

The use of cattle grazing as a management tool for sustainable Mediterranean woodlands

Schoenbaum I., Kigel J., Yehuda Y., Henkin Z.

in

Kyriazopoulos A.P. (ed.), López-Francos A. (ed.), Porqueddu C. (ed.), Sklavou P. (ed.).
Ecosystem services and socio-economic benefits of Mediterranean grasslands

Zaragoza : CIHEAM

Options Méditerranéennes : Série A. Séminaires Méditerranéens; n. 114

2016

pages 67-70

Article available on line / Article disponible en ligne à l'adresse :

<http://om.ciheam.org/article.php?IDPDF=00007480>

To cite this article / Pour citer cet article

Schoenbaum I., Kigel J., Yehuda Y., Henkin Z. **The use of cattle grazing as a management tool for sustainable Mediterranean woodlands.** In : Kyriazopoulos A.P. (ed.), López-Francos A. (ed.), Porqueddu C. (ed.), Sklavou P. (ed.). *Ecosystem services and socio-economic benefits of Mediterranean grasslands*. Zaragoza : CIHEAM, 2016. p. 67-70 (Options Méditerranéennes : Série A. Séminaires Méditerranéens; n. 114)



<http://www.ciheam.org/>
<http://om.ciheam.org/>

The use of cattle grazing as a management tool for sustainable Mediterranean woodlands

I. Schoenbaum^{1,2*}, J. Kigel¹, Y. Yehuda³ and Z. Henkin²

¹The Robert H. Smith Institute for Plant Sciences and Genetics in Agriculture, Faculty of Agricultural, Food and Environmental Sciences, Hebrew University of Jerusalem, Rehovot 76100 (Israel)

²Beef Cattle Section, ARO, Newe Yaar Research Center, P.O. Box 1021 Ramat Yishay 30095 (Israel)

³MIGAL - Galilee Technological Center, Qiryat Shemona, P.O. Box 90000, Rosh Pinna 12100 (Israel)

*e-mail:isi_shin@yahoo.com

Abstract. Grazing has become an effective and accepted tool for managing open areas for different uses other than meat production, such as minimizing fire risk and increasing species diversity. Although woodlands in Israel are utilized for cattle grazing, the effect of grazing on woody vegetation has not been assessed quantitatively. The aim of this study was to characterize the effect of biotic and management factors, especially animal density, on the structure, composition and regeneration of woody vegetation. The study was conducted in the Western Galilee of Israel. A woodland plot of 211 ha was divided into four sub-plots, with two replications of two grazing intensities. Changes in the woody vegetation were monitored in 56 transects of 20 m length each, sampled at the onset of the study and after four annual grazing cycles. Woody plants up to height 2.1 meter growing along each transect were documented. From these records we derived indices to characterizing vegetation structure, woody biomass removal, species richness and woodland regeneration. It is shown that the extent of grazing effect depends mainly on cattle density, as well as on the type and state of the vegetation. The woody vegetation cover was reduced under the two grazing intensities, but grazing did not affect species richness and sapling abundance. Therefore, it was concluded that the use of cattle is an important tool for sustainable management of Mediterranean woodlands.

Keywords. Animal density – Vegetation type – Cattle utilization – Basal cover.

Utilisation d'animaux brouteurs comme outil pour la gestion durable des zones boisées méditerranéennes

