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The rates of desirable grazing plant species in rangelands: effect of different animal species and grazing pressures

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Abstract. The objective of the study was to determine whether increased grazing pressure (GP) or introducing different grazing animal species (AS) such as a different class of stock (DCS), like sheep or goats into a cattle system in pasture communities might be associated with reduced desirables and pasture condition score or increased invaders in the aboveground vegetation. In this study, natural pasture communities grazed by cattle (C: 100%) or by a mix of species (DCS: 41.7% sheep, 15.2% goats and 43.1% cattle) were selected, and the GPs were classified as <0.30 (very low, VL), 0.31 to 0.60 (low, L), 0.61 to 0.90 (high, H) and 0.91< (very high, VH) livestock unit days ha^{-1}. The percentages of shrubs and herbaceous invasive species were higher and lower for communities grazed by C than by DC, respectively. The L and VH showed higher values for decreasers compared to the VL and H. The percentage of shrubs in the communities under H was lower, whereas the percentages of herbaceous invasive species in the communities under VH were lower compared to the other GP. The interaction effects of grazing AS×GP on all studied parameters were significant. The results suggest that increasing GP depending on grazing AS prevents animals from grazing selectively and can contribute to the control of some weeds.

Keywords. Stocking rates – Weed control – Livestock – Botanical composition.

Le taux souhaitable de plantes ou d'espèces herbacées dans des pâturages naturels broutés par différentes espèces animales et soumis à différentes pressions de pâturage

Résumé. *L'objectif de l'étude était de déterminer si l'augmentation de la pression de pâturage ou l'introduction d'autres espèces d'animaux brouteurs, comme des brebis ou des chèvres, dans un système d'élevage avec pâturage, pourraient amener les communautés à être associées à une réduction des espèces désirables et de l'état des pâturages ou à une augmentation d'invasives dans la partie aérienne de la végétation. Dans cette étude, on a sélectionné les communautés des pâturages naturels pâturées par des bovins (100%, B), ou par un mélange d'espèces (MCB: 41,7% moutons, 15,2% chèvres et 43,1% bovins) et les unités de bétail jours ha^{-1} ont été classées comme <0,30 (très faible, TF), de 0,31 à 0,60 (faible, F), de 0,61 à 0,90 (haut, H) et 0.91< (très haut, TH). Les pourcentages des arbustes et des espèces herbacées envahissantes étaient plus élevés et plus bas pour les communautés pâturées par B et par MCB, respectivement. L et TH ont montré des valeurs plus élevées pour les décroissants par rapport à TF et H. Le pourcentage d'arbustes dans les communautés sous H a été plus faible, tandis que les pourcentages d'espèces herbacées dans les communautés sous TH ont diminué par rapport aux autres pressions de pâturage. Les effets de l'interaction de pâturage DP×DL sur tous les paramètres étudiés ont été importants. Les résultats suggèrent que l'augmentation de DL en fonction du pâturage Comme empêche les animaux de pâturer de manière sélective et peut contribuer à contrôler certaines mauvaises herbes.*

Mots-clés. *Taux de stockage – Contrôle des mauvaises herbes – Élevage – Composition botanique.*

I – Introduction

Grazing animal species and grazing pressure (GP) affect the desirable pasture species and/or the invasion of weeds. The understanding of the interactions between plant species and grazing

animals in rangelands is a key factor for preserving and maintaining both species diversity and optimum rangeland health or to controlling the invasive plants. Although grazing animals play a key role in altering plants diversity in rangelands (Rook and Tallowin, 2003), the long-term ecological consequences of the administration of various livestock grazing systems such as single and multi-species grazing remain poorly understood. Therefore, we hypothesized that grazing by different animal species in rangelands subjected to different grazing pressures can alter the rates of desirable for grazing plant species in these rangelands. Accordingly, the objective of this investigation was to determine whether different GP or introducing a different class of stock (DCS), like sheep or goats into a cattle system in rangelands, might be associated with reduced desirables and rangeland condition score (RCS) or with increased invaders.

