Rangeland use by the European hare (*Lepus europaeus*) in relation to short- and long- term non- grazing

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Abstract

Protection from grazing results in biomass accumulation and lower forage quality, which in the long-run adversely affects lower-seral wildlife species' use. The effects of short-term (i.e. two years) and long-term (more than 15 years) protection from grazing by livestock, on the use of grasslands by the European hare (*Lepus europaeus*) were investigated in a typical Mediterranean grazing land, using the pellet count method. Hares used the grazed sites with a sparse herb layer more intensively than the short- and long- term ungrazed ones where a denser and higher plant structure occurs. The most striking effect was that even the two year protection from grazing was sufficient enough to reduce the hare's grazing intensity to a level similar with that of sites ungrazed for more than 15 years. These findings confirm that vegetation characteristics play a prevailing role on the use of space by the hare. Furthermore, these findings guide new strategies both on hare conservation and multiple rangeland management, since grazing by small ruminants may function as an agent to create suitable habitats for the hare.

Keywords: livestock-wildlife interactions, herbivory, animal behaviour, rangeland management, wildlife management.

Introduction

Livestock grazing affects the composition, structure and the secondary succession of vegetation, which is often beneficial for wild herbivores predominating in earlier stages of succession (Karmiris and Nastis 2007, Kuijper and Bakker 2008). This could be justified by decreasing forage quality, as the plants grow taller and mature in ungrazed sites earlier than in grazed ones (Davidson 1993). However, in addition to forage quality effects, grazing reduces the vegetation sward height, which may be advantageous for small- and medium- sized herbivores, such as the European hare (*Lepus europaeus* – hereafter hare), as it is easier to locate visually approaching predators (Karmiris and Nastis 2007, 2009, Bakker et al. 2009). Therefore, livestock grazing can be used as a valuable 'tool' to manipulate small- and medium- sized herbivores' habitats (Holechek et al. 2001, Karmiris and Nastis 2009).

The hare prefers the grazed and partially disturbed habitats, such as grassland, scrubland, clearings in scrub and forest stands and farmland (Tapper 1987). It is documented that hare seems to prefer the moderately

grazed pastures (about 40% of the annual production grazed) with a sparse herb layer over lightly grazed ones (about 20%), and avoid the ungrazed habitat patches (Karmiris and Nastis 2007). Despite its importance, little is known about the effects of the ceasing of grazing on hare's use of space.

The aim of this study was to investigate the impact of grazed, short-term (i.e. two years) and long-term (i.e. more than 15 years) exclusion of grazing by livestock on the potential use by the hare. Our hypothesis was that there was no significant difference in the use by the hare of short-term ungrazed sites in relation to the long-term and the grazed ones. Given that, the hare avoids the ungrazed sites (Karmiris and Nastis 2007) and uses the microhabitats covered by short and sparce herb layer (Karmiris et al. 2010), we predicted that the hypothesis tested should be false at least for the latter comparison. However, significant differences between short- and long- term ceasing of grazing depend primarily on the plasticity of the hare's behaviour by responding to changes in the biotope and making shifts in its feeding areas in a relatively short space of time.

Material and Methods

The study was conducted in a 100 ha rangeland (360-520 m altitude), located north of the city of Thessaloniki, in central Macedonia, Greece, covered approximately 70% by shrubs and 30% by herbaceous species. There was no farmland in the study area. The soil was shallow, of low productivity and partially degraded. The climate is semiarid (average annual precipitation 416 mm), with cold winters and hot dry summers.

This area is a mosaic of kermes oak (*Quercus coccifera*) shrubland sites intermingled with scattered grassland sites (0.3 and 3 ha). Other shrub species, such as Jerusalem thorn (*Paliurus spina cristi*), dog rose (*Rosa canina*), hawthorn (*Crataegus monogyna*) and phryganic plants, such as pink rockrose (*Cistus incanus*) and asparagus (*Asparagus acutifolius*) also coexisted in the study area. The main herbaceous species in the study area were brush grass (*Chrysopogon gryllus*), yellow bluestem (*Dichanthium ischaemum*), sheep's fescue (*Festuca valesiaca*), Bermuda grass (*Cynodon dactylon*), drooping brome (*Bromus tectorum*), ovate goatgrass (*Aegilops ovata*), cocksfoot (*Dactylis glomerata*), star clover (*Trifolium stellatum*), hairy medick (*Medicago polymorpha*), haresfoot clover (*Trifolium arvense*) and hop trefoil (*Trifolium campestre*). The main wild mammal species in the study area were brown hare, fox (*Vulpes vulpes*), beech marten (*Martes foina*), weasel (*Mustela nivalis*) and badger (*Meles meles*).

