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Ouled Belgacem A., Papanastasis V.P.

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A. Ouled Belgacem and V. Papanastasis
Mediterranean Agronomic Institute of Chania (Crete) and Aristotelian University of Thessaloniki (Greece)

Résumé : La production animale est l'activité économique la plus importante en Epanochori, village représentatif de l'Ouest de la Crête, avec un grand nombre d'animaux (ovin-caprins) dû aux possibilités de subventions. Les parcours qui sont dominants, sont à base de maquis et phyrygana. Le pâturage est collectif et combiné au feu sauvage. Il influence plus la végétation située aux alentours des bergeries et des abreuvoirs. Environ 59% de la variation en couvert, hauteur de la végétation et biomasse est lié à la distance de ces points focaux. Les parcours les plus dégradés sont donc surtout situés près des bergeries et des abreuvoirs, en liaison avec une charge élevée, un pâturage libre, la pratique du feu pastoral ainsi qu' un statut foncier complexe.

Mots-clés: Couvert, Composition floristique, hauteur, biomasse, Epanochori.

INTRODUCTION

Epanochori, composed of four hamlets, is a representative village community of western Crete and has an area of 4650ha at an altitude ranging from 300 to 1600m. The climate is humid mediterranean with cold winters; and soils are derived from hard limestone and metamorphic rocks.

Rangelands are the dominant land use covering 55% of the whole area; they are made mainly of phrygana and maquis.

Sheep and goats are the only animals utilizing rangelands in Epanochori. In 1991, they were 3660 and 3880 heads respectively. A large proportion (1/3 of the total) live in modern stables. The remaining are either kept in house (small number) or in traditional fenced stalls (Ouled Belgacem and Papanastasis, 1993).

All grazing lands of the village are state-owned and they are communally used by shepherds including the available watering points. An exception is made for the areas around the modern stables where the owners have exclusive use rights by tradition. All flocks graze around the hamlets during the spring and autumn, but in the winter time the majority of them move outside the village community to the coastal area; in the summer, they move to the high area of the village, where they stay 4-5 months grazing on both wild and arable lands (stubble).

Fire is traditionally used by shepherds to open up the dense shrublands, suppress the unpalatable shrubs and encourage the growth of herbs, mostly legumes, after burning. Most wildfires are set around the focal points of livestock activities, chiefly stables (Ouled Belgacem and Papanastasis, 1993).

In this paper, the impact of grazing practices on structure and productivity of vegetation around permanent stables and watering points is investigated so that the propre utilisation of rangelands is facilitated and implemented.

MATERIALS AND METHODS

One range unit from each hamlet (four in total) was selected for detailed vegetation measurements. In the the spring-autumn rangelands, where grazing is self-allocated among the individual livestock owners, the range unit was defined as the area surrounding the stable where the animals of a particular shepherd grazed most often. In the summer rangelands, where grazing is communal, the identification of the range unit was based on the watering points; two such range units were studied.

For each range unit, vegetative cover, species composition and biomass were measured along straight lines to the north, east, west and south of the stable or the watering point at 50m intervals. Each interval constituted a sampling area.

Cover and species composition

Point sampling was applied in the study area by systematically taking points along line transects. More specifically, two tapes of 25m each were perpendicularly stretched at each sampling area and point measurements were taken with a pinpoint every 50cm along the tapes. The species composition was determined from the total vegetative cover.

Biomass

The method used was that of Tadmor *et al.*, (1975) which is called the calibrated weight estimate. In each sampling area, the quadrat was placed at 6m intervals along the line transects and 5 qudrats were clipped, weighed and recorded. Ten more quadrats were estimated visually, randomly selected within the sampling area. From each clipped quadrat a representative sub-sample was weighed before and after oven-drying at 80°C and converted to g/m². The dry weights of clipped samples (Yc) were plotted against their fresh weights (Xc) and a calibration equation was developed ($Yc = a+bXc$) to convert the mean visual estimate of fresh weights of all quadrats (harvested and unharvested) into mean dry weights.

Statistical analysis

Several linear and non linear regression equation were tested, namely :

$y = a + bx$; $y = a + bx + cx^2$; $y = a + bx + cx^2 + dx^3$

where : x : distance from stable or watering point (m)

y : biomass (g/m²); %plant cover, shrub cover, phrygana, herbs cover and bare soil; and height of vegetation (m).

For each equation, the coefficient of determination (R^2) was calculated and compared with others so the best fitted to the data are determined.