Le broutage est devenu un outil efficace et accepté pour la gestion de zones ouvertes pour différents usages autres que la production de viande, tels que la minimisation du risque d'incendie et l'augmentation de la diversité d'espèces. Bien que les zones boisées en Israël soient utilisées comme pacage pour le bétail, l'effet de brouter la végétation ligneuse n'a pas été évalué quantitativement. Le but de cette étude était de caractériser l'effet de facteurs biotiques et de gestion, en particulier la densité animale, sur la structure, composition et régénération de la végétation ligneuse. L'étude était menée dans l'ouest de la Galilée en Israël. Une parcelle boisée de 211 ha a été divisée en quatre sous-parcelles, avec deux répétitions de deux intensités de broutage. Les modifications de la végétation ligneuse ont été suivies dans 56 transects de 20 m de longueur chacun, échantillonnés au début de l'étude et après quatre cycles annuels de broutage. Les plantes ligneuses jusqu'à une hauteur de 2,1 mètres poussant le long de chaque transect ont été documentées. À partir de ces données, on a dérivé des indices pour caractériser la structure de végétation, le prélèvement de biomasse ligneuse, la richesse en espèces et la régénération des zones boisées. Il a été montré que l'ampleur de l'effet de broutage dépend principalement de la densité de bétail, ainsi que du type et de l'état de la végétation. La couverture de végétation ligneuse était réduite sous les deux intensités de broutage, mais le broutage n'a pas affecté la richesse en espèces et l'abondance en jeunes arbres. Toutefois, il a été conclu que l'utilisation de bétail est un outil important pour une gestion durable des zones boisées méditerranéennes.

Mots-clés. Densité animale – Type de végétation – Utilisation du bétail – Couverture basale.

I – Introduction

Over the last thousands of years Mediterranean evergreen oak woodlands have been utilized efficiently by traditional grazing of mixed herds, mostly consisting of goats. Grazing maintains an open woodland formation, reduces biomass, thus minimizing risk of fire, increases species diversity and facilitates recreational use of the landscape (Perevolotsky and Seligman, 1998; Gutman *et al.*, 2000; Henkin *et al.*, 2011). In recent years, goat grazing in the woodlands of Israel has decreased, while grazing by cattle herds has become more common. Cattle herds were introduced into the woodlands with the aim of increasing meat production, while replacing goat grazing for woodland management. However, unlike goats, which are adapted to browsing in Mediterranean woodlands, the woody vegetation is considered unsuitable for cattle due to its poor nutritional quality, partly caused by its high tannin content (Perevolotsky *et al.*, 1993; Papachristou *et al.*, 2005). Furthermore, the limited accessibility of the dense woody vegetation, poor productivity of the herbaceous vegetation and the generally difficult topographic conditions make cattle grazing more difficult. Although today woodlands in Israel are utilized for cattle grazing, the effect of grazing on the woody vegetation has not been assessed quantitatively. This study aims to characterize the effect of vegetation type and grazing animal density on the structure, composition and regeneration of woody vegetation in the Mediterranean woodlands.

II – Materials and methods

The study was conducted at the Hatal experimental farm in the Western Galilee, Israel (long. 35°15', lat. 33°01', alt. 200–500 m a.s.l.). The study area is characterized by a combination of closed woodland vegetation dominated by *Quercus calliprinos* Webb., and an open woodland dominated by *Callicotome villosa* (Poiret) Link and *Sarcopoterium spinosum* (L.) Spach. Herbaceous vegetation appears as patches in the open areas within the woody vegetation, and provides 3-4 months of high-quality forage during winter and spring. A woodland plot of 211 ha was divided into four paddocks of 40–66 ha each. The treatments were two animal densities: low (0.33 cow·ha⁻¹) and high (0.55 cow·ha⁻¹), which were replicated twice. For a period of four years (2007-2011), 94 Baladi×Hereford cows grazed on the experimental paddock from mid-March to mid-November and were given supplementary feed according to the state of the vegetation. During the rest of the year the cows were kept in holding plots outside of the experimental area.

