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in

Baumont R. (ed.), Carrère P. (ed.), Jouven M. (ed.), Lombardi G. (ed.), López-Francos A. (ed.), Martin B. (ed.), Peeters A. (ed.), Porqueddu C. (ed.).
Forage resources and ecosystem services provided by Mountain and Mediterranean grasslands and rangelands

Zaragoza : CIHEAM / INRA / FAO / VetAgro Sup Clermont-Ferrand / Montpellier SupAgro
Options Méditerranéennes : Série A. Séminaires Méditerranéens; n. 109

2014
pages 339-343

Seasonal preferences of grazing goats in a Mediterranean oak-juniper rangeland

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Abstract. The purpose of this study was to investigate the seasonal grazing behavior of goats in an oak - juniper rangeland ecosystem in the Mediterranean region. The research was conducted in Megalo Dereio, which is located in Evros region, northeastern Greece and is grazed by a flock of 750 local goats. Grazing behavior data were recorded in late spring (May), middle of summer (July) and late autumn (November) of 2010 and 2011. Behavioral data from five adult goats, randomly selected every time, were recorded for four consecutive days during each trial period. These animals were monitored sequentially for five minutes, in the morning and in the afternoon (total observation period of 50 min per day). Measurements included: number of bites per plant species and bite size as the average of hand-plugged samples similar to those consumed by the animals. Statistical analysis was conducted to test the seasonal preferences on the base of plant group species. According to the results significant differences on preferences were observed among the tested periods. Herbaceous vegetation was preferred during spring, while during summer and late autumn goats grazed mainly the woody species of the region (*Juniperus oxycedrus, Quercus frainetto, Cistus creticus*). The most preferred woody species was *Quercus frainetto* indicating that oak is the most essential browse species of the region for goat nutrition.

Keywords. Browse – Grazing behavior – Oak – Direct observation.

Préférences saisonnières des chèvres pâturant un parcours de chêne-genévrier méditerranéen

Résumé. *Le but de cette étude était d'étudier le comportement saisonnier des chèvres en période de pâturage dans un écosystème de chêne-genévrier dans la région méditerranéenne. L'étude a été menée dans Megalo Dereio, qui est situé dans la région d'Evros, au nord-est de la Grèce, dans une prairie qui est pâturée par un troupeau de 750 chèvres locales. Les données sur le comportement de pâturage ont été enregistrées à la fin du printemps (mai), au milieu de l'été (juillet) et à la fin d'automne (novembre) de 2010 et 2011. Les données comportementales de cinq chèvres adultes, sélectionnées chaque fois au hasard, ont été enregistrées pendant quatre jours consécutifs au cours de chaque période d'essai. Chaque animal a été surveillé pendant cinq minutes, le matin et l'après-midi (période d'observation totale de 50 min par jour). Les mesures comprenaient : le nombre de bouchées de chaque espèce végétale et la taille de la bouchée, qui a été calculée par la moyenne des prélèvements simulés (cueillis à la main) correspondant à chaque type de bouchée. L'analyse statistique a été réalisée pour tester les préférences saisonnières sur la base du groupe d'espèces végétales. Selon les résultats des différences de préférences considérables ont été observées parmi les périodes examinées. La végétation herbacée a été préférée au printemps, tandis que durant l'été et à la fin de l'automne les chèvres pâturent principalement les espèces ligneuses (*Juniperus oxycedrus, Quercus frainetto, Cistus creticus*). L'espèce ligneuse la plus préférée était* Quercus frainetto *indiquant que le chêne est l'espèce essentielle de la région pour la nutrition des chèvres.*

Mots-clés. *Parcours – Comportement de pâturage – Chêne – Observation directe.*

I – Introduction

Oak woodlands and shrub-lands are important forage source for grazing animals and mainly for goats in the Mediterranean basin (Perevolotsky *et al.*, 1998). It is well documented that goats prefer woody species more than the herbaceous ones and their diet mainly consists of lignified species (Dumont *et al.*, 1995). Due to their metabolic efficiency and their ability to convert the low-quality vegetation into high-quality products, they are able to utilize hilly and shrubby rangelands that cannot be used by other domestic animals. On the other hand, it has been reported that herbaceous species are preferred by goats during spring (Kababya *et al.*, 1998).

