

**Mediterranean herbaceous vegetation response to high animal density and grazing deferment: Implications for management and conservation**

Gutman M., Perevolotsky A., Ungar E.D., Sternberg M., Kigel J.

*in*

Etienne M. (ed.).  
Dynamics and sustainability of Mediterranean pastoral systems

Zaragoza : CIHEAM  
Cahiers Options Méditerranéennes; n. 39

1999  
pages 161-164

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

<http://om.ciheam.org/article.php?IDPDF=99600066>

To cite this article / Pour citer cet article

Gutman M., Perevolotsky A., Ungar E.D., Sternberg M., Kigel J. **Mediterranean herbaceous vegetation response to high animal density and grazing deferment: Implications for management and conservation**. In : Etienne M. (ed.). *Dynamics and sustainability of Mediterranean pastoral systems*. Zaragoza : CIHEAM, 1999. p. 161-164 (Cahiers Options Méditerranéennes; n. 39)



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

## Mediterranean herbaceous vegetation response to high animal density and grazing deferment: Implications for management and conservation

**M. Gutman\*, A. Perevolotsky\*, E.D. Ungar\*, M. Sternberg\*\* and J. Kigel\*\***

\*Agricultural Research Organization, Dept. of Natural Resources,  
The Volcani Center, P.O. Box 6, Bet Dagan 50250, Israel

\*\*The Hebrew University of Jerusalem, Faculty of Agricultural, Food and Environmental Sciences,  
Dept. of Agricultural Botany, Rehovot, Israel

**SUMMARY** - Widely contrasting stocking rates and grazing schedule treatments were imposed upon a Mediterranean herbaceous community in northern Israel. Botanical composition was monitored for 3 years. The vegetative community was found to be highly resilient to the treatments. Perennial grasses and legumes were among the resilient plants. These results are consistent with the view that Mediterranean ecosystems have inherent adaptations to disturbances such as grazing due to their long history of association with human activity. If these findings persist over time, they may affect the conceptual basis for sustainable grazing management in Mediterranean grasslands by allowing higher grazing pressures than are currently recommended. Moreover, heavy cattle grazing should then be considered as a potential management tool for maintaining high biodiversity in Mediterranean grassland ecosystems.

**Key words:** Biodiversity, stocking rate, cattle grazing, Mediterranean ecosystem, herbivory impact.

**RESUME** - "Réponse de la végétation herbacée méditerranéenne face à une forte densité animale et mise en défens temporaire : Implications pour la gestion et la conservation". Des taux de charge et des calendriers de pâturage très divergents ont été imposés sur une communauté herbacée méditerranéenne au Nord d'Israël. La composition botanique a été suivie pendant 3 années. La communauté végétative était très résiliente aux traitements. Les graminées et légumineuses perpétuelles étaient parmi les plantes résilientes. Ces résultats sont logiques si l'on considère que les écosystèmes méditerranéens présentent des adaptations inhérentes aux perturbations telles que le pâturage en raison de leur longue histoire d'association avec l'activité humaine. Si ces situations persistent dans le temps, ils peuvent affecter la base conceptuelle pour une gestion durable de pâturage dans les prairies méditerranéennes en autorisant des pressions de pâturage plus fortes que celles qui sont actuellement recommandées. De plus, un pâturage très fort par les bovins devrait être considéré comme un outil potentiel de gestion pour maintenir une forte biodiversité dans les écosystèmes des prairies méditerranéennes.

**Mots-clés :** Biodiversité, taux de charge, pâturage de bovins, écosystème méditerranéen, impact des herbivores.

### Introduction

Grazing by domestic livestock is considered an ecological disturbance that may affect the vegetative community either by decreasing the presence (cover) of its components or by reducing its diversity (number of species present) (Huntly, 1991). On the other hand, grazing may reduce the density of highly competitive species, thus allowing the weak competitors to increase their presence (Lubchenco, 1978).

Both range managers and conservation biologists are interested in quantifying the damage that grazing causes to the vegetative community and ecosystem. While the former emphasizes the long-term secondary production and profitability of the operation, the latter seek to establish and maintain a sustainable ecological state which is believed to be achieved by high biodiversity (Tilman *et al.*, 1996). Empirical research on the impact of grazing on species diversity has not produced conclusive findings.

In this paper we examine the impact of grazing pressure (moderate vs heavy) and timing (early vs late) on the structure of a Mediterranean herbaceous community in northern Israel. The experiment enables us to compare the ecological outcome of the normative management in the region (moderate grazing pressure, continuous grazing in large paddocks from early winter to mid-summer) with an intensive system (heavy, rotational grazing on smaller paddocks).

