

Extensive management of sheep grazing in upland sown grassland: long-term effects on plant species composition

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Introduction Changes in the Common Agricultural Policy have led to the development of agri-environment schemes to deliver environmental goods from grasslands. These schemes encourage more extensive grazing systems, and change the emphasis from animal output to issues such as increasing biodiversity. Lower stocking densities are expected to promote the development of a heterogeneous habitat and associated compositional changes in plant species. The long-term effect of more extensive sheep management, combining cessation of fertiliser and lower grazing intensity, on botanical composition and animal output in upland sown grassland has been studied at 3 sites (Marriott *et al.*, 2002) since 1990. We describe changes in vegetation at one site between 1990 and 2004.

Materials and methods The site was on a freely draining brown forest soil at Sourhope Research Station (2°14' W 55°29' N, 367m ASL) in SE Scotland. An intensive, control treatment (4F) was maintained from Apr until mid-Nov at a sward height of 4cm and was fertilised (150kg/ha N and 20kg/ha each of P₂O₅ and K₂O/year). Three extensively managed treatments received no fertiliser and were grazed to maintain two sward heights, 4cm (4U) or 8cm (8U), or were ungrazed (UN). Swards were grazed by Scottish blackface ewes, with their single lambs from May until weaning in mid-Aug. Height treatments were maintained by adjusting ewe numbers in response to weekly measurements of sward surface height. The plots were circa 0.45 ha, and each treatment was replicated twice in a randomised block design. Vegetation composition was measured at 18 permanent locations/plot, using an inclined point quadrat to measure percentage specific frequency and a 0.5 x 0.5m grid quadrat to count the number of species present. Percentage specific frequency of unsown species was analysed by REML, a generalised analysis of variance suitable for unbalanced data (treatment UN was not measured in years 11 and 13). The number of species (grasses, forbs, legume, rushes and sedges, total) was analysed by analysis of variance.

Results There was a large and rapid increase in specific frequency of unsown species in treatment UN (Table 1) and the sown species virtually disappeared within 5 years. The differences between grazed treatments were smaller and varied between years, but the specific frequency of unsown species was generally higher in treatment 8U than 4F from 6 years after the experiment began. Increases in the number of species present did not necessarily accompany changes in specific frequency. The total number of species and the number of forbs increased ($p < 0.01$) in treatment UN, exceeding the numbers in all other treatments. Some forb species were found only in treatment UN, e.g. *Cirsium arvense*, *Conopodium majus*, *Endymion non-scriptus*, *Galium aparine* and *Viccia cracca*. In the grazed treatments, there was a small increase in the number of species in treatment 4U, due mainly to an increase in the number of grass species ($p = 0.067$), but no difference in treatments 8U or 4F.

Table 1 Species composition

Year	4F	4U	8U	UN	s.e.d. ¹
% Specific frequency of unsown species					
1990	29.3	26.3	36.6	33.8	4.94
1994	46.3	48.8	51.9	100	(4.38)
2003	47.5	58.5	68.1	-	
Total number of species					
1991	16.0	15.5	18.0	15.0	2.74
1995	15.0	16.0	19.0	13.0	(1.47)
2004	17.5	19.0	17.5	23.5	
Number of forb species					
1991	4.0	5.0	4.0	2.5	2.10
1995	4.0	4.5	3.5	2.5	(0.91)
2004	5.5	5.5	4.0	10.0	
Number of grass species					
1991	10.5	9.0	12.0	11.5	1.22
1995	9.0	9.5	13.5	10.5	(0.91)
2004	10.5	11.5	11.5	13.0	

¹ S.e.d. in parenthesis to compare within treatment

Conclusions Species composition changed rapidly when grazing was removed and swards were abandoned. However, it appears to be difficult to increase botanical diversity in upland sheep systems simply by removing fertiliser and reducing grazing intensity. This is most likely due to a lack of seed sources of new plant species in sown grasslands. The presence of a diverse range of vegetation types within the local area could improve on the colonisation by new plant species. Otherwise, reseedling with desired species may need to be considered.

Reference

Marriott, C.A., G.R. Bolton, G.T. Barthram, J.M. Fisher & K. Hood (2002). Early changes in species composition of upland sown grassland under extensive grazing management. *Applied Vegetation Science*, 5, 87-98.