The whole study area was grazed by sheep and goats in common for several decades, following a traditional continuous grazing system. In order

to protect this area from development and to maintain its conservation and aesthetic role, several protection measures have been applied, such as hunting ban and limitations on grazing. Recently, about one third of the total area was protected and grazing herds moved to other areas. As a result, there are sites which have not been grazed for more than 15 years, others which have been ungrazed for the last 2 years and those which have been moderately grazed by sheep and goats (ratio 1:4). Hereafter, these 3 categories of sites (i.e. grazed, short- and long-term ungrazed) are considered as treatments. Hares were using the grasslands at night as feeding places while during the day they usually rested in shelters under shrubs. This is a typical behaviour of the hare (Hutchins & Harris, 1995; Holley, 2001, Karmiris 2012). The evaluation of the spatial distribution of the hare was based on pellet counting, which is considered as an appropriate estimate of the abundance and the feeding intensity of hare (Langbein et al. 1999). Fifty permanent fecal-pellet count plots (0.5 m radius) were randomly established on each treatment. Faecal pellets were counted and subsequently removed from each plot.

Pellet count data were subjected to ANOVA using the S.P.S.S. statistical package (version 13.0). Treatments were fixed factors. Homogeneity of variances was checked using Levene's test (Petrie and Watson 1999). A log(x+1) transformation of the original data was used in order to homogenise the variance between treatments (Steel and Torrie 1980). Mean differences were evaluated with Tukey's HSD at $P < 0.05$.

Results and Discussion

The feeding intensity (as estimated by the number of pellets per m^2) of hares in the grazed sites was significantly higher ($F = 9.7$, d. f. = 2, $P < 0.001$) than both the short-term and the long-term ungrazed sites (Figure 1). However, non-significant differences were detected between short- and long- term ungrazed sites ($P = 0.980$).

Based on previous studies from northern Europe, the hare might be disturbed by the presence of farm animals (Barnes et al. 1983, Tapper and Barnes 1986), one might expect the opposite outcome, i.e. the grazed sites should be used less than the ungrazed ones. If the overriding factor shaping spatial distribution of the hare was the decreasing forage quality as the plants grow taller and mature in ungrazed sites (Rhodes and Sharrow 1990), then the observed differentiation between the grazed and ungrazed sites should not be apparent in spring when the growing plants are usually short and more nutritious, a hypothesis however that has been rejected (Karmiris and Nastis 2007). Under this perspective, the more intensive use of grazed

sites by the hare in relation to the ungrazed ones, which was observed in this and in previous studies (Karmiris and Nastis 2007, 2009), should probably be the outcome mainly of the modified structure of vegetation mainly by the domestic herbivores. It seems that the hare is seeking for feeding areas covered by short and sparse plant communities (Karmiris et al. 2010). Hence, the effects of plant structure seem to be more important than disturbance by livestock for the hare and under proper grazing management strategy the co-development of livestock and game in the same time-space is feasible.

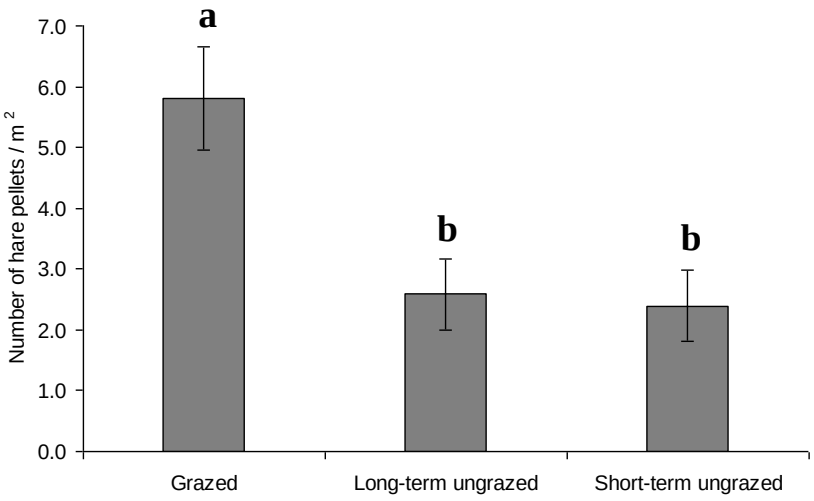

Figure 1. Mean number of hare pellets (± SE) deposited in grazed, short-term (2 years) and long-term (> 15 years) ungrazed sites. Different letters indicate significant differences at $P < 0.001$.

