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Grazing behavior and dietary preferences of sheep grazing a Mediterranean rangeland

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Abstract. Shepherds manage the feeding and grazing system of their flocks in order to achieve the coverage of animals' nutritional requirements and to maximize their productivity. The present study aimed to assess sheep grazing behavior and forage selection throughout the year, in order to provide useful information for the shepherds' management decisions. For this purpose, a flock of 250 Chios crossbreed sheep grazing in a hilly Mediterranean rangeland in Northern Greece was used. Grazing behavioral data was recorded using the direct observation method during three seasons (spring, summer and autumn). Measurements included the number of bites per functional plant group (grasses, forbs and woody plants) consumed by sheep. The animal's behavioral activities (feeding, walking and resting) were also recorded and analysed. Significant differences in dietary preferences were observed among the seasons. Grasses were selected mainly in spring and autumn at a rate significantly higher (60.3% and 54.2%, respectively) than summer whereas forbs were preferred in summer. Woody species were not consumed in spring whereas their contribution to sheeps' diet significantly increased in summer and autumn (21.4% and 20.5%, respectively) when the availability of herbaceous vegetation was reduced. Feeding was the main activity on the rangeland, represented an average of 70.4% of the recorded activities. Walking lasted significantly longer in autumn and resting time increased in summer probably due to the higher temperature. Despite the fact that sheep select mainly herbaceous species, woody vegetation is considered as an important forage source during the periods with low availability of herbaceous forages and it complements sheep nutrient intake.

Keywords. Selection – Grasses – Forbs – Woody plants – Behavioral activities.

Comportement pastoral et préférences alimentaires des moutons pâturent dans les pâturages méditerranéens

Résumé. Les bergers gèrent le système d'alimentation et de pâturage de leurs troupeaux afin de couvrir les besoins nutritionnels des animaux et d'optimiser leur productivité. La présente étude visait à évaluer le comportement d'ovins au pâturage et leur sélectivité tout au long de l'année, en vue de fournir des informations utiles aux choix de conduite des bergers. À cette fin, un troupeau de 250 ovins croisés de race Chios pâturent un parcours méditerranéen vallonné du nord de la Grèce a été utilisé. Les données relatives au comportement au pâturage ont été enregistrées à l'aide de la méthode d'observation directe pendant trois saisons (printemps, été et automne). Les mesures incluaient le nombre de bouchées par groupe fonctionnel de plantes (graminées, diverses et ligneux) consommées par les ovins. Les activités comportementales de l'animal (alimentation, marche et repos) ont également été enregistrées et analysées. Des différences significatives dans les préférences alimentaires ont été observées entre saisons. Les graminées ont été sélectionnées principalement au printemps et à l'automne à un taux nettement supérieur (60,3% et 54,2%, respectivement) à celui de l'été, alors que les herbacées ont été préférées pendant l'été. Les espèces ligneuses n'étaient pas consommées au printemps alors que leur contribution à l'ingéré était nettement accrue en été et en automne (21,4% et 20,5%, respectivement), périodes où la disponibilité de la végétation herbacée était réduite. L'alimentation était la principale activité sur parcours, représentant en moyenne 70,4% du temps d'observation. La durée de la marche était supérieure en automne et le temps de repos augmentait en été, probablement en raison de la température plus élevée. Bien que les ovins sélectionnent principalement des espèces herbacées, la végétation ligneuse est considérée comme une source de fourrage importante pendant les périodes de faible disponibilité de fourrages herbacés et complète l'ingestion de nutriments.

Mots-clés. Sélection – Graminées – Diverses – Plantes ligneuses – Activités comportementales.

I – Introduction

The most common sheep farming system in Greece is the traditional “semi-extensive system”, where grazing is applied in communal natural rangelands and on stubble after harvest (Hadjigeorgiou *et al.*, 1999). Shepherds are managing the feeding and grazing system of their flocks in order to achieve the coverage of animals’ nutritional requirements and to maximize their productivity (Manousidis *et al.*, 2016). Sheep prefer grazing than browsing and their diet consists mainly of herbaceous species (Mphinyane *et al.*, 2015). As woodlands and shrublands represent the dominant vegetation type in Greece (Papachristou *et al.*, 2005), the study of the seasonal preferences of sheep grazing in a rangeland is of great interest. The purpose of this study was to investigate the seasonal grazing behavior and forage selection of sheep in a Greek Mediterranean rangeland in order to contribute to the shepherds’ management decisions.

II – Materials and methods

The research was conducted in a communal rangeland in the foothills of the *Menikio* Mountain, close to *Sfelinos* village, in *Serres* region, northern Greece, at 430 m a.s.l. The climate of the area is characterized as Sub-Mediterranean. The mean annual precipitation is 589 mm and the mean temperature is 13.2 °C. The vegetation of the area consists mainly of herbaceous species as grasses and forbs. The area contains sparse woody vegetation usually in patches. The most common woody species are *Paliurus spina-cristi*, *Celtis australis*, *Ficus carica*, *Pyrus pyraster*, *Pyrus amygdaliformis* and *Rosa canina*. The area is grazed mainly by sheep and less by goats.