## Materials and methods

The experiment was conducted at the Karei Deshe Range Station with a commercial cattle herd. A thorough description of the environmental conditions of the site are provided elsewhere (Gutman, 1978; Naaly, 1996). A detailed account of the experiment is provided by Naaly (1996).

The experiment was established in 1993 and is still running. It is comprised of six treatments with two replications. The use of a low number of replications but large paddocks (25-54 ha) and groups of animals (15-40 cows) was determined by logistic constraints.

This paper presents results for two stocking rates, 0.45 and 0.9 ha per cow (the normative management in the region is 1.8 ha per cow); and two timing treatments, E - early (beginning of green season - mid-January, which corresponds to the normative management) and L - late (end of green season). The above subset of treatments was analyzed as a 2x2 factorial design. The grazing pressure among replications was adjusted according to actual live-weight of the whole group.

Vegetation cover transects were conducted annually since 1994, during the peak production season (early to mid-April). Well-marked, permanent, long transects were established in each paddock along which cover was recorded (plant species, bare soil, rock, organic matter, stone). Vegetation data were also gathered in an adjacent paddock from which grazing was excluded for the past 17 years (ungrazed treatment). Species richness and the cover of selected, dominant species were analyzed by ANOVA, following suitable transformation. Factors examined in the model were year, stocking rate-SR, grazing timing-T, year\*SR, year\*T, SR\*T and year\*SR\*T.

## Results and discussion

The treatment effect was first examined for plant cover of three common grass species, representing different life-forms. *Triticum dicoccoides* (TD), a tall annual grass, comprised, under most grazing regimes, a small portion of the rangeland (2-5%) but moderate, late grazing (0.9L) can double its abundance. Very heavy grazing (0.45E) did not affect (over time) TD cover. In contrast, the cover of short annual grasses (represented by *Bromus alopecurus*), which is very low under most grazing regimes (<0.5%), increased 2-5 times under early, very heavy grazing pressure (0.45E). The cover of *Hordeum bulbosum*, a tall perennial grass, exhibited changes over the years, with a significant effect of grazing timing but not of grazing pressure.

The cover of *Trifolium pilulare*, a common (10-15% of the total cover), short, annual legume, decreased during the experimental period with no significant differential effect of the treatment. The abundance of *Bituminaria bituminosa*, a dominant perennial legume (20-35% of total cover) declined under all grazing regimes and stabilized on a lower cover level (10-15%).

The cover of *Scolymus maculatus*, a tall thorny composite forb, increased significantly with early, heavy grazing pressure (0.45E). The statistical model indicates that timing of grazing is significant in this case, but not so the stocking rate. *Rapinastrum rugosum*, a tall, annual, cruciferous forb, became more abundant under heavy grazing conditions (both early and late) although this trend is not significant statistically.

The relationship between grazing management and species richness did not show a consistent trend (Fig. 1). It is clear, however, that early, heavy grazing - potentially the most destructive regime - did not have a negative effect on the community structure, and perhaps even helped some new species to colonize over time. On the other hand, it seems that late, moderate grazing resulted in a decrease in species richness, although this trend was not statistically significant. Species richness in the long-term, ungrazed paddock was 25, 36 and 31 in 1994, 1995 and 1996, respectively. Various species of forbs dominated the community (cover of 40-50%) under these conditions of no grazing.