The most profound outcome of this study was the non-significant differences between the use of short- and long- term ungrazed sites ($P = 0.980$). Within a time interval of two years since the protection from grazing the use of short-term ungrazed sites were very low and similar with that of the long-term ones. This raises the hare's ability to make shifts in the use of space according to changes in the vegetation characteristics in a relatively short space of time. From these findings can be concluded that livestock grazing can be used as a 'tool' for the creation of suitable habitats for the hare and to influence its movements and the use of space.

Conclusions

Grazed rangeland sites, under moderate levels of grazing intensity, were used more intensively by the hare as feeding places than the short- and the long- term grazing exclusion treatments. Just two years of exclusion seems to be sufficient to suppress the feeding intensity of the hare to a similar level with that of sites ungrazed for more than 15 years. Reduction in aboveground biomass can be used as a means for the management of wildlife species, such as the hare, which is inhibited by tall and dense vegetation. Thus, livestock grazing can be used as a 'tool' to create suitable habitats for hares. The Mediterranean rangeland management strategy should be focused to a more holistic approach integrating livestock and hare needs.

Acknowledgements

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References

Bakker, E. S., Olff, H. & Gleichman, J. M. 2009: Contrasting effects of large herbivore grazing on smaller herbivores. *Basic and Applied Ecology*, 10:141-150.

Barnes R.F.W., S.C. Tapper and J. Williams. 1983. Use of pastures by brown hares. *Journal of Applied Ecology*, 20:179-185.

Davidson D.W. 1993. The effects of herbivory and granivory on terrestrial plant succession. *Oikos*, 68:23-35.

Holechek J.L., R.D. Pieper and C.H. Herbel. 2001. Range management principles and practices. Prentice-Hall, Upper Saddle River, New Jersey. 587 pp.

Karmiris I. 2012. Movements and use of dens by radiotracked captive-reared European hares (*Lepus europaeus*). *Scientific annals of the department of Forestry and Management of the Environmental and Natural Resources*. (in press).

Karmiris I. and A. Nastis. 2007. Intensity of livestock grazing in relation to habitat use of brown hares (*Lepus europaeus*). *Journal of Zoology*, 272:193-197.

Karmiris I. and A. Nastis. 2009. Small ruminants as manipulators of brown hare (*Lepus europaeus*) habitat in kermes oak rangelands. *Options Méditerranéennes*, 85:171-176.

Karmiris I., I. Pappas, Z. Koukoura and M. Kitsos. 2010. Plant cover influences on the use of microhabitats by the European hare (*Lepus europaeus*) in recently burned rangelands. In: A. Sidiropoulou, K. Mantzanas and I. Ispikoudiss (eds). Range Science and Life Quality. Proceedings of the 7th Panhellenic Rangeland Congress. pp. 217-222. (In Greek with English Abstract).

Kuijper D.P.J. and J.P. Bakker. 2008. Unpreffered plants affect patch choice and spatial distribution of European brown hares. *Acta Oecologica*, 34:339-344.

Langbein J., M.R. Hutchings, S. Harris, C. Stoate, S.C. Tapper and S. Wray. 1999. Techniques for assessing the abundance of brown hares *Lepus europaeus*. *Mammal Review*, 29:93-116.

Petrie A. and P. Watson. 1999. Statistics for veterinary and animal science. Blackwell Science Ltd. London. 243 pp.

Rhodes B.D. and S.H. Sharrow. 1990. Effects of grazing by sheep on the quantity and quality of forage available to big game in Oregon's coast range. *Journal of Range Management*, 43:235-237.

Steel R.G.D. and J.H. Torrie. 1980. Principles and procedures of statistics: A biometrical approach. 2nd edition. McGraw-Hill, USA. 633 pp.

Tapper S.C. and R.F.W. Barnes. 1986. Influence of farming practice on the ecology of the brown hare (*Lepus europaeus*). *Journal of Applied Ecology*, 23:39-52.

Tapper S. 1987. The brown hare. Shire Natural History, No. 20. 24 pp.