At the beginning of the study, the area was classified into three vegetation types using aerial photography and ERDAS imaging, which were verified at the landscape level: Dense woodland (80-100% tree cover), Open woodland (50-80% tree cover) and Garrigue (<50% tree cover). The effect of grazing intensity on woodland structure and composition was assessed by comparing permanent vegetation transects that were sampled at the commencement of the study (2007), and once again after four cycles of annual grazing (2011). Transects 20 m long were placed in each of the four paddocks in two vegetation types that we thought will be more affected by grazing - Dense woodland and Open woodland. A total of 56 permanent transects (7 transect x 2 cattle densities x 2 replicates of each density x 2 vegetation types in each paddock) were monitored. All plants up to a height of 2.1 m (maximum height of vegetation for cattle grazing) along each transect were recorded and sketched, including plant locations. Vegetation variables that characterize vegetation structure, woody biomass removal, species richness and woodland regeneration by saplings were recorded:

- a. Above canopy: canopy cover in each of the 20 meter transect.
- b. Species richness: number of trees, shrubs and climber species.
- c. Number of individuals by plant size: large tree (> 80 cm), small tree (10-80 cm), large shrub (> 40 cm), small shrub (10-40 cm), twigs shrub and twigs tree (number of twigs in the transect from plants not rooted in the transect).
- d. Basal cover: vertical projection of rock, litter and soil, tree and shrubs.

- e. Available canopy surface for cattle grazing: surface contour of woody vegetation, assessed by measuring the contour of each plant with flexible measuring tape.
- f. Sapling: tree, shrub and climber less than 10 cm height

Changes in the vegetation after four grazing periods were assessed by calculating the absolute differences of above vegetation variables between the beginning and end of the study. Data were analyzed using two way Anova, with animal density and vegetation type as fixed factors. Since significant differences in the initial state of the transects were found, we used the initial state of the vegetation (2007 sampling) as covariant. T-tests were conducted to determine whether changes in the vegetation variables after four grazing seasons were significantly different from zero. Statistical analyses were carried out with the JMP software, version 7.1 (SAS Institute, Cary, NC).

III – Results and discussion

The main consequences of cattle grazing in terms of the woody vegetation were expressed via changes in vegetation removal, especially in the high animal density treatment. After four grazing seasons, basal tree cover decreased by 20% ($1.0 \pm 0.3\text{m}$; $P=0.0008$) (Fig. 1). Consequently, woody vegetation overlap decreased by 25% and bare ground and plant litter cover increased. This happened at a higher rate in open woodland compared to dense woodland (18% and 2.5%, respectively; $P=0.002$). In contrast, under the lower cattle density, no significant changes were found in tree basal cover and in the cover of bare ground and litter. Grazing reduced shrub cover by 16% with no effect of cattle density. Available canopy surface for cattle consumption was the most affected vegetation variable in both grazing treatments. Total canopy surface was reduced by 41% ($9.2 \pm 1.1\text{m}$) under the high cattle density compared to 27% ($5.7 \pm 1.3\text{m}$) under the low density. Canopy surface of rooted trees decreased by 40% vs 25% ($P=0.008$) and rooted shrubs decreased by 37% vs 18% ($P=0.002$) in the high and low grazing intensities, respectively. Above canopy cover increased slightly (8%; $P<0.05$), except for that of the dense woodland that was under high grazing density.

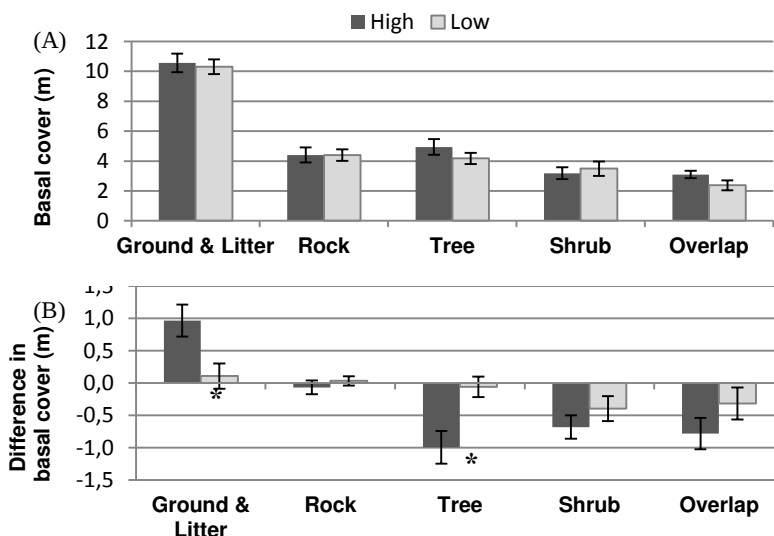


Fig. 1. Basal cover of trees, shrubs, rocks, ground and litter and overlap of woody plants in 20 m transects at study onset (2007) (A) and the change (difference) after four grazing periods (B), under high (dark) and low (light) cattle density. Data are mean $\pm$ SE.

