

# Establishment of a mobile sheep flock to maintain and improve mesotrophic species-rich grasslands in Fife and Falkirk, Scotland

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## SUMMARY

The Scottish Wildlife Trust established a mobile flock of sheep to manage its Sites of Special Scientific Interest (SSSI) designated grasslands in eastern Scotland. A programme of monitoring (quadrat sampling and 'Site Condition Monitoring') was established to record vegetation responses to sheep grazing over several years. The project has resulted in the sheep-grazed grasslands moving towards favourable condition in terms of target plant communities. It has highlighted the need to take a flexible and responsive approach to conservation grazing, and has demonstrated the usefulness and necessity of detailed monitoring in guiding changes to grazing regimes; the level of grazing 'fine-tuning' could not have been achieved, in this instance, using external graziers.

## BACKGROUND

Scottish Wildlife Trust (SWT) manages four species-rich grasslands designated as Sites of Special Scientific Interest (SSSI) in the counties of Fife and Falkirk, eastern Scotland. These SSSI sites are selected for one or more plant community features (in this case mesotrophic MG5 *Cynosurus cristatus* - *Centaurea nigra* grassland) of conservation value. Each community feature has a 'conservation objective' (also known as a 'condition objective') which contains a target or target ranges that must meet if the plant community is to be judged in favourable condition. The indicators used to assess MG5 grassland include:

*Positive indicator species*: two target plant species frequent and four occasional;

*Negative indicator species*: agricultural weeds – no more than occasional; agriculturally favoured species/rank grasses – no more than 10%;

*Sward height* – between 5 and 20 cm.

Prior to 2001, the grassland sites were grazed with sheep through agreements with local graziers on an *ad hoc* basis. This however, made it difficult to graze at appropriate times of year and with appropriate stocking levels to maintain the grasslands in favourable condition (i.e. with regards maintaining desired plant communities). The sites were in unfavourable condition and declining in quality in terms of target plant communities. It was clear that this approach was not achieving management objectives, and that a new approach had to be found. In 2001, an opportunity arose to establish a mobile flock of sheep specifically for the purpose of grazing SWT reserves in the east of Scotland. The 'flying flock' was established to enable SWT to manage its own flock of sheep, aiming to bring reliable and effective management to the Fife and Falkirk reserves and to demonstrate the benefits of conservation grazing to local farmers, landowners and other nature conservation organizations.

## ACTION

**Establishment of the sheep flock:** In 2001, the project employed a shepherd who purchased 50 Shetland sheep from Orkney (northern Scotland) in the winter of 2001/02. A four-wheel-drive crew-cab vehicle and a double deck stock trailer were purchased for moving stock between sites. A mobile handling system for gathering, penning, foot-bathing and sorting sheep was also purchased along with a quantity of electric fencing to enable concentration of grazing on particular parts of larger sites. The project cost approximately £55,000 to set up and approximately £30,000 per year to run.

Shetland sheep were chosen for their hardiness, ability to thrive on poor quality grazing, easy lambing and good mothering qualities. In the first year of lambing, pure-bred Shetland lambs were produced in order to maintain the flock and some revenue was generated by the sale of cull ewes and excess lambs. Since that time however, Shetlands have been crossed with a Cheviot or Texel tup breeds to produce more commercially saleable lambs. Lamb and wool sales are used to offset some of the costs of the project. By 2009, the flock had increased in size to around 400 sheep, and the scope of grazing was extended to other sites beyond the original core area.

**Grazing:** At all four mesotrophic grassland study sites, vegetation was initially grazed over the autumn and winter only, with stock being removed before the spring. This however had a limited effect on the sward height and reduction in grass litter. On some sites, therefore, lower density spring and summer grazing was introduced to reduce dominance of grazing-intolerant coarse grasses, such as false oat grass *Arrhenatherum elatius*, cock's-foot *Dactylis glomerata* and Yorkshire fog *Holcus lanatus*, and to hopefully encourage the spread of finer grasses and other more grazing tolerant species while opening up gaps in the sward for colonization by other species.

