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Systèmes sylvopastoraux. Pour un environnement, une agriculture et une économie durables

Zaragoza : CIHEAM
Cahiers Options Méditerranéennes; n. 12

1995
pages 213-216

Plant and animal responses to beef cattle grazing in a Mediterranean oak scrub forest in Israel

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Summary: A cattle trial was conducted during eleven years in a Mediterranean oak scrub forest in Israel. The herbaceous cover increased steadily under both heavy and moderate grazing, this increase was accompanied by a decrease in the prunings and leaf litter that were almost eliminated over time. The herbaceous cover was higher and the woody cover was lower in the heavily grazed paddock. There was a steady increase in herbaceous biomass throughout the study period, particularly in the heavily grazed paddock where the biomass at the end was nearly ten times greater than at the beginning.

The mean grazing pressure was about 50% higher in the heavily grazed paddock. Nevertheless, there was almost no difference in mean weaning weight between the stocking rates, and as a consequence, the production of weaned calf weight per unit area was 50% higher in the heavily grazed paddock . This was partially balanced by heavier supplementation per cow so that the feeding investment was about 13% higher per weaned kg.

Key-words: cattle, oak, woodlands, grazing, thinning.

INTRODUCTION

Dense scrub forest covers extensive areas of uncultivable uplands in Israel and in most countries with Mediterranean climates (Naveh, 1982). The wood of the scrub forest has no value as timber, but is used to provide fuel and goat grazing. These activities offer low return to labor and are often restricted to the close vicinity of villages. Large areas are not utilized and as a result represent a growing fire hazard as fuel accumulates.

It has been suggested that the dense tall scrub can be converted into an open woodland with a good herbaceous layer, by thinning and pruning of trunks, and maintained by heavy cattle grazing. This management option has been studied in the Hatal scrub grazing project that was initiated in Israel in 1981.

EXPERIMENTAL DEVICE

The Hatal station is situated in the Western Galilee, about 400 meters above sea level. The climate is Mediterranean with mild winters and hot dry summers. The average rainfall is 640 mm mostly in the period November to March. Maximum daily temperatures in summer are 30-40° C and average relative humidity, 50-60%. The area consists of moderate to steep slopes, with 20-40 % cover of limestone and dolomite rocks, between which there are pockets of terra rossa soil of very variable depth. The vegetation is dominated by oak scrub forest (Quercus calliprinos).

An area of 116 ha was fenced and provided with water and supplement feeding facilities. At the end of May 1981 a herd of beef cattle was introduced into the area. Simultaneously the oak thinning operations began.

The herd was composed mostly of crossbred local Arab, Simmenthal, and Brahman cows. During the first year the herd grazed continuously in the whole plot. In 1983, the whole herd was confined in a subplot of about 10 ha from February 3 to March 17. From the 1983/84 season onwards the herd was confined each year in early winter for about 80-90 days. After the end of the confinement period the herd was divided into two and grazed in separate plots with two stocking rates, heavy (1.6 ha/cow) and moderate (2.4 ha/cow).

From 1982 to 1986, bulls (grade Simmenthal or Angus) were with the cows between November and May, so that the calving season extended from September to March. As calving during the late summer and autumn needed large amounts of supplementary feed, in 1986, the breeding season was changed in order to concentrate calving from December to March. After 1986, the bulls served the cows during February-May when herbaceous growth is vigorous and forage quality is high.

Calves were weaned, in both calving regimes, generally between July and August.

The changes in the vegetation were monitored in quadrats 5 x 5 m located at random in the different habitats. In spring, relative cover of rocks, trees, shrubs, litter and herbaceous vegetation was measured along line transects. Herbaceous biomass was measured by visual estimations and calibrated with clippings (Tadmor et al. 1975). The height of stymp resprouts of trees was also measured.

RESULTS AND DISCUSSION

Vegetation cover dynamics

Fluctuations in the components of the vegetation cover make it difficult to detect clear trends in the cover of woody vegetation. If anything , the situation at the end of six years was similar to that at the beginning. In contrast the herbaceous cover increased steadily under both heavy and moderate grazing, but mainly during the first three years after which it stabilized more or less. The increase in herbaceous cover was accompanied by a decrease in the prunings and leaf litter that were almost eliminated over time. The herbaceous cover was higher and the woody cover was lower in the heavily grazed paddock.

