Spatial heterogeneity of seasonal grazing pressure created by herd movement patterns on hilly rangelands using GPS and GIS

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Keywords: Bedouin, rangeland, heterogeneity, GPS, GIS

Introduction The spatial heterogeneity of grazing pressure on extensive rangelands has management implications (Adler *et al.*, 2001) but it has traditionally been difficult to quantify. Combination of technologies based on GPS (Global Positioning System) and GIS (Geographic Information Systems) is a quantum leap in our ability to address this issue. These tools were used to estimate the spatial heterogeneity of grazing pressure at a farm scale, and examine the relation between local landscape features and local grazing pressure.

Materials and methods The study site is in the hilly, semi-arid region of Israel (31°20' N 34°45' E), populated by a mixed herd of sheep and goats (400 animals) which is shepherded as a group across the landscape, with a fixed night corral and watering point. The herding route was tracked on 78 days in the green season of 2003 (Feb to June), using a tagged goat, harnessed with a GPS rover unit (Trimble GEII Explorer) that recorded a position every 0.5min. The routes were overlaid on GIS raster layers containing data on abiotic factors, at a resolution of 25x25m/cell. For each GPS location, 25min of animal presence was accrued to each of the 8 closest raster grid cells, based on animal number and the estimated area occupied by the stationary herd.

Results The area available to the herd was 9648 raster grid cells (627ha), of which 7312 (457ha) had non-zero animal presence. Average velocity based on adjacent GPS locations was 0.28m/s. The total animal presence time accrued was 65736h, yielding an average of 9h/cell, visited at least once, or 144hr/ha. The frequency distribution of grazing pressure for the area visited (Figure 1a) was highly skewed to the right, with a long tail (not all shown) reaching a maximum of 2000hr/ha. Of the area grazed, 67% was frequented less than the expected mean. Presence was greater on the shallower slopes (<9°) and lower on the steeper slopes (>13°) than expected randomly (Figure 1b). Presence according to distance from the night corral deviated strongly from random, with a strong preference for the 800-1000m category (Figure 1c). Presence according to aspect showed a small increase for North and decrease for East (Figure 1d).

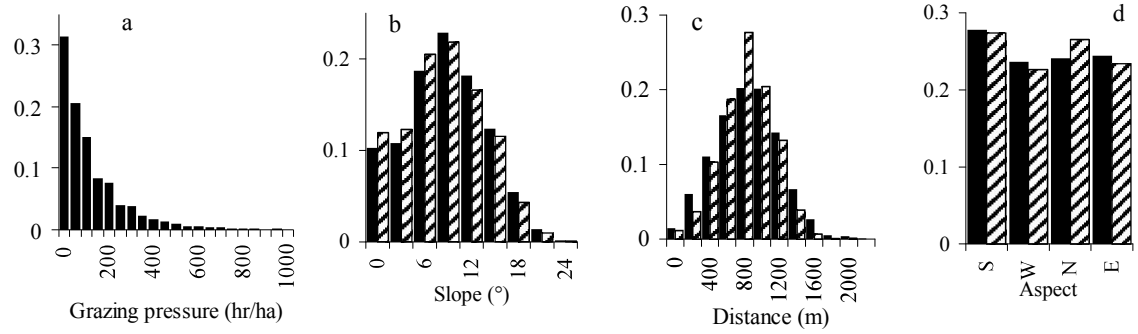

Figure 1 Frequency distributions of (a) grazing pressure, (b) slope, (c) distance from night corral, (d) aspect. Y axis is relative proportion of observations. In (b), (c) and (d), black = landscape, striped = animal presence

Conclusions Using GPS and GIS, it is feasible to map and analyse the cumulative seasonal grazing pressure imposed by a herd over an entire grazing season. These tools also enable expected spatial distributions for null hypotheses to be computed that are site-specific. The observed spatial use deviated strongly from random or highly systematic patterns. Statistical analyses of observed versus expected distributions are planned using filtered data sets to reduce autocorrelation.

References

Adler, P. B., D. A. Raff & W. K. Lauenroth (2001) The effect of grazing on the spatial heterogeneity of vegetation. *Oecologia*, 128, 465-479.