Abstract

Grazed ecosystems, in which large mammalian herbivores interact with vegetation mosaics, account for one fifth of the earth's land surface and provide both food and economic resources. Although grazed ecosystems have provided a fruitful base for scientific study for many decades, due to the complexity of these systems and the lack of appropriate tools, analysis of the spatial aspects of plant-herbivore interactions is still in its infancy. The aim of this study was to contribute to the understanding of spatial aspects of plant-herbivore interactions within a grazed grass-shrub system, using heather moorland - an internationally important ecosystem dominating much of the Scottish uplands - as the object of investigation.

A three-year field experiment was conducted to observe plant-herbivore interactions between Scottish Blackface sheep and heather-grass mosaics. Due to the complexity of grazing systems, traditional experimentation is limited in providing insights into the complexity of interactions occurring. Therefore modelling tools were also employed to allow for virtual experimentation, thus complementing and extending the field data.

The results of the field experiment showed the importance of a spatially explicit approach to understanding the interactions. The pattern of use of the vegetation mosaics by sheep was strongly heterogeneous, with spatially limited areas of intensive use intermixed with large areas of extensive use. Foraging and ruminating behaviour showed distinctively different patterns of impact, indicating that multiple processes determine herbivore use of vegetation mosaics and their concomitant impacts on the dynamics of the vegetation.

Application of a spatial interaction model, previously used in human geography, to the field data revealed that the amount of grass in an area was a good predictor of the local heather defoliation. Heather defoliation was highest near large grass patches and lowest away from small grass patches. The virtual experiment showed further that cognitive aspects of foraging behaviour could play an important role in determining the pattern of use by herbivores. Performance of foraging strategies was strongly affected by the heterogeneity of the vegetation, suggesting that herbivores could adapt their foraging strategies depending on the pattern of vegetation.

This study provides new insights into the spatial aspects of plant-herbivore interactions in grass-shrub mosaics and offers a starting point for more detailed investigations. At the same time the results necessitate the increased use of spatially explicit approaches in the management of grazed ecosystems.