

# Changes in the composition of a species-rich montane grassland following the removal of grazing livestock

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## Introduction

Changes in the way that farmers are subsidised are likely to lead to modifications in livestock numbers particularly in the hills. Although land abandonment and under-grazing are not allowed under cross-compliance, sheep numbers on the hills are likely to decline in many areas. This will have a considerable impact on the vegetation and landscape. Some habitats may benefit while others, such as species-rich grasslands, may suffer. As part of a project to encourage the development of montane willow scrub within the Ben Heasgarnich Special Area of Conservation, a small stock-proof enclosure was erected in 1998 on an area of species-rich montane grassland on the Cam Chreag, a mountain near Crianlarich in west Perthshire. This provided an opportunity to monitor changes in species composition and sward structure following the exclusion of sheep.

## Study Site

A stock-fenced enclosure was erected on the Cam Chreag in the autumn of 1998. The enclosure was 0.9 hectares in size and located at an altitude of 720 m (Ordnance Survey grid reference NN 370 341). The enclosure contained areas of species-rich U5c *Nardus stricta-Galium saxatile (Carex panicea-Viola riviniana)* grassland, CG11 *Festuca ovina-Agrostis capillaris-Alchemilla alpina* grass-heath and M11 *Carex demissa-Saxifraga aizoides* mire. There was also a cliff (with associated boulder talus), which supported a small population of *Salix arbuscula*, plus tall herb species including *Trollius europaeus*, *Geranium sylvaticum* and the red data-book species *Bartsia alpina*. Ninety-four species of vascular plant have been identified within the 0.9 ha enclosure. Over 140 *Salix arbuscula* plants, grown from seed collected from the Cam Chreag, were planted in the enclosure between 2000 and 2003.

## Methods

Nine randomly located 1 m<sup>2</sup> permanent quadrats (split into 100, 10 x 10 sub-cells) were surveyed within the CG11 grass-heath inside the enclosure in the summer of 1999. The number of sub-cells in which each vascular plant species was found was recorded. The quadrats were re-surveyed in the summer of 2004. One hundred random sward surface height measurements were taken from inside the enclosure using a HFRO sward stick (Barthram 1986). Measurements were taken in August each year from 1999 (the first summer after enclosure) to 2004.

## Results

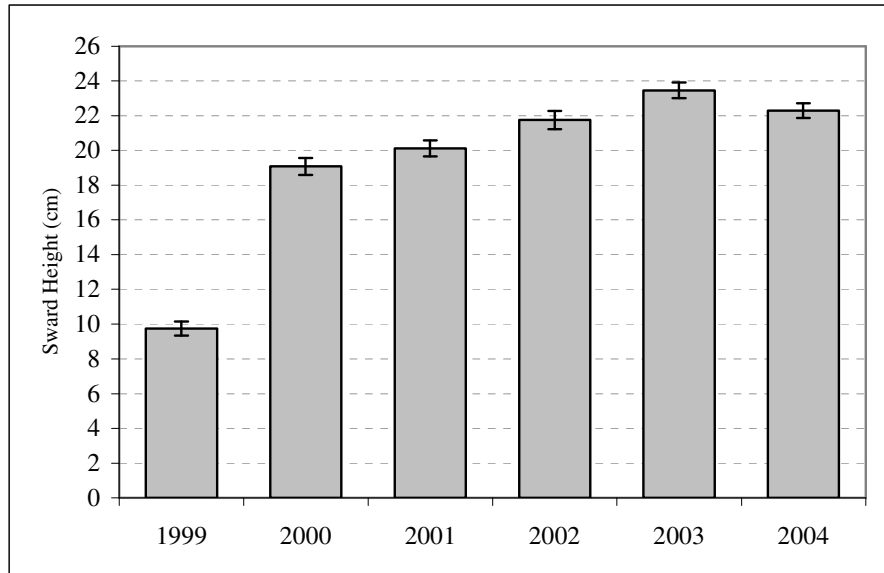
A total of 62 species of vascular plant were recorded within the nine quadrats. After only five years of stock exclusion some major changes in species composition were observed (Table 1). Annual and low growing perennial herbs, such as *Euphrasia* agg., *Bellis perennis*, *Linum catharticum* and *Thymus polytrichus*, tended to decline, while perennial sedges and grasses, and dwarf shrubs tended to increase. A number of the rarer montane species, including *Sibbaldia procumbens*, *Silene acaulis* and *Carex capillaris*, declined. There was an increase in the frequency of some of the tall herb species, including *Trollius europeus* and *Geum rivale*, but few of the tall-herbs flowered and many remained short in stature.