As goats are classified as selective feeders because of their special feeding behavior (Ngwa *et al.*, 2000), the further study of their seasonal preferences and the exploration of the botanical composition of their selected diet are of great interest. The purpose of this study was to investigate the seasonal grazing behavior of goats on a mixed oak-juniper rangeland ecosystem in the Mediterranean region.

II – Materials and methods

The research was conducted in an open oak forest in Megalo Dereio, Evros region, Northeastern Greece, at 380 m a.s.l. The climate of the area is characterized as Sub-Mediterranean. The mean annual precipitation is 560 mm and the mean temperature is 13.7 ^{o}C. The vegetation of the area on average consists of: *Quercus frainetto (8.93*%), *Juniperus oxycedrus* (8.46%), *Cistus creticus* (15.85%), other woody (0.72%), grasses *(35.76%),* legumes *(14.24%)* and forbs (16.04%). The dominant herbaceous species were the grasses *Dactylis glomerata, Poa pulbosa, Aegilops lorentii,* the legumes *Trifolium arvensis, Trifolium campestre, Lotus corniculatus* and the forbs *Sanquisorba minor, Matricaria chamomilla, Anthemis parnassica*. The area is grazed mainly by goats and less by sheep and cattle.

A representative flock of 750 local breed goats which are fed exclusively in the rangeland without any additional feeds was studied. Grazing behavior data were recorded in spring (May), summer (July) and late autumn (November) of two consecutive years 2010 and 2011. Behavioral data from five adult goats, randomly selected every time, were recorded for four consecutive days during each test period according to Altman (1974) sampling method and its modification described by Mancilla-Leytón *et al.* (2012). Each animal was monitored for 5 minutes in the morning and 5 minutes in the afternoon (total observation period of 50 min per day). The observations were performed sequentially with an interval of 10 to 20 minutes to collect forage samples for identification, covering a large part of the grazing time for each day.

Measurements included: Number of bites per plant species and bite size as the average of hand plucked samples to those consumed by the animals (Cook, 1964). Plant samples were collected in paper bags, oven-dried at 65^{o}C for 48 hours and weighed. Thus, the average weight of dry matter of bites per plant species was calculated. Herbaceous species were grouped into grasses, legumes and forbs.

The percentage of bites per plant group species was calculated using the following formula:

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

In order to calculate diet composition data were further grouped into four major categories: Oak, other woody species, acorns and herbaceous species. Diet composition was calculated for each observation day and period using the following formula:

$$\frac{\text{Number of bites per plant group species x Weight of its bite}}{\text{Total bites all plant groups species x Weight of its bites}} \times 100$$

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

III – Results and discussion

The percentage of bites of woody species (93.03%) was significantly higher in summer than the other two studied seasons (Table 1), while the higher percentage of herbaceous species was in spring and autumn. These results were expected as the available herbaceous vegetation is limited during summer due to the dry and warm weather conditions (Papachristou *et al*., 2005). The most selected woody species was *Quercus frainetto* which was preferred mostly in summer with a significantly higher percentage (56.41%) than in spring and in autumn (Table 1). *Juniperus oxycedrus* was consumed by goats mainly in spring when its leaves were more gently. The deciduous species *Carpinus orientalis* was preferred mainly in summer. Similar findings have been reported by Papachristou (1996) in Northern Greece. On the contrary, *Cistus creticus* was selected mainly in autumn, when the more palatable deciduous woody species had started to drop their leaves. There were no significant differences among the seasons for *Rubus* sp. and *Paliurus spina-christi.* Regarding the herbaceous species, grasses were the most preferred by 15.09% and 20.55% respectively, especially in spring and autumn. Their relatively high percentage of preference in autumn could be related to their high regrowth rate, especially in 2010. Legumes were selected mainly in spring at a rate significantly higher than the other two seasons. Acorns were selected only in the autumn of 2010 due to the oak's masting that year.