Herbaceous biomass

There was a steady increase in herbaceous biomass throughout the study period, particularly in the heavily grazed paddock (Fig. 1) where the biomass at the end was nearly ten times greater than at the beginning. The herbaceous biomass was dominated by annual legumes (*Medicago polymorpha, Medicago rotata, Trifolium pilulare* and others).

The remarkable increase in the herbaceous component appears to be related to the fact that the animals are fed poultry litter as a supplement that contains about 2% P. The total amount eaten and excreted over the whole period is calculated as the equivalent of about 400 kg super phosphate per hectare (Henkin, 1986).

Grazing effects on the woody vegetation

In both the heavy and moderately grazed paddocks, grazing has clearly influenced the form of the woody vegetation, but particularly in the heavily grazed paddock. The basal regrowth at the end of the summer has been maintained at less than 0.5 m in the heavily

grazed paddock and at just under 1.0 m in the moderately grazed one (Fig. 2). The dense hedging of the basal growth is very similar to that achieved by goat grazing. As a consequence, many woody species (*Quercus calliprinos, Quercus infectoria, Phillyrea media, Arbutus andrachne, Olea europea ,Ceratonia siliqua*) have developed strong central trunks with a canopy that extends from 2 to 3 m upwards. The overall aspect is one of an open park-like formation.

Beef herd performance

Over the years 1984/90, the mean grazing pressure (measured in cow days per ha) was about 50% higher in the heavily grazed paddock (Table 1). Nevertheless, there was almost no difference in mean weaning weight between the stocking rates, and as a consequence, the production of weaned calf weight per unit area was 50% higher in the heavily grazed paddock. This was partially balanced by heavier supplementation per cow (Table 1) so that the feeding investment was about 13% higher per weaned kg.

Breeding season

In 1987 the breeding season was changed from autumn to spring. Calf weaning weight went down as expected (Table 2), but average daily gain (ADG) from birth to weaning was about 35% higher. When Creep feeding (barley supplied only to the calves, 1 kg per head per day) the weaning weight was similar in the autumn and spring calving seasons.

Because of higher calving and weaning rates, the weaned live weight production per unit area was higher in the case of spring calving, and the supplementation feed investment was significantly lower. (Table 2).

Table 1. Effects of grazing pressure on animal performance and supplement feed consumption (7 years average 1984/1990)

	Grazing pressure	
	Moderate	**Heavy**
Grazing pressure (grazing days per ha)	106	163
Calf live-weight at weaning (kg)	169.9	169.3
Weaned calf prod. per ha (kg)	61	91
Supplementary feed energy, M.E. (Mcal/cow/yr)	2838	3133

Table 2. Effects of calving season on animal performance and supplemental feed consumption.

Variable Period	Calving season **Autumn** 1983/96 (4 years)	**Spring** 1987/92 (7 years)	
Liweight at weaning			
Cows (kg/cow)	398	446	
Calves (kg/calf)	191	164	(Creep Fed 181)
Calving rate (%)	71	75	
Average calving date	Oct 12	Feb 9	
Calf age at weaning (days)	269	154	(Creep Fed 184)
Calf daily live weight gain from birth to weaning (g/day)	576	755	(Creep Fed 966)
Supplementary feed energy, M.E. (Mcal/cow/yr)	3024	3041	(Creep Fed 3540)

CONCLUSIONS

After eleven years of beef cattle grazing on an Mediterranean type oak scrub woodland, a balance of achievement and failure can be drawn up:

- A commercial beef herd has been maintained continuously (with continual replacement as necessary) for eight consecutive years and has performed moderately in comparison with commercial standards in the region.
- The woody vegetation has been utilized fairly intensively and basal regrowth has been effectively suppressed. Many trees have been developed clear straight trunks with canopies that extend from 2 to 3 m upwards creating an aspect of open park land.
- The herbaceous vegetation has developed dramatically and in the last two years, the sward of mixed annual legumes has become a major factor in the animal nutrition balance.
- The beef herd performance has not come up with expectations.

In conclusion, it is clear that a dynamic ecosystem like the Mediterranean oak scrub woodland presents complex management problems. Some problems can be solved by ecological means, mainly grazing pressure and feed recycling, others may require technological intervention, in particular, repeated selective control of spiny shrubs with herbicides.

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