* Indicates significant differences between cattle densities ($P < 0.05$).

Despite the changes in vegetation cover found at the two levels of cattle density, the effect of four grazing seasons on species richness was relatively minor. Richness increased or decreased only by 0.5 species per transect on average, with no effect of cattle density on this change. Similarly, grazing did not have a detrimental effect on woodland regeneration by saplings. On the contrary, the number of saplings increased by 19% after four grazing seasons, especially in the dense woodland ($P=0.003$). Furthermore, the number of individuals of woody species present in the transects increased marginally ($P=0.1$), with a larger increase shown by young trees lower than 80 cm (4.1 ± 1 in the dense woodland compared to 1.5 ± 1.2 in the open woodland; $P<0.001$), with no effect of grazing intensity. In the current study both low and high cattle densities resulted in the removal of woody biomass at a quantity which was larger in paddocks under the higher grazing intensity. On the other hand, since the rate of change of the woody components was slow, no effect was found on species richness during the time span of the current experiment. Similarly, we could not detect a negative impact of grazing on the regenerative capacity of the woodland via saplings. Saplings continued to appear and grow into small trees. Nevertheless, it is possible that the effects of grazing on species composition and vegetation structure would have manifested themselves after longer periods of grazing.

IV – Conclusions

Quantitative analysis of changes in woodland vegetation showed that four consecutive grazing periods resulted in relatively high biomass removal, especially in the high animal density, but had no detrimental effect on woody species richness or regeneration from saplings. Therefore, cattle grazing in the present animal densities can protect woodlands from fires without damaging regeneration, thus supporting the use of cattle as a tool for sustainable management of Mediterranean woodlands. As a general rule, sustainable management of cattle grazing on woodland must be based on ecological and landscape considerations, in addition to meat productivity as a source of livelihood for herders. Such a management plan will lead to optimal utilization of woodland landscapes without damaging them, while improving cattle performance. In this way, it should be possible to minimize the conflicts between herders' interests and nature conservation concerns, thus enabling the use of cattle grazing as an efficient, multi-purpose tool for open landscape management in the Mediterranean woodlands.

Acknowledgments

We would like to thank Nekudat-Hen project of the Yad Hanadiv foundation for funding this research.

References

- Gutman M., Henkin Z., Holzer Z., Noy-Meir I. and Seligman N.G., 2000. A case study of beef-cattle grazing in a Mediterranean-type woodland. In: *Agroforestry Systems*, 48, p. p. 119-140.
- Henkin Z., 2011. Cattle grazing and vegetation management for multiple use of Mediterranean shrubland in Israel. In: *Israel Journal of Ecology & Evolution*, 57, p. 43-51.
- Papachristou T.G., Platis P.D. and Nastis A.S., 2005. Foraging behaviour of cattle and goats in oak forest stands of varying coppicing age in Northern Greece. In: *Small Ruminant Research*, 59, p. 181-189.
- Perevolotsky A., Brosh A., Ehrlich O., Gutman M., Henkin Z. and Holzer Z., 1993. Nutritional value of common oak (*Quercus calliprinos*) browse as fodder for goats - experimental results in ecological perspective. In: *Small Ruminant Research*, 11, p. 95-106.
- Perevolotsky A. and Seligman N.G., 1998. Role of grazing in Mediterranean rangeland ecosystems - Inversion of a paradigm. In: *Bioscience*, 48, p. 1007-1017.