

Spatio-temporal analysis of sheep and goats grazing in different forage resources of Northern Greece

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Abstract

Grazing animal moving patterns are largely affected by the shepherd himself but also related with the grazing season as well as the kind of livestock species and the available forage resources. In this paper, the spatial distribution of representative flocks of sheep and goats were recorded in different grazing areas of Askos village in Northern Greece in order to study the total time spent for the activities of feeding, moving, ruminating and standing in different forage resources during the day as well as the time they devoted for the activity of feeding during the year. It was found that sheep and goats used to a different extend the grazing areas, depending on season, and vegetation type. More specifically, during the spring period, both animal kinds spent more time (sheep 255 min/day and goats 298 min/day) in rangelands (mainly shrublands and grasslands) than in agricultural land (mainly temporal pastures and fallow land; 108 min/day for sheep and 123 min/day for goats). During summer, goats used more agricultural land (mainly cereal stubble and fallow land) than rangelands (325 min/day and 255 min/day, respectively), while sheep did the opposite (270 min/day and 398 min/day, respectively). Rangelands were mainly used during the winter period, when weather conditions allowed animals to graze (2475 min/day for sheep and 3025 min/day for goats). It seems that animals spent more time searching for feed in rangelands and this was more pronounced during spring for goats and in summer for sheep. Agricultural land and rangelands supplemented each other in providing forage throughout the year, while animal activities were diversified according to animal kind and season.

Key words: small ruminant grazing activities, rangelands, Greece

Introduction

The production system of sheep and goats in northern Greece is based traditionally on grazing of communal rangelands, which can provide forage to animals for only 6-7 months during the year (Yiakoulaki et al. 2003). Agricultural land (e.g. fallow land and temporary pastures during spring as well as cereal stubble after harvesting in summer) are used alternatively by farmers to fill the feed gap in the remaining months of the year.

Rangeland and agricultural land use depends to a great extent on grazing animal moving patterns, which are largely affected by the shepherd himself, but also related with the grazing season as well as the kind of livestock species and forage availability. Sheep and goat flocks following

specific grazing circuits from sheds to these diversified forage resources come across an extremely heterogeneous environment which dictates their behaviour, especially their feeding, moving and standing activities (Evangelou et al. 2008).

In this paper, the spatial distribution of representative flocks of sheep and goats were recorded in communal mediterranean rangelands as well as agricultural land, in order to study the total time spent for grazing in different forage resources during the day as well as the time they devoted to the various activities during the year.

Material and methods

The research was conducted in the Askos village of the Lagadas County, located northeast to the city of Thessaloniki, Northern Greece, during spring and summer of 2007 and winter of 2008. The study area has a total surface of 7,871 ha. Mean annual precipitation is 556 mm and mean air minimum temperature is 3 °C, indicating a semi arid mediterranean climate. Topography varies with the flat areas occupied by arable lands and the hills and mountains covered by natural vegetation. The latter is dominated by evergreen shrublands mainly composed of kermes oak (*Quercus coccifera* L.) interspersed by openings with herbaceous species (Hugues et al. 2008). The available resources were classified as rangelands (grasslands, shrublands and forest ranges) and agricultural land (temporary pastures, fallow land and cereal stubbles after harvesting). The experimental animals were raised for milk and meat purposes. They were moved by shepherds to grazing areas during the largest part of the day while at night they were sheltered in sheds.

Animal activities of four representative sheep and goats flocks (two flocks from each animal kind) were recorded in different seasons of the year. A focal sampling technique (Altman, 1974) was applied in six adult female animals (three sheep and goats of each flock) which have randomly selected. These animals were marked with large numbers on their sides for identification. The animals were followed continuously with a sampling period of 10 minutes, by three observers for two consecutive days in each studied period. The recorded activities were:

- feeding time (the time that animals spent for grazing and browsing),
- moving time (the time that animals spent for moving from one site to another site),
- standing time (the time that animals stopped all their activities and stood inactive),

- ruminating time and
- laying time (the time animals devoted for laying or rest)

During the experimental periods, the daily track of the flocks was recorded with the use of a handheld GPS. This route was exported into ArcGIS and segments of 10 minutes as sampling units were cut. Each segment was overlaid with a detailed land use map, which was created from IKONOS image (acquisition date November 2007) and from field records.

Animal activities of each flock were grouped according to the season, animal kind and forage resource. The average time devoted from sheep and goats to the different forage resources were subjected to Univariate Analysis of Variance (General Linear Model) with SPSS and, when needed, LSD test was applied for multiple comparisons (SPSS Inc. 2001).

Results and discussion

Taking into account the time spent (Table 1) for feeding in relation to other activities (moving, standing, and ruminating), it was found that both kind of animals spent for this activity less time in rangelands in comparison to agricultural land ($P \leq 0.05$) during spring and summer. Sheep spent more time for feeding than goats during spring, while in summer the opposite ($P \leq 0.05$) happened. During winter, animals were found to graze only in rangelands, while there was no significant difference ($P \leq 0.05$) in feeding time between animal kinds. Goats were found to spend more time for moving than sheep during spring and summer ($P \leq 0.05$). Only in summer, feeding, moving and standing showed interaction between animal kind and resources with significant differences ($P \leq 0.05$). Sheep were not found laying, while goats devoted only a very small part of their total time (less than 2%). For this reason, this activity was not considered in further analyses.

