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The impact of transhumant livestock system on the diversity of two mountainous grasslands in Northern Greece

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Abstract. The transhumant livestock system, which involves sheep and goats, is common in many countries of the Mediterranean basin. In Greece, transhumance uses the semi-natural vegetation of intermediate and high elevation grasslands for 5-6 months imposing variable pressures on the native vegetation. This paper investigated the impact of long term grazing of transhumant sheep and goats flocks on the diversity and land reclamation of two mountainous grasslands of Northern Greece. The experiment involved two high elevation Mediterranean grasslands of Northern Greece (Smolikas and Vermion mountains) located approximately 120 km apart. Measurements were carried out in the above areas in the middle of June 2012 including vegetation cover, while composition and the richness of the species were calculated. Thereafter, the index of similarity and plant species diversity and evenness were estimated. The results revealed no differences between the two grasslands regarding the (a) composition of species, (b) diversity of plant species, and (c) species richness. The percentage of vegetation cover was similar in the two grasslands, while the similarity index was small.

Keywords. Species composition – Richness – Sheep – Goats – Similarity index.

L'impact du système d'élevage transhumant sur la diversité de deux prairies montagneuses dans le nord de la Grèce

Résumé. *Le système d'élevage transhumant, qui associe des moutons et des chèvres, est courant dans de nombreux pays du bassin méditerranéen. En Grèce, la transhumance utilise la végétation semi-naturelle des prairies d'altitudes intermédiaires et élevées pendant 5-6 mois, imposant des pressions de pâturage variables sur la végétation indigène. Nous avons étudié l'impact à long terme du pâturage de troupeaux de moutons et de chèvres transhumants, sur la diversité et la remise en état des terres de deux prairies montagneuses du Nord de la Grèce. L'expérience comportait deux prairies méditerranéennes de haute altitude de la Grèce du Nord (montagnes de Smolikas et Vermion) situées à environ 120 km de distance. Les mesures ont été réalisées dans ces domaines au milieu de Juin. La couverture de la végétation a été mesurée, tandis que la composition et la richesse en espèces ont été calculées. Par la suite, l'indice de similarité et la diversité des espèces végétales et la régularité ont été estimées. Les résultats n'ont révélé aucune différence entre les deux prairies quant à (a) la composition des espèces, (b) la diversité des espèces végétales, et (c) la richesse en espèces. Le pourcentage de couverture de la végétation était similaire dans les deux prairies, tandis que l'indice de similarité était faible.*

Mots-clés. *Composition des espèces – Richesse – Moutons-Chèvres – Indice de similarité.*

I – Introduction

The transhumant livestock system is common in many countries of the Mediterranean basin. Transhumance developed by the livestock farmers in order to cope with the grazing seasonality of Mediterranean (Galanopoulos *et al*., 2011). In Greece, transhumance uses the semi-natural vegetation of intermediate and high elevation grasslands during late spring to autumn (5-6 months) (Zervas, 1998). In these mountainous areas plant species are still actively grow due to later stages

of maturity and wetter climatic conditions ensuring abundant and nutritious forages to fill up the feeding gap of the animals (Ispikoudis *et al*., 2004). The transhumant sheep and goats livestock system has a dynamic character, which is manifested through its social, economic and environmental impact in the areas involved. It also constitutes a particularly suitable activity for the development of less-favoured areas (Laga *et al.,* 2012) and it helps to keep cultural linkages among winter and summer residences. However, in Greece as well as in many Mediterranean countries (Oteros-Rozas *et al*., 2013), the transhumant livestock system presented a decreasing trend during the last 30 years.

This decrease affects the grassland landscape ecology as the characteristics of grassland communities (composition, production) are strongly oscillating in space and time according to plant species composition, succession stages, herbivore pressure, human activities as well as climatic conditions (Gatti et *al.,* 2005; Karatassiou and Koukoura, 2009). Moreover, grazing animals represent a key factor to avoid the activation of the successional processes, which causes the replacement of herbaceous communities with shrub communities (Rook *et al.,* 2004; Gatti *et al*., 2005). Shrub encroachments are generally assumed to have negative effects on floristic diversity (Dalle *et al.,* 2006; Kyriazopoulos *et al*., 2012) and to animals' diet as many of these are often unpalatable even to browsers (Knapp *et al*., 2008).

The two mountainous rangelands Smolikas and Vermion for many years have received high grazing pressure during late spring and summer from the transhumant sheep and goats especially from Thessaly (central Greece), but over the last year's this pressure seems to relaxed. The aim of this study was to investigate the impact of long term grazing of transhumant sheep and goats flocks on the diversity and land reclamation of two mountainous grasslands of Northern Greece.

