

As regards the role of the environmental variables, our results are highly concordant with those of similar studies that focused on semi-natural grasslands, confirming that site characteristics are effective drivers of variation in species composition at the local scale, particularly in view of their relationship to climatic conditions (Marini et al. 2007; Raatikainen et al. 2009).

Erysimum pseudorhaeticum

Conclusions

The meaning of spatial distances varies at the different scales considered. At the finest scale, the effect of spatial distance is likely to be related to spatial autocorrelation.

By contrast, at the subregional scale it is related to biogeographical differences in the species pools. Indeed, the area analyzed in this study is crossed by the boundary between the Eurosiberian and the Mediterranean regions (Rivas-Martínez et al. 2004; ETC-BD 2006).

Conclusions

The unexplained variation is maximum at the broadest scale, since at this scale differences in the historical and current management of the grasslands as well as in its intensity may result in compositional differences.

Conclusions

β-diversity patterns may be used to drive grassland conservation policies by contributing to the selection of sites that should be targeted for management activities aimed at maximizing grassland habitat biodiversity.

Our findings demonstrate that conservation plans should take into account:

- the spatial patterns;
- scale issues;
- site characteristics and climatic variables.

Verbascum samniticum

Annual rainfall and stoniness proved to be critical factors for the grasslands of Habitat 6210(*) in southern Lazio, and should be taken into account when Natura 2000 sites for this Habitat are selected.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