Table 1. Total bites/ species/ season (%) produced by the direct observation of goats

	Spring	Summer	Autumn	p-value
Woody	**50.91**	**93.03**	**60.32**	***
Quercus frainetto	19.94 ^{B}	56.41 ^{A}	24.58 ^{B}	***
Juniperus oxycedrus	20.61 ^{A}	7.89 ^{AB}	6.28 ^{B}	*
Cistus creticus	4.52 ^{B}	1.50 ^{B}	29.02 ^{A}	***
Rubus sp.	1.03	2.37	0.44	NS
Carpinus orientalis	4.51 ^{B}	22.47 ^{A}	0.00 ^{B}	***
Paliurus spina-christi	0.29	2.39	0.00	NS
Herbaceous	**49.09** ^{A}	**6.97** ^{B}	**34.45** ^{A}	***
Grasses	15.09 ^{A}	3.44 ^{B}	20.55 ^{A}	**
Legumes	21.78 ^{A}	1.27 ^{B}	4.29 ^{B}	***
Forbs	12.23 ^{A}	2.26 ^{B}	9.61 ^{AB}	*
Acorns	**0.00**	**0.00**	**5.23**	***

*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).

The largest proportion of the total goats' diet consisted of woody species, particularly *Quercus frainetto* (Fig. 1). The high contribution rate of *Quercus frainetto* is due to its high preference and the large amount of weight of each bite. The participation rates of the other woody species were not significantly different among the seasons. The proportion of herbaceous species in goats' diet was significantly higher (42.09%) in spring compared to autumn although there were no differ-

ences in the corresponding percentages of bites. This result is probably explained by the larger size of bites in the spring compared to the autumn. Acorns participated only in autumn in goats' diet at a rate of 25% approximately, which was significantly higher than the corresponding level number of bites in the same period (Table 1) due to the very large weight of each bite which consisted of a whole acorn.

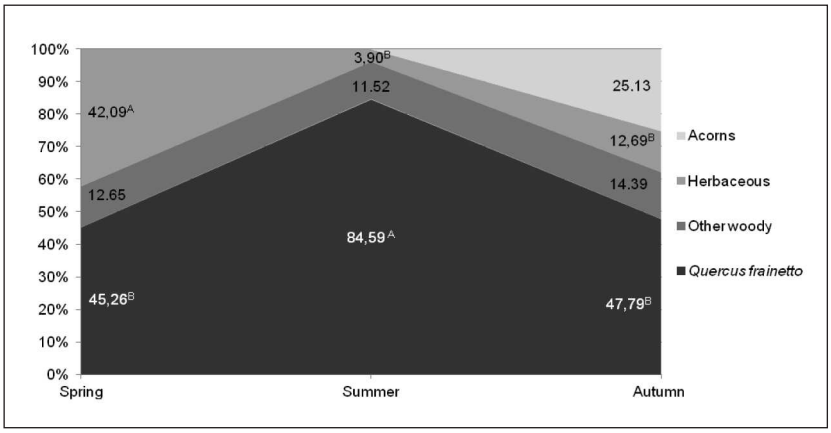

Fig. 1. Percentage (%) of goats' diet composition in major plant categories.
Means followed by the same letter are not significantly different (P ≥ 0.05).

IV – Conclusions

Although preliminary, the results indicate that the herbaceous vegetation was equally preferred to woody species only during spring, while during summer and autumn goats grazed mainly the woody species. Acorns are also an important part of goats' diet during mast years. The most preferred species was *Quercus frainetto* indicating that it is an essential browse species for goat nutrition in the dry periods of the year in the Mediterranean basin. Thus, this fact should be taken into consideration for the sustainable management of oak woodlands.

Acknowledgments

This paper is dedicated to the loving memory of associate professor Zafeiris Abas, Democritus University of Thrace, Greece. He was not only a superior scientist, but also a warm-hearted human being.

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