A flock of 250 *Chios* crossbreed sheep was monitored throughout the year (spring, summer and autumn), for four consecutive days during each observation period. A shepherd led the flock to a communal rangeland during all the grazing period, according to the traditionally extensive grazing system. The flock returned to the stall and was housed at night. Behavioral data was recorded using the direct observation method according to Altman (1974) sampling method and its modification described by Mancilla-Leytón *et al.* (2012) and Manousidis *et al.* (2016). Ten adult sheep were randomly selected each day from the flock in order to determine their dietary preferences. The observations were performed sequentially with an interval of 10 to 20 minutes to cover a large part of the grazing time for each day. The selected forage plants were grouped into grasses, forbs and woody species. The percentage of bites per plant group species, was used to express the forage selection by sheep, which was calculated using the following formula:

$$\frac{\text{Number of bites per plant group species}}{\text{Total bites}} \times 100$$

Sheep behavioral activities were also recorded using the regular interval observation technique with 15 min interval between observations (El Aich *et al.*, 2007). The activities were divided into feeding (grazing, browsing, walking between feeding stations), walking (directional movements), and resting (resting and/or ruminating, social activities and idling) (Schlecht *et al.*, 2006). The relative duration of each activity was calculated as the percentage of total of records per observation period.

All measurements were subjected to a one-way analysis of variance using version 8.0 of the JMP software (SAS Institute Inc, Cary, North Carolina). A multiple comparison for all pairs of means was performed using Tukey-Kramer HSD. The significance level was set to $P < 0.05$.

III – Results and discussion

According to the results, significant differences in dietary preferences were observed among seasons (Fig. 1). Grasses were selected mainly in spring and autumn at a rate significantly higher (60.3% and 54.2%, respectively) than in summer, when grass availability is usually limited due to the dry and warm weather conditions (Papachristou *et al.*, 2005). The contribution of forbs in sheep's diet tended to be higher in summer, but no significant differences were found between spring and summer. Woody species were not consumed in spring whereas their contribution to the diet was significantly increased in summer and autumn (21.4% and 20.5%, respectively) when the availability of herbaceous vegetation was reduced. Sheep avoid selecting woody plants in spring when the herbaceous species grow rapidly and are abundant due to the seasonal rainfalls, but when herbaceous species become scarce they rely on browsing (Rafiq *et al.*, 2010). This finding is accordance with Ngwa *et al.*, (2000), who reported that sheep spent a quarter of their grazing time browsing in a Sahelian rangeland dominated by thorn shrubs, during post-rainy and dry seasons. Additionally, Sanson *et al.* (2005) stated that sheep can be more selective compared with the larger ruminants, because of their narrow bite and split upper lip.

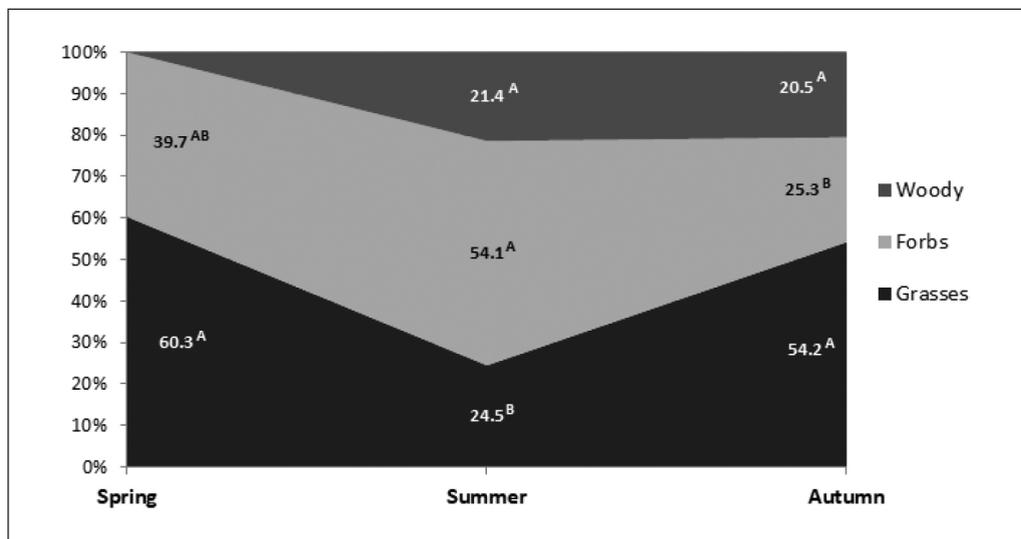


Fig. 1. Forage selection (%) by sheep in major plant categories.

Means followed by the same letter are not significantly different ($P \geq 0.05$).

Significant differences were recorded in the feeding and walking activities among seasons (Table 1). Feeding was the main activity and represented an average of 70.4% of the time. The higher percentages of feeding time were recorded in spring and summer (72.9% and 79.3%, respectively) whereas the walking activity was lowest during summer probably due to the higher temperature. Herders and animals reduced the daily walking distances during summer due to the high temperatures as they interrupted for a midday break (Akasbi *et al.*, 2012). Also, the distances travelled by Merino sheep in the Southern rangelands of Western Australia were reduced during the hot days (Thomas *et al.*, 2008).

Table 1. Behavioral activities (% of daily time in the rangeland) of sheep per season

	Spring	Summer	Autumn	p-value
Feeding	72.9 ^A	79.3 ^A	59.0 ^B	***
Walking	24.6 ^B	14.8 ^C	34.5 ^A	*
Resting	2.5	5.9	6.5	NS

*P<0.05, **P<0.01, ***P<0.001, NS: non significant. Means in the same row followed by the same letter are not significantly different (P≥0.05).

IV – Conclusions

Despite the fact that sheep select mainly herbaceous species, woody vegetation is an important forage source during the dry periods with low availability of herbaceous forages in the Mediterranean rangelands, and it contributes to fulfill their nutritional requirements. However, further quantitative measurements of available forage per vegetation type could bring other useful information to optimize shepherds' grazing management practices and supplementary strategies.

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