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Vegetation cover and species composition under different grazing intensity in mountainous grasslands of Northern Greece

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Abstract. Grazing disrupts plant communities and affects the composition of species. The composition of species depends on season, frequency and especially on the intensity of grazing. The main purpose of this research is to study the effect of grazing intensity on species composition of mountainous grasslands. The vegetation cover and species composition were measured under three different grazing intensities (no grazing, moderate grazing and heavy grazing) at the peak of the plant's growth for two consecutive years (2013-2014) in grasslands of mountain Cholomontas in Northern Greece. Woody species predominated in no-grazing compared to both grazing treatments in both years of measurements while forbs only the first year. Grasses were higher on grazing treatments than in non-grazing for the two years, while legumes were higher in the heavy grazing treatment. Legumes and grasses increased gradually from the no-grazing to heavy grazing conditions both years of measurements. Litter was lower and higher in no-grazed grassland compared to moderate and to heavy grazed grasslands the first and second year of measurements respectively.

Key words. Grasses – Legumes – Forbs – Ungrazing – Moderate grazing – Heavy grazing.

La couverture végétale et la composition des espèces sous différentes intensités de pâturage dans des prairies montagneuses du nord de la Grèce

Résumé. *Le pâturage perturbe les communautés végétales et a des effets sur la composition des espèces. La composition des espèces dépend de la saison, la fréquence et en particulier l'intensité du pâturage. Le but principal de cette recherche était d'étudier l'effet de l'intensité du broutage sur la composition des espèces des prairies montagneuses. La couverture de végétation et la composition en espèces ont été mesurées sous trois différentes intensités de pâturage (sans pâturage, pâturage modéré, et pâturage intensif) à l'apogée de la croissance des plantes pendant deux années consécutives (2013-2014) dans les prairies des montagnes Cholomontas du nord de la Grèce. Les espèces ligneuses ont prédominé dans la situation sans pâturage par rapport au pâturage sur les deux années de mesures, tandis que les herbacées seulement la première année ; les graminées ont été plus fréquentes dans les deux traitements de pâturage pendant les deux années d'étude, tandis que les légumineuses ont été plus fréquentes dans la situation de pâturage intensif. Les légumineuses et les graminées ont augmenté graduellement à mesure que l'intensité de pâturage était augmentée pour les deux années de mesures. La litière était inférieure et supérieure dans les pâturages non broutés par rapport à ceux pâturés modérément et intensivement pour la première et la deuxième année de mesures respectivement.*

Mots clés. *Graminées – Légumineuses – Plantes herbacées – Pâturage – Modéré – Intensif – Non-pâturage.*

I - Introduction

Plant species composition and species response to grazing are fundamental for planning the managing of grasslands (Vesk *et al*., 2004). According to Landsberg *et al*. (2002) quantifying the impacts of livestock grazing on natural communities has become a major issue in the management of grasslands. The most obvious effects of grazing disturbance on plant communities include changes to vegetation structure and composition of species (Pettit *et al*.,

1995). Depending on the grassland and the intensity, grazing by livestock animals can dramatically change the structure of the vegetation (Pettit *et al*., 1995). Vegetation changes in response to grazing management decisions often modify primary plant and animal production and economic returns from the system, as well as other benefits like conservation value (Diaz *et al*., 2001).

The main purpose of this research was to study the effect of the intensity of grazing in vegetation cover and species composition of mountainous grasslands.

II – Methods and materials

The research was conducted in the University Forest of Taxiarchis in Cholomontas mountain, Chalkidiki (40°23' – 40°28' N, 23°28' – 23°34' E), at 800 m a.s.l., at the peak of plant's growth (May-June) for two consecutive years (2013 and 2014). The climate of the area is classified as subhumid Mediterranean, with a mean annual air temperature of 11.1° C and an annual rainfall of 767 mm.

The whole forested area is, around 5800 ha (3918 ha forested areas, 276 ha partially forested areas, 1563 ha agricultural areas and 86 ha abandoned fields). Grasslands are about 2500 ha. They are public and are communally grazed by 1200 goats and 900 sheep during the year.

Three sites of similar vegetation type but different grazing intensity in terms of Forage Utilization Percentage (FUP) (data not shown) were selected: (1) Ungrazed (FUP=0%), (2) Moderate grazed (FUP<50%) and (3) Heavy grazed (FUP>60%) (Taxiarchis Forest Service Station, 2013). The ungrazed area is private and has not been grazed for over 40 years. Each area covered approximately 2 ha. In each condition, 10 transects of 25 meters each were taken randomly and the cover of vegetation using the line-point method was measured (Cook and Stubbendieck, 1986). The species composition was derived from the measurements of cover, after deducting the litter, bare soil and stones.