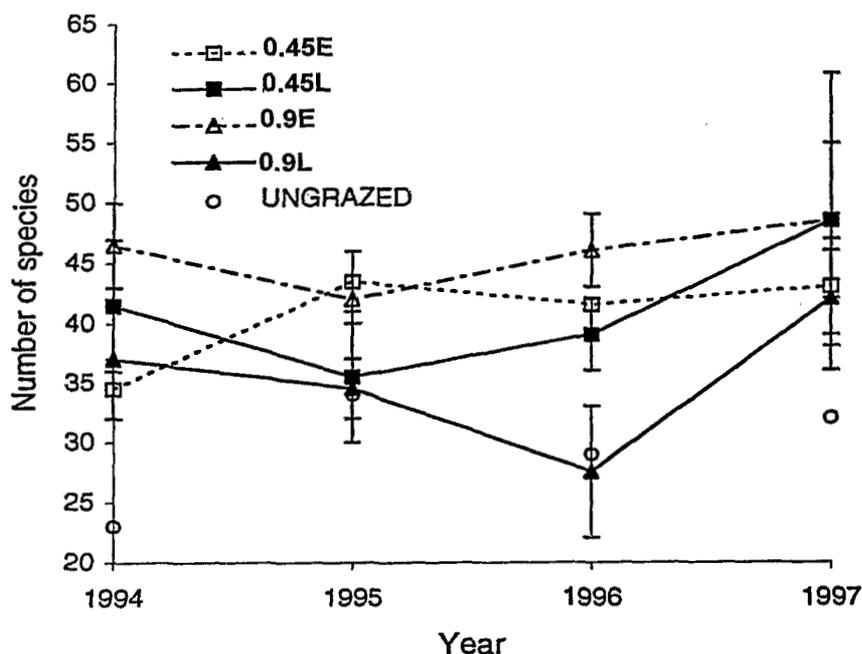


Fig. 1. Changes in species richness at Karei Deshe.

The results of the reported grazing experiment force us to re-examine the conventional paradigm of grazing impact on Mediterranean grasslands. The fact that trends of cover decrease were not evident, even under heavy, early grazing, and that so-called sensitive life-forms (legumes in general, and especially tall ones, or tall, perennial grasses - Noy-Meir *et al.*, 1989) were not strongly affected by high grazing pressure, implies that the studied vegetation is very resilient to grazing disturbance. Moreover, if this resilience persists (> 5 years), more intensive management, in terms of stocking rate and timing (0.45 ha per cow, early rotational grazing), may be proposed with no fear of ecological damage. The economic performance of such intensive management is still to be compared with that of the regular grazing regime (1.8 ha per cow with continuous grazing).

The same is true if high biodiversity is sought. Grazing seems to be an important management tool for maintaining high species richness or for controlling the abundance of specific life-forms. Grazing in Mediterranean grasslands should then be considered as a management agent of conservation rather than as a destructive disturbance.

We suggest that there has been specific species selection in response to the continuous grazing pressure exerted on rangeland ecosystems in the Middle East since biblical times. Thus, domestic animal husbandry should be an integral part of the Mediterranean grasslands ecosystem if high biodiversity is sought (conservation). It also appears that these ecosystems are neither fragile nor degraded, and can be exploited more intensively than is commonly recommended. Interestingly enough, similar conclusions were reached for the Mediterranean woody ecosystem (Seligman and Perevolotsky, 1994) and other Mediterranean grasslands (Noy-Meir, 1995).

## Conclusions

(i) All grazing regimes studied, including early-season heavy stocking rate, improved biodiversity compared with ungrazed paddocks.

(ii) Number of species present in the sward was highest under continuous heavy grazing and lowest in the paddocks protected from grazing for a long period (17 years).

## References

- Gutman, M. (1978). Primary production of transitional Mediterranean steppe. In *Proc. 1st Int. Rangeland Congr.*, Denver, CO., USA, pp. 225-228.
- Huntly, N. (1991). Herbivores and the dynamics of communities and ecosystems. *Annu. Rev. Ecol. Syst.*, 22: 477-503.
- Lubchenco, J. (1978). Plant species diversity in a marine intertidal community: Importance of herbivore food preference and algal competitive abilities. *Am. Nat.*, 112: 23-39.
- Naali, A. (1996). *The effect of grazing management (pressure and timing) on the rangeland ecosystem and animal performance in a beef herd in the upper Galilee*. MSc Thesis, Faculty of Agriculture, The Hebrew University of Jerusalem, Rehovot, Israel [Hebrew, with English Summary].
- Noy-Meir, I. (1995). Interactive effects of fire and grazing on structure and diversity of Mediterranean grasslands. *J. Vegetative Sci.*, 6: 701-710.
- Noy-Meir, I., Gutman, M. and Kaplan, Y. (1989). Response of Mediterranean grassland plants to grazing and protection. *J. Ecol.*, 77: 290-310.
- Seligman, N.G. and Perevolotsky, A. (1994). Has intensive grazing by domestic livestock degraded the old world Mediterranean rangelands? In *Plant-animal interactions in Mediterranean ecosystems*. Arianoutsou, M. and Groves, R.S. (eds). Kluwer Academic Publishers: Dordrecht, The Netherlands, pp. 93-103.
- Tilman, D., Wedin, D. and Knops, J. (1996). Productivity and sustainability influenced by biodiversity in grassland ecosystems. *Nature (Lond.)*, 379: 718-720.