Do Species and Functional Diversity Indices Reflect Changes in Grazing Regimes and Climatic Conditions in Northeastern Spain?

F. de Bello
Forestry and Technology Centre of Catalonia, Spain

J. Leps
University of South Bohemia, Czech Republic

M. T. Sebastià
Forestry and Technology Centre of Catalonia, Spain

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Do species and functional diversity indices reflect changes in grazing regimes and climatic conditions in northeastern Spain?

F. de Bello[1], J. Leps[2] and M.T. Sebastià[1]

[1]*Laboratory of Plant Ecology and Forest Botany, Forestry and Technology Centre of Catalonia, pujada seminari s/n. E-25280 Solsona, Lleida, Spain, Email: fradebello@ctfc.es,* [2]*Department of Botany, Faculty of Biological Sciences, University of South Bohemia. Na Zlate stoce 1 CZ-370 05 Ceske Budejovice, Czech Republic*

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Introduction Understanding the mechanisms that maintain biodiversity in various ecosystems enables the development of management practices that prevent degradation (Canals & Sebastia, 2000). Each diversity index reflects some compositional properties and could be influenced differently by stress and disturbance factors (Magurran, 2004). In this study, we aim to reveal 1) which management practices and environmental factors affect biodiversity in rangelands of northeastern Spain and 2) the relationship between species diversity and functional diversity (SD and FD).

Methods Species frequencies were measured in natural slope vegetation areas, along a gradient of sheep grazing pressure (high, low, abandonment). Five locations were selected across a steep altitudinal and corresponding climatic gradient from Mediterranean rangelands to natural sub-alpine grasslands. The factorial design was 3 sheep grazing intensities x 5 locations x 2 aspects x 2 replicates = 60 plots. We calculated: 1) species richness (number of species); 2) species diversity according to Shannon (H^1) and Simpson (1-D); 3) species evenness according to Pielou and Camargo (see Canals & Sebastia, 2000); 4) species rarity (number of species classified "rrr") and 5) functional diversity (FD). The average of the pair-wise species differences weighted for their relative frequencies was used as a measure of the functional diversity in such a way that, if difference in all species pairs equals 1, the Simpson index is obtained (Shimatani, 2004). Species differences were calculated on the basis of 8 life history traits for the 467 species found. Three-way ANOVA was used and slope inclination (º) was covariate in the model. Duncan post-hoc test was performed to detect mean differences.

Results The effect of the studied factors on the diversity indices are given in Table 1. Climatic variables were the most important factor affecting species and functional diversity. Generally, diversity indices were lowest in a water-stressed environment (in the driest sites and southern aspects) and increased toward moist areas. FD reached its peak at intermediate elevations but the values in the wettest site resembled those in dry sites. Grazing enhanced species diversity, but no effect was found on functional diversity; species rarity was higher in abandoned areas. There was no clear relationship between species and functional diversity indices.

Table 1 Results of 3-way ANOVA for various diversity indices. Letters indicate different means. (*=P<0.05;**=P<0.01;***=P< 0.001)

	Richness	Shannon	Simpson	E Pielou	E Camargo	Rarity	FD
Slope (covariable)	NS	NS	NS	NS	NS	NS	NS
Aspect (south-north)	*	**	*	**	0.055	NS	***
Location (along climatic gradient)	***	***	***	***	***	***	**
Grazing intensity	0.060	**	*	***	***	*	NS
Aspect x Location	*	0.091	*	NS	NS	0.072	***
Aspect x Grazing	NS	NS	NS	NS	NS	**	NS
Location x Grazing	NS	*	*	*	**	***	***
Aspect x Location x Grazing	NS	NS	NS	*	**	NS	***
R^2 adj	0.60	0.74	0.76	0.73	0.71	0.67	0.86
GRAZING (abban/low/high)	a/b/b (+)	a/b/b (+)	a/b/b (+)	a/a/b (+)	a/a/b (+)	b/a/a (-)	NS

Conclusion Water stress decreases species diversity. Species rich grasslands are not functionally different. Grazing increased species diversity only, having no clear effect on functional diversity. Adequate grazing pressure on natural slope vegetation maintained the diversity of species.

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