General linear models procedure of SPSS statistical software (IBM SPSS 21 for windows) was used for ANOVA. The Duncan criterion at the 0.05 probability level was used to detect the differences among means (Steel and Torrie, 1980).

III – Results and discussion

The heavy grazing area had significantly lower and higher percentage of vegetation cover and bare soil respectively than the moderate and no-grazing ones (Table 1). On the other hand, the percentage of litter did not significantly differ among the grazing intensities in both years of measurements (Tables 1 and 2). Increased percentages of bare soil and low vegetation cover in heavy grazing areas have been also reported by Alrababah *et al*. (2007).

Table 1. Mean plant cover (%) in the three grazing treatments (year 2013)

Category	Heavy grazing	Moderate grazing	No-grazing
Vegetation	90.9 b	95.9 a	95.3 ab
Litter	5.8 a	3.6 a	4.2 a
Bare soil	3.3 a	0.5 b	0.5 b

[1]Means in the same line followed by the same letters are not significant different at the 0.05 level of significance.

Karakosta *et al*. (2010) reported that the total vegetation cover was significantly decreased due to grazing in the same study area.

Table 2. Mean plant cover (%) in the three grazing treatments (year 2014)

Category	Heavy grazing	Moderate grazing	No-grazing
Vegetation	87.6 a	91.1 a	91.3 a
Litter	7.2 a	6.5 a	8.5 a
Bare Soil	5.2 a	2.4 ab	0.2 b

[1]Means in the same line followed by the same letters are not significant different at the 0.05 level of significance.

Regarding the species composition, the percentage of woody species was significantly higher in ungrazed site compared to moderate grazed, while they were completely absent in the heavy grazed plots in both years of measurements (Tables 3 and 4). It is well documented that reduced livestock grazing results in an increase of shrub cover (Perevolotsky *et al*., 1998). Inversely, intense selective grazing pressure reduces the populations of large woody shrubs (Anderson and Hoffman, 2007). Moreover, shrub encroachment is widely recognised as one of the major threats to biodiversity in rangeland ecosystems (Dalle *et al*., 2006). On the other hand the loss of woody shrubs may increase the risk of soil erosion or disrupt nutritient cycling (Pettit *et al.,* 1995).

The percentage of grasses and legumes was significantly lower in the ungrazed site compared to moderate and heavy grazed sites in both years of measurements. Inversely, the percentage of forbs was significantly higher in the ungrazed in comparison to moderate and heavy grazed at least in the 1st year of observations. According to the results, the grazing exclusion affected the plant community composition, favouring mainly the forbs. On the contrary, Oba and Kotile (2001) reported a low cover of grasses and high cover of forbs in grazed sites compared to the ungrazed ones in arid zone grazing lands. According to Diaz *et al.* (2006) grazing does not uniformly favour forbs, graminoids or woody species. The plant composition in grazed lands is affected by numerous ecological and management factors (Gusmeroli *et al*., 2012).

Table 3. Mean plant composition (%) in the three grazing treatments (year 2013)

Category	Heavy grazing	Moderate grazing	No-grazing
Grass	63.53 a[1] (11)[2]	64.00 a (15)	28.90 b (8)
Legumes	16.06 a (3)	11.23 ab (8)	7.50 b (11)
Forbs	20.41 b (15)	23.17 b (27)	40.77 a (37)
Woody	0.00 b (0)	1.60 b (6)	22.83 a (6)

[1] Means in the same line followed by the same letters are not significant different at the 0.05 level of significance. [2]Number of species.

The second year of the measurements (2014) was unusually warm during the growing season (data not shown). This had as a result the drying some species (especially annuals) very early at the end of growing season. This fact could explain the absence of legumes in the no- grazing treatment.

Table 4. Mean plant composition (%) in the three grazing treatments (year 2014)

Category	Heavy grazing	Moderate grazing	No-grazing
Grass	59.2 a[1] (11)[2]	54.8 a (20)	39.9 b (6)
Legumes	16.2 a (14)	8.4 b (14)	0.7 c (5)
Forbs	24.6 a (16)	34.6 a (39)	34.2 a (30)
Woody	0.0 b (0)	2.2 b (1)	25.2 a (5)

[1]Means in the same line followed by the same letters are not significant different at the 0.05 level of significance. [2]Number of species

IV - Conclusions

Grazing pressure resulted in the decrease of vegetation cover and the increase of bare soil while litter remained stable. Grazing exclusion affected the plant community composition, favouring mainly the forbs.The present of woody species was higher in the ungrazed site compared to moderate grazed, while they were completely absented to the heavy grazed.

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