**Monitoring:** A system of vegetation monitoring was established at the commencement of the project. This involved quadrat monitoring and standard 'Site Condition Monitoring' (following JNCC guidelines). Quadrat monitoring comprises permanent randomly positioned 1m<sup>2</sup>

quadrats established at each site. Each quadrat was marked with a blue post at two opposite corners, and a 10-figure Ordnance Survey grid reference was recorded using a Global Positioning System (GPS) device to allow the quadrats to be relocated. Each quadrat was divided into 20 x 20 cm subdivisions (for plant frequency of occurrence estimates) and the following were recorded:

- i) vegetation height (measured using a sward stick), recorded as the average of five measurements taken at the centre and each corner of the quadrat;
- ii) plant species frequency - the number of subdivisions in which each species was present;
- iii) plant litter and bare ground - the number of subdivisions in which a plant litter mat and bare ground (other than rock) occurred.

Site condition monitoring allows the whole site to be assessed and any large-scale temporal changes in the condition of the vegetation to be recorded. Abundance of positive (e.g. desired forbs and less-aggressive grasses) and negative (e.g. competitive grasses) indicator species are visually assessed using the DAFOR ([dominant (50 – 100%), abundant (30 – 50%), frequent (15 – 30%), occasional (5 – 15%) and rare (<5%)]) scale. Grass to forb ratio, vegetation height, litter and extent of bare ground are also measured. For each habitat, the results can be compared with the ascribed indicator species (see above) to assess whether the habitat is in favourable condition.

## CONSEQUENCES

Using the two monitoring methods has allowed a good understanding of changes brought about by the grazing regimes. A summary of the British National Vegetation Classification communities (Rodwell 1992) of the four study sites, grazing regimes and consequences in terms of plant community responses are described below. In Appendix 1, available DAFOR scale plant species abundance data are presented for each site.

**Kilminning Coast SSSI, Fife**

A 10.8 ha mixed MG1 (*Arrhenatherum elatius* grassland), MG11 (*Festuca rubra* - *Agrostis stolonifera* - *Potentilla anserina* grassland) and MG5 (*Cynosurus cristatus* - *Centaurea nigra* grassland) site.

Grazing regimes: 3.7 -11 sheep/ha; 2003 – late summer, autumn and winter; 2004-2005 – late summer and autumn; 2006-2008 – autumn; 2009 – autumn, spring and summer.

Difficulties in stock-proofing some parts of the site resulted in only one compartment (6.28 ha) of three being grazed. However, this allowed grazing resources to be targeted on what was a more manageable area, whilst enhancing the interest and diversity of the site as a whole (through allowing scrub development in the ungrazed areas).

Grazing was initially restricted to autumn and winter, at medium to high density. This resulted in some improvements to condition, but did not reduce sward height and litter sufficiently for it to be classified as favourable. Initial monitoring following the introduction of grazing raised concerns that common knapweed *Centaurea nigra* was being lost through grazing. Monitoring in recent years has indicated that if grazing is increased, other floristic benefits will outweigh any reduction in abundance of *C.nigra*. Consequently, a decision has been taken to graze the site throughout the spring and summer in an attempt to reduce sward height and reduce dominance of more aggressive species (e.g. *A.elatius*). This regime will be kept under review and altered as necessary.

**Fleecefaulds Meadow SSSI, Fife**

A 12.75 ha MG5 *Cynosurus cristatus* - *Centaurea nigra* grassland.

Grazing regimes: 2.9 - 8.8 sheep/ha; unit 1-3, 2001-2009 – autumn, winter and spring; unit 4, 2001-2009 – autumn, winter, spring and summer.

This site is divided into four sections, all of which responded slightly differently to the introduction of sheep grazing. The south compartment (unit 1) has been the most successful (grazed at a medium density over the autumn and winter); a steady improvement through the years has been recorded and has been assessed as being in favourable condition.

Ruderals and weedy species are scarce. There are low levels of hawthorn *Crataegus monogyna* scrub (following initial scrub removal at the start of the project). This will be monitored and measures undertaken as required, to ensure it does not encroach to the detriment of the site.

