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Amit Dolev
Northern R&D, Israel

Eugene D. Ungar
Agricultural Research Organization, Israel

Zalmen Henkin
Agricultural Research Organization, Israel

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Factors influencing the spatial distribution of beef cattle on Mediterranean rangeland

A . Dolev[1] , E .D . Ungar[3] and Z . Henkin[2,3]
[1] Northern R&D , Migal , Industrial area , P .O .Box 831 Kiryat Shemona 11016 , Israel , E-mail : amit _ dol@zahav .net . il ,[2] Beef Cattle section , Newe-Ya'ar Research Center , Department of Natural Resources , Agricultural Research Organization , P .O . Box 1021 , Ramat Yishay , 30095 , Israel , [3] Department of Agronomy and Natural Resources , Agricultural Research Organization-the Volcani Center , P .O . Box 6 , Bet Dagan 50250 , Israel .

Key words : cattle , grassland , landscape , spatial distribution

Introduction The rules governing spatial distribution of beef cattle on rangelands are poorly understood . Nevertheless , animal movement patterns are known to often lead to non uniform utilization of the rangeland . For example , cattle prefer to move along trails that incur low costs of energy expenditure that depend on vegetation quality and paddock size (Ganskopp et al . , 2000) . Their movements are influenced also by the location of watering points (Ganskopp 2001) . The spatial differences in forage consumption lead to high grazing pressure on some patches , while in others cattle presence is low . Understanding the rules of cattle movement can provide us with tools for improving the utilization of rangelands , and can enable us to direct cattle utilization to management-targeted areas . The objective of this research was to study the grazing behavior of free-ranging cattle in a spatially explicit way to better understand the interrelationships between features of the landscape and cattle movement patterns .

Material and methods The experiment was conducted at the Karei Deshe experimental farm in northern Israel (32°55′N , 35°35′ E) . The area is a Mediterranean rangeland with rich hemicryptophytic vegetation , hilly topography with slopes generally less than 20° , and an average annual rainfall of 570 mm that falls mostly from November to March . During the years 2002 to 2005 data on the movements of beef cows (109 in total) was collected by fitting Lotek GPS collars which provided the location and activity of the animals at a temporal resolution of five minutes . Collars were deployed for periods of 2-10 days during different periods of the year (Feb . , Apr . , Jun . , and Aug .) . The paddocks were of approximately 30 ha in size and stocked at a high (HP) or low (LP) grazing pressure of 0 .9 or 1 .8 ha/cow , respectively . Each paddock included a water trough , an area shaded by trees , and a supplementary feeding site which was used during late summer only . Using suitable GIS map layers each plot was divided into a grid of 25×25 m . For each cell the following attributes were computed : slope , and the distances to the water source , shade area , feeding site (whether or not in use) , and the nearest fence . We assessed five factors that might influence cattle distribution : the three resource factors of water , shade and feed supplement locations , the natural characteristic of slope , and the fence line . In three paddocks the water and feed supplement sites were in the vicinity (<100 m) of the shade sites , while in the fourth plot (plot 2) the feeding site was >500 m from the shade site .

Results The proportion of cattle locations within 200 m from water site (Figure 1 and Table 1) shows a dramatic increase (0 .29—0 .74) in use from winter (Feb .) to late summer in paddocks having adjacent resource factors (plots 4 , 5 , 7) . In plot 2 , where the feeding and shade sites were far apart , a relatively similar use for all seasons was obtained . Comparison of the utilization of slopes to their distribution in the paddock showed no significant difference during early winter (Feb .) , while in later seasons a high preference of slopes <8° was found . No effect of the fence line on cattle distribution in the different paddocks was found at this stage .

Table 1 *Proportion of cattle GPS locations within 200 m of the watering trough .*

Plot	Stocking rate	Feb/Mar	Apr	Jun	Aug
2	LP	0 .45	0 .40	0 .30	0 .46
4	HP	0 .33	0 .53	0 .72	0 .86
5	LP	0 .29	0 .47	0 .55	0 .60
7	HP	0 .17	0 .54	0 .66	0 .78

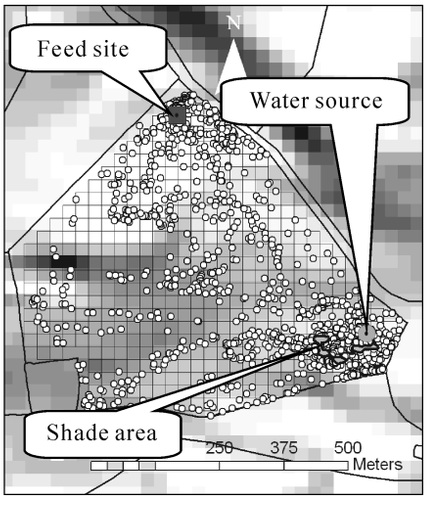

Figure 1 *Cattle spatial distribution (white dots) in plot 2 , August 2005 . Darker cells have a higher slope . Dotted circle : water trough ; dotted square : feed site ; colored polygon : trees site .*

Conclusions The relative position in a paddock of resource factors has a major effect on the spatial distribution of cattle . Thus it might be possible to change grazing patterns and improve forage utilization by altering resource positioning . Such changes should be cognizant of the distribution of topographic conditions and other natural resources in the paddock .

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