**Table 1.** Some of the major changes in species composition after excluding livestock for five years

Species	% of cells in which present in 1999 (I = Initial Frequency))	% of cells in which present in 2004 (F = Final Frequency)	C = Change = $100 \times (F - I) / (F + I)$	Degree of Change
<i>Bellis perennis</i>	4.8	0.1	-95.5	
<i>Euphrasia</i> agg.	13.6	0.4	-93.7	
<i>Cerastium fontanum</i>	6.0	0.2	-92.9	
<i>Sibbaldia procumbens</i>	5.0	0.3	-87.5	
<i>Selaginella selaginoides</i>	2.7	0.2	-84.6	Strong Decrease
<i>Linum catharticum</i>	1.2	0.1	-83.3	
<i>Silene acaulis</i>	4.1	0.6	-76.2	
<i>Carex capillaris</i>	4.6	1.0	-64.0	
<i>Luzula multiflora</i>	6.2	1.6	-60.0	
<i>Viola palustris</i>	10.2	2.7	-58.6	
<i>Persicaria vivipara</i>	28.0	9.7	-48.7	
<i>Galium saxatile</i>	17.3	6.9	-43.1	
<i>Campanula rotundifolia</i>	9.0	4.2	-36.1	
<i>Alchemilla alpina</i>	55.4	27.6	-33.6	
<i>Thymus polytrichus</i>	75.2	42.0	-28.3	Moderate Decrease
<i>Alchemilla glabra</i> & <i>filicaulis</i> ssp. <i>filicaulis</i>	33.9	19.3	-27.3	
<i>Lysimachia nemorum</i>	1.1	0.7	-25.0	
<i>Nardus stricta</i>	31.1	19.8	-22.3	
<i>Anthoxanthum odoratum</i>	43.6	28.1	-21.6	
<i>Carex panicea</i>	18.3	27.6	20.1	
<i>Carex bigelowii</i>	4.7	7.1	20.8	
<i>Carex binervis</i>	7.2	11.7	23.5	
<i>Deschampsia cespitosa</i>	1.7	2.9	26.8	Moderate Increase
<i>Trollius europeus</i>	0.4	0.9	33.3	
<i>Geum rivale</i>	3.9	7.8	33.3	
<i>Vaccinium myrtillus</i>	12.0	24.8	34.7	
<i>Carex pulicaris</i>	8.2	19.4	40.6	
<i>Hieracium</i> sp.	0.2	1.0	63.6	Strong Increase
<i>Anemone nemorosa</i>	0.9	7.9	79.7	

The mean summer sward surface height of the CG11 grass-heath increased significantly from less than 10 cm in 1999 to over 23 cm in 2003 ( $F_{1,198} = 502.7$ ,  $P < 0.001$ ) (Figure 1).

**Figure 1** - Mean sward surface height of the vegetation inside the enclosure (n=100) in August 1999, 2000, 2001, 2002, 2003 and 2004 (Error bars are  $\pm 1$  S.E.).



## Conclusions

The removal of grazing livestock caused rapid changes in the species composition and structure of the sward. The conservation value of the Cam Chreag would be considerably reduced if sheep were removed entirely from the site. Grazing is essential if these important species-rich grasslands are to be maintained. Any removal of livestock from the mountains of Scotland, whether as a result of CAP reform or not, will have a significant impact on montane grasslands. Tall herb vegetation and dwarf shrub heath are likely to benefit from a reduction in sheep numbers. Getting the right management to maintain or enhance the biodiversity of montane grasslands within Special Areas of Conservation, under the new Single Farm Payment subsidy system, will be a difficult challenge for land managers, conservationists and policy makers.

## References

Barthram G.T. (1986) Experimental techniques: the HFRO sward stick. *Hill Farming Research Organisation, Biennial Report, 1984-1985*. pp. 29-30.

## Acknowledgements

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