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Contents

Small ruminants as a fire management tool in a Mediterranean mountain region

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Introduction

Forests represent a key-resource for the Mediterranean region and have supplied wood and non-wood products for centuries. Socioeconomic transformations that have been taking place for the last one hundred years convert forestlands into time bomb able of blowing up every summer. Actually, Southern Europe has in last years experienced dramatic changes in the fire regime because of changes of land use. Further alterations toward more severe fire events are expected with the prospect of a warmer and drier future. Portugal has adopted some policy regulations to protect the forest, including a national strategy for forests and a national defense plan against forest fires. Despite improvements in fire statistics, Portugal failed to achieve the goals it had set itself. Political options privilege fire suppression, even though land and forest management issues are at the core of the wildfire problem. Agroforestry systems can be used as a forest fire prevention technique, since they implement a fuel management network at different scales of landscape. Particularly, silvopastoral systems (SSP) are especially interesting as a fuel management tool and reducing fire risks. The objective of this study was to compare the diet of goats and sheep in a SSP namely *mosaic of different land uses within one management unit* (Etienne, 1996).

Material

The experiment was carried out in Morais region, NE of Portugal (Nature network, 2000). It is one of the most representative serpentine areas of Portugal. Extensive livestock production is a key activity in this region. Forestland use occupies about 68 % of the territory (ICN, 2006) and it is comprised by semi-natural grasslands and scrublands (about 43 % of the surface), and woodlands (about 25 % of the forest land use). The herds of goats and sheep, guided by a shepherd, set out for pasture every day. For the purpose of the present study three herds of goats (*Serrana* breed), and three herds of sheep (*Churra Terra Quente* breed) were followed. To evaluate diet composition and goats and sheep selectivity (herbaceous, shrub and tree), a method of visual observation was used (Altmann, 1974). Animal activity and grazed species were checked each 15 minutes (instantly recorded). Field observations were made in September (autumn) 2010, January (winter), April (spring), and July (summer) 2011. During summer, when temperatures were very high, herds of

sheep were monitored at night. Grazing itineraries of each herd were recorded by GPS (one day per season). Data GPS comprise time, geographical position and land cover of 24 herd itineraries (4 by herds). Diet composition was estimated by the ratio between the number of animals in each vegetal plant and the total of animals in feed activity. Diet selection was estimated by the preference index of Krueger (Krueger, 1972). It is described as the ratio of the percent of a species in the diet to the percent on the study area: $RP_i = \Sigma_{k=1,n} (D_{ik}/RA_{ik})/n$, where P_i is the mean preference ratio over *n* areas; D_i is the percent of species *i* in the diet, and RA_i is the percent of species *i* in the area. This model is easy to interpret in terms of whether an animal is for or against a species. Values greater than 1 indicate preference, while values less than 1 indicate avoidance. Preference index was calculated in goats and sheep in each sampling season (spring, summer, autumn and winter). With ANOVA analysis we tested the effect of herds (sheep or goats) and season (autumn, winter, spring or summer) on diet diversity. Logarithmic transformations and the Bonferroni test were used to detect any significant differences ($P<0.05$). The statistical software package SYSTAT 12 was used for all analyses.

Results

Herbaceous ingestion in goats and sheep tended to increase in spring, although not significantly, compared to the other grazing seasons (Table 1). The presence of tree species in the diet of goats and sheep increased significantly in autumn compared to the other seasons ($P < 0.05$). Shrubs ingestion tended to increase during summer and winter compared to autumn, in goats; and decreased in autumn compared to winter, in sheep.

	Goats			Sheep		
	Herbaceous	Shrub	Tree	Herbaceous	Shrub	Tree
Autumn	49	16	35a	80	1	19a
Winter	42	37	21bc	78	11	11b
Spring	69	21	10c	94	6	0.2c
Summer	38	33	30b	83	6	11b

Table 1. Percentage of herbaceous, shrubs and tree in the diet of goats and sheep in autumn, winter, spring and summer. Different letters indicate significant differences between seasons in the same vegetation type.

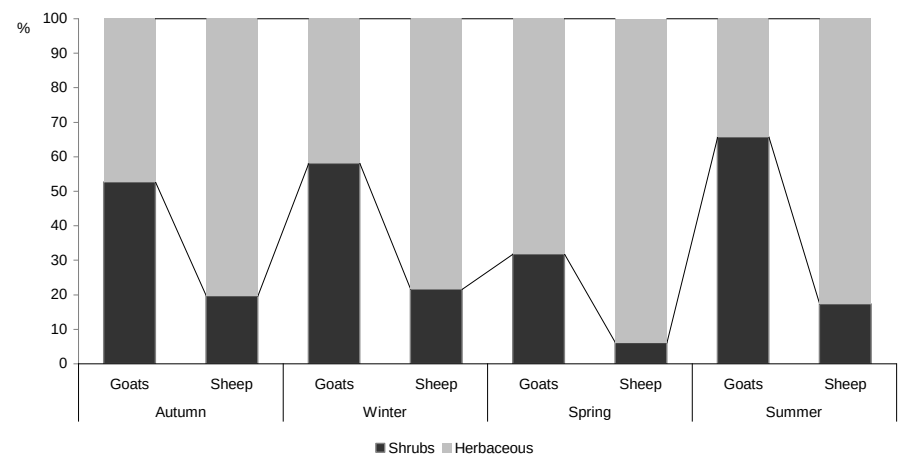

Fig. 1 Percentage of herbaceous species and shrubs in goats and sheep diet in each season