II – Materials and methods

The study was conducted in grazed rangelands located near the village Ano Grammatiko (Vermion mountain) and Samarina (Smolika mountain) about 125 km and 225 km west of Thessaloniki, Greece respectively. Four experimental sites were selected in both areas in an altitude range from 1400 m to 1500 m. The areas are grazed mainly by sheep and goats from May to October. According to the bioclimatic map of Greece (Mavromatis, 1978) the climate of the two regions is characterized by a sub-Mediterranean and belong to humid bioclimatic floor with severe winter.

In both areas, ground cover was measured, at the middle of June 2012, according to the line and point method (Cook and Stubbendieck, 1986). Thereafter, species composition was estimated in four plant groups: (1) grasses, 2) legumes, (3) other forbs, and (4) shrubs. Three transect lines of 20 m long were used in each experimental site. In order to calculate the species richness (S), and evenness (E), two sampling quadrats of 0.35 x 0.35 m were used in every transect line. Species diversity was calculated by the Shannon Index (H'). Also, the similarity coefficient Sj (Jaccard) was calculated using the formula: Sj = a/(a+b+c) where a = number of species common in both areas, b = number of species in the first area only, c = number of species in the second area only (Magurran, 1991; Gurevich *et al*., 2006).The data were analyzed by ANOVA (Steel and Torrie, 1980) using the SPSS statistical software v. 20.0 (SPSS Inc. Chicago, IL, USA).

III – Results and discussion

The ground cover was 87.5% and 84.3% in Smolikas and Vermion respectively and, therefore, no significant differences were detected ($P \geq 0.05$). In addition, there were no significant differences ($P \geq 0.05$) in the contribution of the various plant groups in vegetation composition of the two grasslands. Significant differences ($P < 0.05$) were found only among the different plant groups within each grassland.

Table 1. Plant groups composition (%) in the two experimental mountain areas

Plant groups	Vermion	Number of species	Smolikas	Number of species
Grasses	60.51Aa	10	47.31Aa	9
Legumes	5.63Bb	2	23.17Ba	6
Other forbs	31.32Ca	13	27.08Ba	11
Shrubs	2.54Ba	1	2.44Ca	1

Means with different lower case letter in the same row differ significantly (P<0.05).
Means with different capital letter in the same column differ significantly (P<0.05).

In both experimental areas, the grass species contribute with the highest percentage compared to other plant groups. In Smolikas grasslands, participation of legumes species was significantly higher compared to Vermion ones. The differences in the vegetation composition between the two areas could be attributed to the biotic and/or abiotic factors such as climatic fluctuations, grazing pressure and/or to soil conditions (Gatti *et al.,* 2005; Salis, 2010).

Table 2. Species richness (S), Shannon diversity index (H') and evenness (E) in the two experimental areas. Values present means ± SE

Experimental area	(S)	H'	E
Vermion	26	1.84 ± 0.102	0.42 ± 0.023
Smolikas	27	1.70 ± 0.112	0.37 ± 0.028

During the experimental period, in the area of Vermion 26 plant species had been recorded while in the Smolikas one 27. There were no significant differences between grasses and other forbs, which were the dominant species in both areas. The species richness is in agreement with the species composition (Table 1), and it seems that the group species with the higher abundance contributed with higher percentage in vegetation composition of the two areas. The Shannon index and evenness presented the higher values in the Vermion grasslands but without significant differences from the Smolikas ones. These results confirm that vegetation of these areas has been formed by long term grazing for many years from the transhumant sheep and goats though both ecological and evolutionary process (Noy-Meir, 1998). Although, high similarity between the two areas was expected the similarity index between them was very low (17%). Low similarity coefficient under grazing has been earlier demonstrated (see Osem *et al*., 2004). The low similarity index between the two areas could be explained by the different grazing pressure (in recent years Vermion had low grazing pressure) as well as to different soil and climatic conditions (Migo, 2006; Ali-Shtayeh and Salahat, 2010). It is known, that the continuous grazing system with moderate grazing pressure allows the establishment and development of a more species-rich community compared to seasonal grazing (Sternberg *et al.,* 2000).

IV – Conclusions

Although the two mountainous grasslands present comparable species richness, diversity and evenness their similarity index is very low. It seems that the low grazing pressure (Vermion) negatively affected the number of legumes, and positively the number of grasses and forbs. In order to draw safer conclusion further and more research needs to be done.

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