The second compartment (unit 2) is a steep bank, which monitoring suggests has been through a phase of rank MG1 but now developing following grazing towards shorter MG5 grassland. However, as the sward height remains too tall, grazing will be extended to spring and summer in order to reduce it further. Creeping thistle *Cirsium arvense* and wild raspberry *Rubus idaeus* are also a problem in this area, both will be controlled through cutting and treating with glyphosate herbicide. Hawthorn scrub in this unit is extensive but is mature and does not appear to be invading the grassland to any great extent under grazing.

The third unit is short, herb-rich MG5 grassland which has been assessed as being in good condition. It has benefitted from higher grazing levels and grazing during the spring.

The most northerly compartment (unit 4) is a mixture of tall MG1 and MG1 – 5 grassland. There is much scrub, and *Cirsium arvense* and *H.lanatus* are present. It is apparent that grazing needs to be at a higher intensity and for a greater duration than the current regime to begin to move this area towards favourable condition.

**Lielowan Meadow SSSI, Fife**

A 2.4 ha MG5 *Cynosurus cristatus* - *Centaurea nigra* grassland.

Grazing regimes: 12.5 sheep/ha; 2002 – autumn; 2003 – autumn; 2004-2009 – spring, summer and autumn

This site was initially grazed to an autumn/winter regime at a medium to high density. Monitoring demonstrated that this was ineffective at reducing the rank sward and improving the condition of the site, and, despite grazing, the site was declining in condition. Spring and summer grazing was therefore introduced, and the benefits of this changed regime became apparent. Within a year, subtle signs of increased diversity were recorded, and this has continued in subsequent years. The latest round of monitoring indicated a continued improvement and the site is now classified as 'unfavourable recovering'.

**Bo'Mains Meadow (part) SSSI, Falkirk**

A 2.54 ha mixed MG5 (*Cynosurus cristatus* - *Centaurea nigra*) and MG9 (*Holcus lanatus* - *Deschampsia cespitosa*) grassland.

Grazing regime: 15.7 sheep/ha; 2004-2009 – autumn/winter.

This site is cut each year at the end of the summer, with the cuttings removed. Medium-high intensity grazing (i.e. 15.7 sheep/ha) is undertaken for a short period the cut has been taken. An interesting flora occurs on this site, with species including great burnet *Sanguisorba officinalis* being recorded in 2009. This is the first record of this species in the Lothians and the northern most native record in Britain.

Due to restrictions in funding, it was not possible to include this site in the monitoring regime for years earlier than 2009. Monitoring in 2009 however, indicated that management of the site is having the required benefits, with the site being assessed as being in favourable condition.

**Conclusions:** The project has demonstrated the benefits of having complete control over the grazing at these four SSSI grassland sites. The ability to respond quickly and efficiently in terms of alterations to the sheep grazing regimes in accordance to vegetation responses highlighted by the monitoring programme has resulted in favourable changes to the plant communities in the study grasslands.

The project has also emphasized that no two sites are the same, and that an appropriate grazing regime must be tailored for each individual site. Even sites classified as the same NVC grassland habitat type may display significant differences in response to grazing and hence may require refinements to the grazing regime. It is likely that these will only become apparent over several years into a grazing project, and it is essential that a flexible and long-term approach is maintained to allow lessons learned to be implemented.

A robust monitoring scheme is essential to inform management. The quadrat monitoring scheme used in this project was useful in conjunction with more broad-scale monitoring, i.e. Site Condition Monitoring. Random quadrats on their own run the risk of not picking up broader-scale changes in abundance of for example aggressive species (such as some

widespread nitrophilous grass species), simply because of their random distribution (sometimes aggregated) of occurrence. Likewise, Site Condition Monitoring on its own cannot detect the subtle changes in grassland sward composition that quadrat monitoring can. By using the two systems side by side, an in-depth understanding can be developed of the response of sites to targeted grazing.

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**Appendix 1.** Changes in plant species abundance as indicated by DAFOR data, 2003-2009.