RESULTS AND DISCUSSIONS

In the four range units of the spring-automn rangelands, the means show that the total cover increased as the distance from the stable increased (table 1). It varied from 70% at 50m to more than 89% at 300m. similar variation was also found for the shrub cover which was mosly composed of *Erica arborea, E. manipuliflora* and *Arbutus unedo.* However, phrygana cover decreased with distance. The main phryganic species were *Sarcopoterium spinosum, Genista acanthoclada* and *Calycotome villosa.* Herbs also decreased despite a relative increase in *Brachypodium ramosum*, which was more abundant where there was dense maquis vegetation.

The average height of vegetation in the four range units ranged from 0,34 at 50m to 1,44m at 300m away from the stables (table 1).

Almost all the lowest values of the above ground biomass were found at 50m from the stables and increased with distance depending on the particular range vegetation in each unit. The mean biomass varied from 600g/m² at 50m to more than 1600g/m² at 300m from the stable (table 1).

The total plant cover in the summer range units was about 58% at 50m from the watering point and it reached more than 70% at 150m apparently as a result of reduced animal actions (Table 1). The main species were phryganic such as *Phlomis creticus, Genista acanthoclada* and *Satureja thymbra.*

The mean height of vegetation in the two range units ranged from 0,188 at 50m to 0,24m at 150m away from the watering points (Table 1).

The mean biomass increased by 55% (from 400 to 650g/m²) between 50 and 150m away from the watering points (Table 1).

Table 1. Means of vegetation parameters in the spring-autumn and summer range units in successive distances away from the focal points.

Vegetation parameter	Spring-autumn rangelands Distance from stables (m)						Summer rangelands Distance from watering points (m)		
	50	100	150	200	250	300	50	100	150
Total cover (%)	70,68	78,02	74,16	83,66	86,75	85	58	63,04	71,54
Shrubs (%)	7,09	17,41	19,48	36,87	32,05	36,35	-	2,07	-
Phrygana (%)	63,26	56,08	52,68	39,24	41,18	41,03	62,41	69,09	75,88
Herbs (%)	29,62	26,53	27,81	23,41	25,27	22,34	37,58	28,67	24,14
Height (%)	0,34	0,52	0,49	0,86	1,08	1,44	0,188	0,254	0,240
Biomass (g/m²)	648,4	1146,4	1155,4	1677,9	1958,0	2064,4	485,1	471,7	618,5

Comparing the summer with the spring-autumn units, the latter were in better condition both in plant cover and biomass than the former. This probably was due to high numbers of animals using the summer units (including watering points), thus exerting heavier grazing pressure and having a greater impact on the soil.

The mathemtical relation between vegetation characteristics (cover, biomass and height) and distance from the focal points of livestock activities (stable and watering point) is best expressed either by second or third degree equations (Table 2). The mean variation accounted for by distance from focal points was approximately 55% for plant cover, 58% for height and 65% for biomass, an overall mean of 59%. The remaining variation may be attributed to physical factors such as soil and relief, since the village is a mountainous. According to Vallentin (1980), slope is an important factor affecting grazing distribution.

In all units, the presence of low palatability species indicates the poor condition of rangelands which are overgrazed. Ouled Belgacem (1992) has found that stocking densities are high in Epanochori (4 animals/ha/year if considering only rangelands and 1.8 if both rangelands and forests are considered), although the mean grazing capacity, based on the six units studied, is lower than 1 animal/ha/year. More specifically, the areas closest to the focal points were more degraded than the ones further away. This is may be due to the frequent fires set around the stables and watering points which is exemplified by the high presence of phryganic species resistant to fire. In addition, animals must have greater influence on productivity by defoliation their digestive processes and physical damage, with their movements. The results of this study confirm Vallentine (1980), who states that concenteric rings of utilization are generally found around the watering points on level terrain, with utilization decreasing as distance from the water increases. Heady (1975) reports that animals tend to concentrate near water because of the availabilty of green vegetation mainly in the summer.

Table 2. Mathematical relations between vegetation characteristics (y) and distance (x in m) from the focal points (stables and watering points).

Variable	Model	R^2
Plant cover(%)	$y= 82.76-0.23x+0.1x^2$	0.55**
Height (m)	$y= 0.696-0.009x+0.00005x^2$	0.58**
Biomass (g/m^2)	$y= -1058.6+41.9x-0.22x^2+0.0004x^3$	0.65**

**: highly significant ($p<0.01$)

CONCLUSION

Grazing practices in Epanochori, a representative village of western Crete, are traditional and include free grazing and occupational burning to improve rangeland productivty by suppressing unpalatable woody plants in favour of palatable herbs. The grazing system is communal, characterized by overstocking as a result of national and EU subsidies. The impact of grazing practices on rangeland vegetation is higher near stables and especially near watering points, because the vegetation is burned more often and animals graze more near such focal points than on other parts of the rangelands. As a result, degradation is concentrated near these points.

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