Soil properties drive plant composition in a Mediterranean alpine metacommunity

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INTRODUCTION

In alpine habitats, plant communities are adapted **to harsh conditions**[1] and usually distributed in isolated patches of suitable habitat following **a metacommunity model**[2]. Dispersal capacity and environmental filters are key **drivers** for explaining community composition and structure[3], but we lack empirical studies focusing on quantifying the specific factors that shape **local** alpine metacommunities[4].

AIMS

- To quantify the relative influence of **topoclimatic predictors**, **physical** and **chemical** soil properties on community composition and structure (see table 1).
- To evaluate whether the influence of these factors differ between **specialist** and **generalist** species.

METHODS

- Following a systematic sampling across ridges, we sampled 40 alpine grassland sites between 1900 and 2190 m a.s.l. in a Mediterranean siliceous mountain region in NW Spain (see Figure 1).
- In each site, we sampled a circular plot with a 3 m radius, recording plant cover (%) of all vascular plants and collecting soil samples from 5 cores inside each plot that were analysed in the laboratory.
- The data was analysed by redundancy analysis (RDA). A first RDA was computed for topoclimatic, physical and chemical variables separately (see table 1). Significant variables were then included in a final RDA model.
- We repeated the same procedure for subsets of specialist and generalist species.

RESULTS

Preliminary RDA analysis showed concordant results across the three datasets. The following variables were found significant:

- **Mountain massif** (see Figure 1) and **latitude** (from topoclimatic variables).
- **Soil texture class** and **bulk density** (from soil physical properties).

The effect of chemical soil properties was not consistent: pH was found significant for all species dataset; carbon and organic matter only for generalists; but none was significant only for specialists.

Interestingly, when we analysed these variables in one final model for each dataset we found concordant results again (see Figure 2). Chemical soil properties had no longer a significant effect. However **soil texture class** and **bulk density** maintained a significant influence in all datasets. The effect of **Mountain massif** was significant for all species and for the specialists, suggesting the influence of spatial aggregation in these data sets (see table 2 for details).

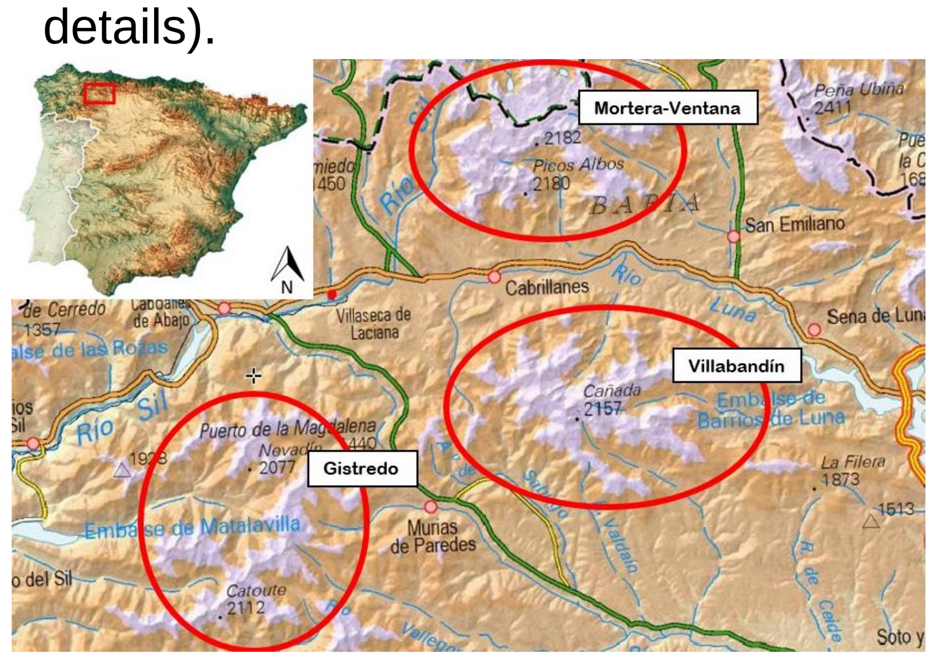


Figure 1. Map of the study area and the three mountain massif .

Topoclimatic	Soil physical	Soil chemical
Altitude	Bulk density	pH
Longitude	Sand fine	Carbon
Latitude	Sand coarse	Organic matter
Mountain massif	Silt	Nitrogen
Northness	Clay	Phosphorous
Eastness	Soil texture class	
Slope		

Table 1. Variables included in this study.