II – Materials and methods

In this study, the botanical composition of rangelands in the Zonguldak province located on the Western Black Sea Region of Turkey (41°27′ N and 31°49′ E) at 40 to 86 m a.s.l., was evaluated. Approximately 2.2% of the studied area is under pastoral land use. The major pastoral system is extensive grazing by cattle on very large properties in the province with a mix of sheep, goats and cattle on the smaller properties in some parts of the province. Animal density in the studied area range between 0.04 and 1.79 livestock unit (LU) ha^{-1} (mean 0.54 LU ha^{-1}). Pastoral property sizes range from 0.62 to 58.7 ha (mean 10.9 ha). Summers are warm and humid, while winters are cool and damp with a mean annual temperature of 13.7 °C ranging from 7.0 °C in winter to 21.2 °C in summer. Average annual rainfall is 1233 mm (TSMS, 2015).

To determinate the rangeland condition, plant species in rangeland community were grouped as decreasers (high producing, palatable plants, and thus more desirable for grazing species), increasers (lower producing and less palatable plants) and invaders (introduced or native plants invade the rangeland as the decreasers and increasers are reduced by grazing). In calculating RCS, the lesser amount of each decreaser and increaser species was used, but invaders were not counted (Dyksterhuis, 1949). To evaluate the effects of grazing animal species (AS) and GP on decreaser, increaser, invader species and RCS we used a factorial arrangement of 2 AS and 4 GP in the completely randomized design. The 8 resulting treatments with 6 replicates were evaluated in a total of 21 rangeland communities (avg size = 10.9±1.47 ha) grazed *ad libitum* throughout the year for a long time and varied in animal density and grazing system. Ungrazed rangeland was not studied as a control. The AS categories were single-species grazing (100% cattle, C) and a DCS or multi-species grazing (composed of 41.7% sheep, 15.2% goats and 43.1% cattle). The GP was the animal unit (<0.30, 0.31 to 0.60, 0.61 to 0.90 and 0.90< LU days ha^{-1}) demand per unit of rangeland area, designated as very low (VL), low (L), high (H) and very high (VH), respectively. Standard deviation (mean±1 or 2 SD) was used as the criteria of grouping GP into the different classes. Animal numbers were obtained from Zonguldak Directorate of Food, Agriculture and Livestock. The total frequency of all plant species were calculated from plants observed using the step point method (Evan and Love, 1957). Then, invasive shrubs and herbaceous species were expressed as a percentage of the invader species.

According to experimental design, data were submitted to a two-way analysis of variance using the GLM procedure of SPSS and the Tukey's multiple range test was used to determine significant differences (SPSS 21.0; SPSS Inc., Chicago, IL, USA).

III – Results and discussion

In studied rangelands, vegetation was a mixture of 49 plant families, and the families such as *Fabaceae* (22.6%), *Gramineae* (16.0%), *Astraceae* (14.6%) and *Rosaceae* (7.1%) dominated the botanical composition. The rates of invasive shrub and herbaceous species were affected

by both the AS and GP while that of the decreaser only by the GP treatment ($p<0.05$, Table 1). The percentage of shrub and herbaceous invasive species in the communities grazed by C were higher and lower than that grazing by DCS, respectively. The L and VH levels of the GP treatments had higher values for decreasers compared to the VL and H. The percentage of shrubs in the communities under H was lower, whereas the percentages of herbaceous invaders under VH were lower compared to the other GPs. The decreasers in communities grazed by C under the VH level of GP had the highest percentage, whereas that in communities grazed by DCS under the L level of GP had the highest rate. The increasers of rangeland communities grazed by C under the VL level of GP had the lowest rate, whereas that of rangeland communities grazing by DCS under the VL and VH levels of GP had the lowest percentage. Regarding of the invaders' percentage, the highest values were recorded on rangelands grazed by C under the VL level and by DCS under the VH level of GP.