Grazing animals used to a different extend the grazing areas, depending on season, resource type and animal kind. Converting the percentage of time of Table 1 in minutes per day it comes out that during the spring season, both animal kinds spent more time (255 min/day and 298 min/day for sheep and goats, respectively) in rangelands than in agricultural land (108 min/day for sheep and 123 min/day for goats). During summer, goats used more agricultural land than rangelands (325 min/day and 255 min/day, respectively). On the contrary, sheep used more the rangelands compared to stubble fields (270 min/day and 398 min/day, respectively). Rangelands were mainly used during the winter period, when weather conditions allowed animal to graze. The corresponding time was 248

min/day for sheep and 303 min/day for goats. Animals also spent more time during the day for feeding, moving and standing, in comparison to ruminating and laying.

Table 1. Percentage of time (%) devoted to animal activities by sheep and goats on different resources during spring, summer and winter

Season	Animal Activities	Animal kind		Forage resource	
		Sheep	Goats	Rangelands	Agricultural land
Spring	Feeding	61.9a ¹	40.6b	38.9b ¹	63.6a
	Moving	19.4b	38.0a	32.1a	25.3b
	Ruminating	1.8a	4.9a	3.2a	3.6a
	Standing	16.9a	14.3a	25.2a	6.1b
Summer	Feeding	31.4b	40.1a	18.1b	53.4a
	Moving	24.6b	34.9a	21.6b	38.0a
	Ruminating	0.2b	2.0a	1.3a	0.9a
	Standing	43.8a	22.8b	58.9a	7.7b
Winter	Feeding	57.8a ²	52.2a	-	-
	Moving	34.7a	33.5a	-	-
	Ruminating	0.2b	3.7a	-	-
	Standing	7.4a	9.6a	-	-

¹Means of animal kind or forage resource within the same row followed by a common letter were not significantly different ($P \leq 0.05$). ²Means of animal kind within the same row followed by a common letter were not significantly different ($P \leq 0.05$)

Percentage of time devoted to animal activities by sheep and goats on different type of resources (grasslands, shrublands and forest ranges as well as fallow, stubble fields and temporary pastures) is presented in Table 2. Specifically, animals spent more time ($P \leq 0.05$) for moving in cereal stubble fields during summer compared to fallow land and temporary pastures.

Furthermore, in agricultural land, sheep spent significantly more time ($P \leq 0.05$) for feeding than goats, while goats spent more time for moving and ruminating. Finally, moving activity in both resources was found to interact between animal kind and resource type ($P \leq 0.05$).

Table 2. Percentage of time (%) devoted to animal activities by sheep and goats on different type of resources

Resource	Animal activities	Animal kind		Resource type		
		Sheep	Goats	Grasslands	Shrublands	Forest ranges
Rangelands	Feeding	33.4a ¹	35.0a	32.8a	37.6a	30.2a
	Moving	31.9a	40.7a	34.9a	34.0a	43.7a
	Ruminating	1.5a	2.8a	2.3a	1.4a	3.4a
	Standing	33.3a	20.5a	29.5a	26.5a	22.3a
Agricultural land		Sheep	Goats	Fallows	Cereals	Temporary pastures
	Feeding	66.6a	49.8b	61.8a	52.3a	60.5a
	Moving	28.8b	35.9a	29.9b	38.9a	28.1b
	Ruminating	0.0b	3.5a	0.9a	1.2a	3.3a
	Standing	4.6a	9.9a	6.6a	7.6a	7.6a

¹Means of animal kind or resource type within the same row followed by a common letter were not significantly different ($P \leq 0.05$)

Conclusions

Animals spent more time searching for feed in rangelands than in agricultural land and this was more pronounced during spring for goats and in summer for sheep. Agricultural land and rangelands supplemented each other in providing forage throughout the year, while animal activities were diversified according to animal kind and season.

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References

- Altman J. 1974. Observational study of behavior: Sampling methods. *Behaviour* 49, 227-267.
- Evangelou Ch., M.D. Yiakoulaki and V.P. Papanastasis. 2008. Evaluation of sheep and goats breeding system and the subsidies paid in Askos village community of Lagadas county, Prefecture of Thessaloniki. In: K. Mantzanas and V.P. Papanastasis (eds). Range science and

Protected Areas. Proceeding of the 6th Panhellenic Rangeland Congress in Leonidio Arcadia Peloponnesus. pp 179-185. (In Greek with English summary).

Hugues L., Ch. Evangelou, M. Stellmes, J. Hill, V.P. Papanastasis, G. Tsiourlis, A. Roeder and E.F. Lambin. 2008. Land degradation and economic conditions of agricultural households in a marginal region of northern Greece. *Global and Planetary Change* 64: 198–209.

SPSS Inc. 2001. SPSS Base 11.0 for Windows User's Guide. SPSS Inc., Chicago IL.

Yiakoulaki M.D., M.P. Zarovali, I. Ispikoudis and V.P. Papanastasis. 2003. Evaluation of small ruminants' production systems in the area of Lagadas County, Greece. In: P. Platis and T. Papachristou (eds). Range Science and Development of Mountainous Regions. Proceeding of the the 3rd Panhellenic Rangeland Congress in Karpenisi Greece, pp. 395-402. (In Greek with English summary).