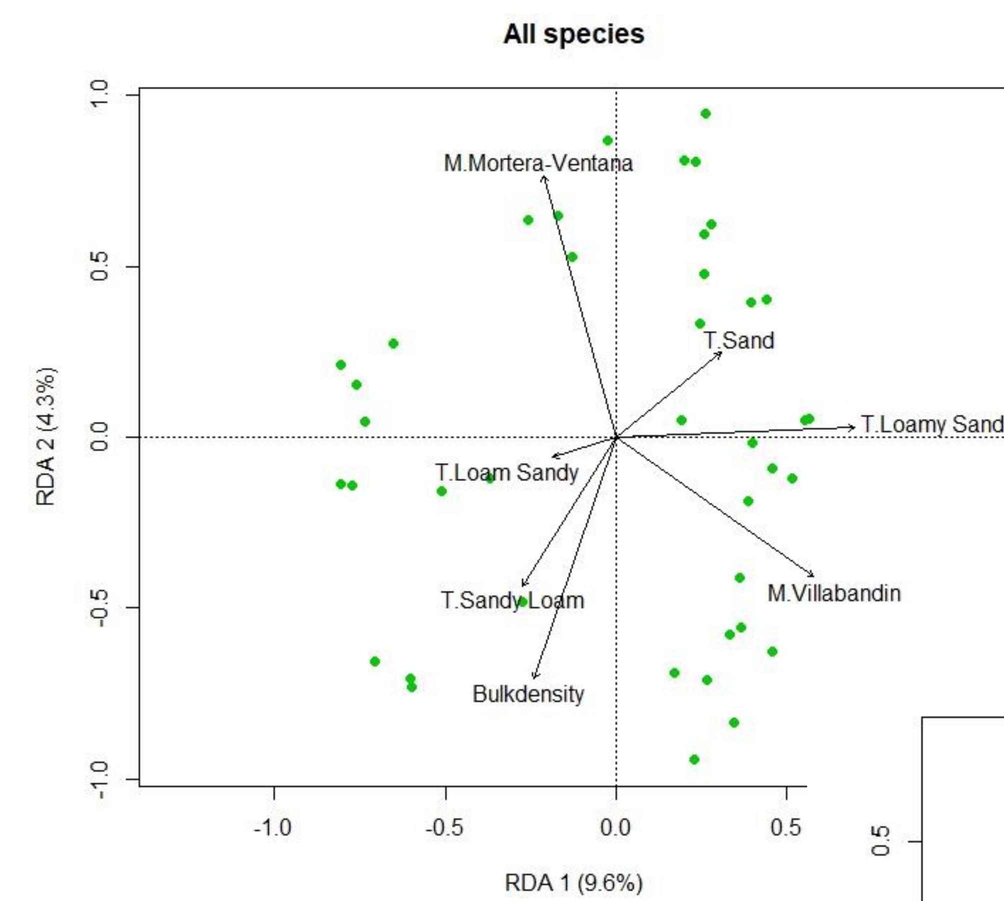
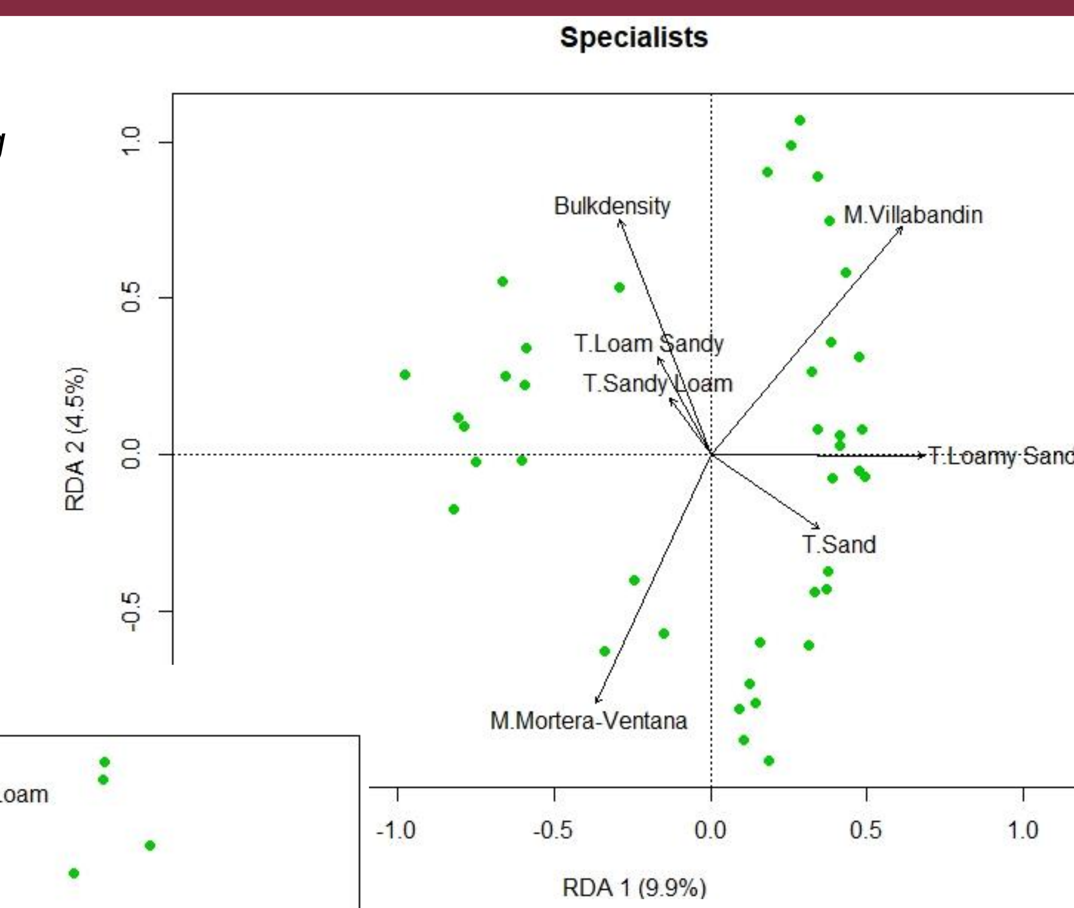
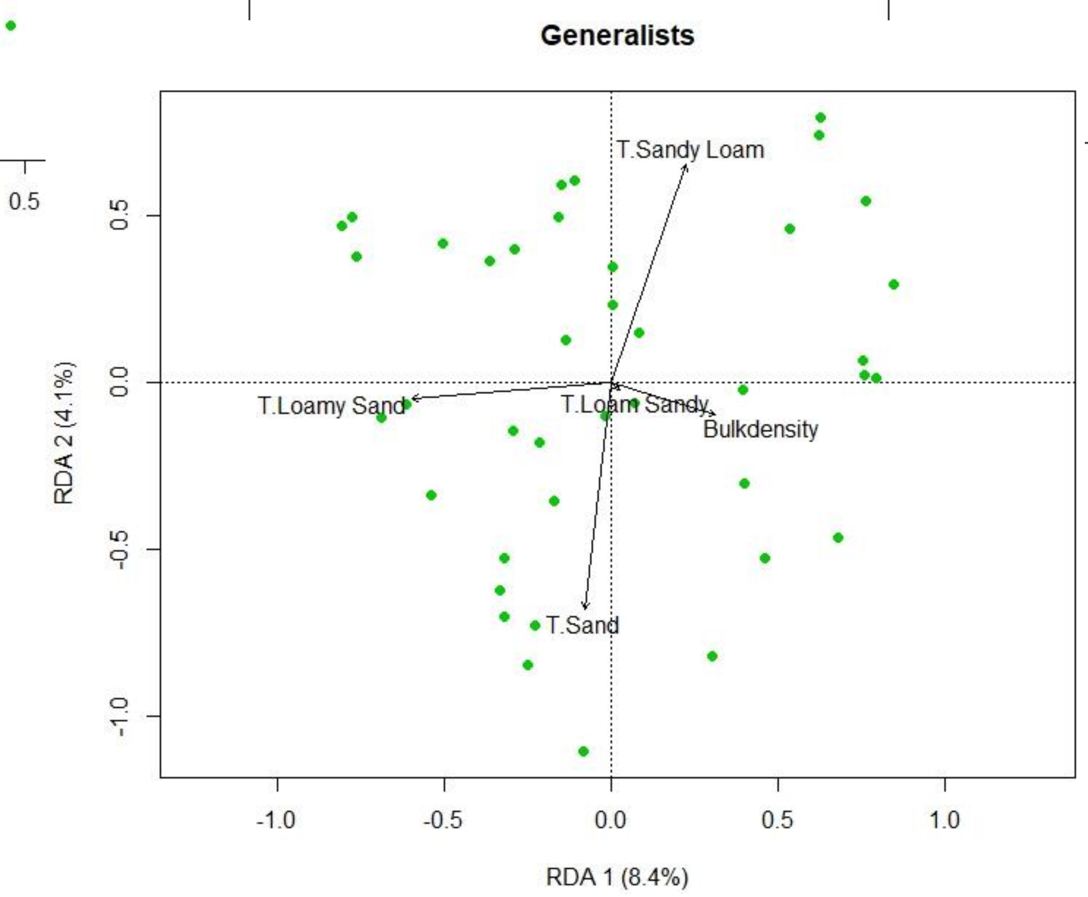


Figure 2. Biplots showing sites and significant variables explaining species composition for: All species, Specialists and Generalists.
***M.** indicate the mountain massif, in our case three (see Figure 1).*
***T.** indicate soil texture class.*





	Soil texture class		Bulk density		Mountain massif		Proportion of inertia explained
	P-value	R^2adj	P-value	R^2adj	P-value	R^2adj	
All species	0.002***	0.105	0.018*	0.138	0.034*	0.168	0.372
Specialist	0.002***	0.083	0.03*	0.154	0.036*	0.122	0.344
Generalist	0.002***	0.092	0.004**	0.13			0.331

Table 2. Final RDA models, for each dataset, with only significant variables specified. Inertia is a measure of variance.

CONCLUSIONS

Our results suggest that physical soil properties related to water content are the main filters structuring local composition in a Mediterranean alpine metacommunity. Specialist plants are further influenced by spatial aggregation, likely because of dispersal limitation (or undetected local factors). Further studies analysing species responses to water availability are needed to improve our understanding of vegetation dynamics under on-going climate change in Mediterranean mountains.

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