Table 1. The percentages of desirable for grazing species, the invaders and rangeland condition score in the natural rangeland communities grazing by different animal species and subjected different grazing pressure

AS	GP	Decreasers	Increasers	Invaders			RCS
				Shrub	Herbaceous	Total	
C	VL	2.47c	12.77b	39.92ab	44.85bc	84.77a	15.23c
	L	6.92abc	16.36ab	32.82abc	43.92bc	76.72ab	23.28bc
	H	11.73abc	14.29b	25.95abc	48.03bc	73.98ab	26.03bc
	VH	17.65a	18.84ab	17.50c	46.01bc	63.51b	36.49a
DCS	VL	5.74c	15.80ab	19.32bc	59.14a	78.46ab	21.54c
	L	17.01ab	18.05ab	15.99c	49.02bc	64.85b	35.06ab
	H	7.43abc	22.84a	12.00c	57.73b	69.73ab	30.27b
	VH	6.28bc	10.75b	43.80a	39.18c	82.98a	17.03c
AS	C	9.69	15.57	29.05a	45.70b	74.74	25.26
	DCS	9.11	16.85	22.78b	51.26a	74.04	25.96
GP	VL	4.10c	14.28	29.62ab	51.99a	81.61	18.39
	L	11.24a	17.18	24.41b	46.45ab	70.86	29.14
	H	9.58b	18.57	18.98c	52.88a	71.85	28.15
	VH	11.96a	14.80	30.65a	42.59b	73.24	26.76
SEM		1.208	0.909	1.658	1.547	3.057	2.057
Main effect of							
AS		NS	NS	*	*	NS	NS
GP		*	NS	*	*	NS	NS
AS × GP		*	*	**	*	*	*

AS: animal species, GP: grazing pressure, C: cattle, DCS: different class of stock, like sheep or goats into a cattle system, LV: very low (>0.30 LU days ha^{-1}), L: low (0.30 – 0.60 LU days ha^{-1}), H: high (0.61 – 0.90 LU days ha^{-1}) and VH: very high (0.90< LU days ha^{-1}), PCS: rangeland condition score. Means with different letters in the same raw are different ($P < 0.05$). *: $P < 0.05$, ** $P < 0.01$.

The multi-species grazing systems can be an effective management tool to control undesirable vegetation or the grazing of one livestock species can influence negatively the botanical composition despite it provides benefits (or facilitate) to other grazing livestock species (Abaye *et al.*, 1997). In this study, the DCS treatment was only beneficial to reduce the percentage of shrubs. Goats (or browsers) who graze primarily on shrubs and sheep (or intermediate feeders) who exhibit no particular preferences among grasses, shrubs or herbaceous invasive species, reduced shrubs cover. Hence, our results support the idea that including sheep and goats in an

extensive management system could have highly beneficial results in terms of vegetation composition (Walker *et al*., 1988). As reported by Abaye *et al*. (1997), rangelands grazed by goats, sheep and cattle had more invasive herbaceous species than rangelands grazed by cattle alone. Therefore, it can be argued that the current problem with invaders in the studied rangelands may be resulted from declining sheep and goat numbers during the past 20-30 years (TUIK, 2015). Indeed, many of the worst weeds in the C-grazed rangelands were shrub and herbaceous invasive species that sheep and goats find palatable such as leafy spurge, yellow star thistle, and spotted knapweed (Rutter *et al*., 2004). However, invasive herbaceous species such as *Dryopteris filix-mas* L. and Schott and *Galega officinalis* L. in the DCS-grazed rangelands were higher compared to the C-grazed rangelands.

The GP is important to express dietary preferences of grazing animals (Tallowin *et al*., 2005). Although preferences of grazing animals is typically problematic over the long term because of decreasing the more desirable species and increasing the less desirable ones (Baumont *et al*., 2005) as the GP increase, it is not necessarily always true, as reported herein. Our results on RCS may be attributed to the positive effects of the grazing herd on the range ecosystem relative to growth and diversity of plants and ecological succession (Bokdam, 2001).Therefore, invasion of weeds do not make the land unhealthy, they appear because the land is unhealthy, as reported by Hickman *et al*. (2004).

IV – Conclusion

The results of the present study indicate that differences in grazing pressure caused by variations in stock density for a long time did not dramatically affect selective grazing and that single-species grazing can have an adverse impact on the botanical composition of studied rangelands due to the fact that it increased the rate of shrubs. These results suggest that increasing GP depending on grazing AS prevents animals from grazing selectively and can be contributed to the control of some invaders. Generally, maintaining more desirable species in rangelands may increase the sustainability of the farming system.

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