Goats' diet composition had higher content of shrubs species than that of sheep along the year while; sheep had a higher content of herbaceous species in their diet (Fig. 1). The presence of shrubs decreased in the diet of both animals during the spring. Finally, the individual preference of the animals being studied by some shrubs species presents in the area can be seen in Fig. 2. *Erica spp.* (Er) in sheep and *Rubus* sp. (Ru) in goats were the shrubs with the highest preference index (both species in summer). Goats showed a higher preference for *Genista hystrix* (Gh), *Erica* spp (Er) and *Cistus ladanifer* (Ci) except in spring. On the other hand, some species such as *Cytisus multiflorus (Cm)*, *Lavandula pendulata* (Lv) (autumn), and *Cistus ladanifer* (Ci) (summer) were avoided by both animals.

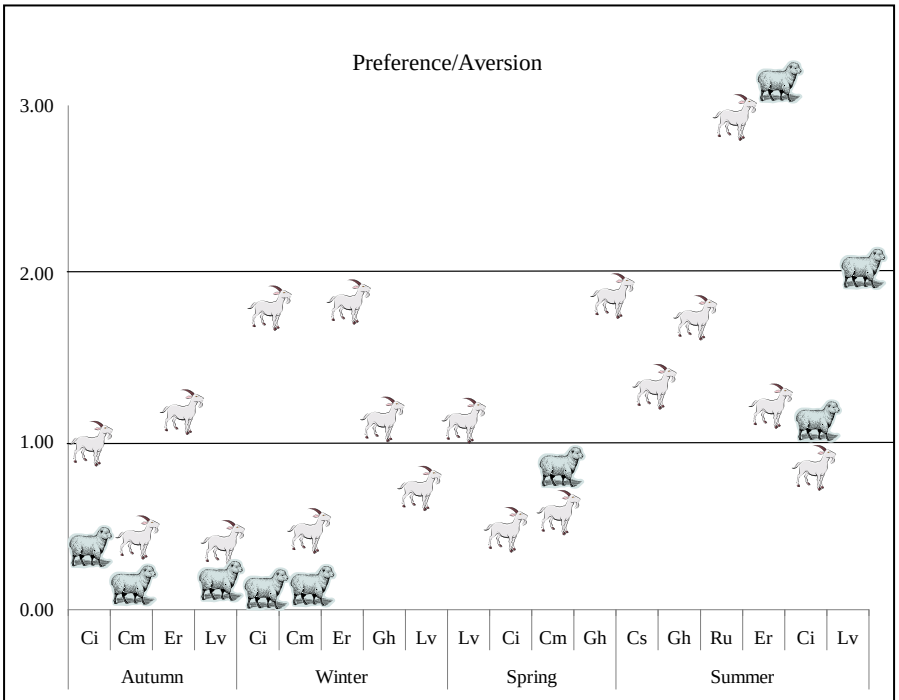

Fig 2. Preference / aversion by goats and sheep for shrubs species in each season. Ci: *Cistus ladanifer*, Cm: *Cytisus multiflorus*, Er: *Erica* sp., Lv: *Lavandula pendulata*, Gh: *Genista hystrix*, Cs: *Cytisus scoparius*, Ru: *Rubus* sp.

Discussion

Goats and sheep showed a different pattern of consumption between themselves and also between seasons. Goats have the highest consumption of trees and shrubs (ligneous) resources while sheep showed the highest value for herbaceous resources. The higher preference for trees and shrubs shown by goats compared to sheep has also been observed in many studies (Celaya et al., 2007). In contrast, herbaceous species are utilized more intensively by sheep than by goats. In the present study, the differences between them may increase during summer where the percentage of herbaceous species in sheep diets was 55 % higher than in goats. In addition, goats showed a typical behaviour of opportunistic feeder, since in winter and summer they consume a greater quantity of ligneous species than herbaceous while; in spring they select more herbaceous species due to their high quality. Nevertheless, sheep showed a preferential consumption to select

herbaceous species along seasons (more than of 75 % of its diet were herbaceous species) and mainly in spring as happened with goats. Then, results obtained in this study confirmed a behaviour *mixed feeder type* for goats and a *grazer type* for sheep in this kind of grazing system.

As is known, sheep and goats vary in the preference, tolerance, and ability to graze lands with different features (Animut and Goetsch, 2008). In the SSP studied, sheep are mainly important to maintain landscape mosaic, by trampling over there. Goats have a decisive function in a shrubby consumption of scrublands and forests. In mountain areas of North Portugal, sheep graze in lands near the urban core, where the meadows and forage cultures are more abundant, while goats use preferentially the most remote areas of the village where the woodlands are most abundant (Castro et al., 2004). Also, the results obtained in this work suggest a seasonal effect on the utilisation ability of ligneous vegetation by goats as a consequence of modifications in its nutritive value according to the time of the year. This variation on preference for some plant species with grazing season should be taken into account when designing management practices in forestry areas.

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