<b>Kilminning DAFOR monitoring summary</b>					
	<b>2003</b>	<b>2004</b>	<b>2005</b>	<b>2008</b>	<b>2009</b>
<b>Positive indicator species/taxa</b>					
<i>Agrimonia eupatoria</i> agrimony				R	R
<i>Carex</i> spp. ( <i>C. flacca</i> , <i>C. nigra</i> , <i>C. panicea</i> )				R	R
<i>Centaurea nigra</i> common knapweed	R	R	F	F	F
<i>Filipendula ulmaria</i> meadowsweet				R	R
<i>Galium verum</i> lady's bedstraw				R	R
<i>Hypochoeris radicata</i> cat's-ear				R	R
<i>Lathyrus pratensis</i> meadow vetchling				R	R
<i>Lotus corniculatus</i> bird's-foot trefoil	R				R
Orchidaceae orchid spp.				R	R
<i>Rhinanthus minor</i> yellow rattle					R
<i>Succisa pratensis</i> devils'-bit scabious			R		
<b>Negative indicator species</b>					
<i>Anthriscus sylvestris</i> cow parsley	R	R			
<i>Cirsium arvense</i> creeping thistle	O	F	F	F – A	R
<i>Cirsium vulgare</i> spear thistle				R	R
<i>Galium aparine</i> cleavers	R	R	O	R	R
<i>Rumex crispus</i> curled dock			R		R
<i>Rumex obtusifolius</i> broad-leaved dock			R		
<i>Senecio jacobaea</i> common ragwort				O	R
<i>Urtica dioica</i> stinging nettle	R	R	O – F	F	R
<i>Holcus lanatus</i> Yorkshire fog	A	A	F	F – A	O
<i>Lolium perenne</i> perennial rye-grass				R	R
<i>Phleum pratense</i> timothy				R	R
<i>Trifolium repens</i> white clover	A	R		R	R
<i>Arrhenatherum elatius</i> false oat-grass	A		A – D	A – D	F
<i>Dactylis glomerata</i> cock's-foot	A		F – A	F – A	R
<i>Pteridium aquilinum</i> bracken			O – F		
<b>Mean sward height (cm)</b>	41.0	14.0	31.8	55.0	65.0

<b>Fleecefaulds Unit 1 DAFOR monitoring summary</b>					
	<b>2003</b>	<b>2004</b>	<b>2005</b>	<b>2008</b>	<b>2009</b>
<b>Positive indicator species/taxa</b>					
<i>Alchemilla</i> spp. lady's-mantle			F	F	O
<i>Carex</i> spp. ( <i>C. flacca</i> , <i>C. nigra</i> , <i>C. panacea</i> )			O – F	F	A
<i>Centaurea nigra</i> common knapweed	O	F	A	A	A
<i>Filipendula ulmaria</i> meadowsweet			O	O	R
<i>Galium verum</i> lady's bedstraw			R	R	R
<i>Hypochoeris radicata</i> cat's-ear			R		
<i>Lathyrus linifolius</i> bitter-vetch				R	O
<i>Lathyrus pratensis</i> meadow vetchling			O – F	A	A
<i>Lotus corniculatus</i> bird's-foot trefoil			F	F	A
Orchidaceae orchid spp.				A	O
<i>Potentilla erecta</i> tormentil			F	A	A
<i>Rhinanthus minor</i> yellow rattle	R	O	F – A	A	A
<i>Succisa pratensis</i> devils'-bit scabious			F	A	A
<b>Negative indicator species</b>					
<i>Cirsium arvense</i> creeping thistle	A	A	O	R	R
<i>Equisetum arvense</i> field horsetail	R			R	R
<i>Galium aparine</i> cleavers	R	R			
<i>Senecio jacobaea</i> common ragwort				R	R
<i>Holcus lanatus</i> Yorkshire fog	A	A	F	A	O
<i>Trifolium repens</i> white clover				F	R
<i>Dactylis glomerata</i> cock's-foot		R		R	R
<i>Deschampsia cespitosa</i> tufted hair-grass	R	R	R	R	R
<b>Mean sward height (cm)</b>	18.6	21.8	18.0	20.0	24.3

<b>Fleecefaulds Unit 2 DAFOR monitoring summary</b>					
	<b>2003</b>	<b>2004</b>	<b>2005</b>	<b>2008</b>	<b>2009</b>
<b>Positive indicator species/taxa</b>					
<i>Alchemilla</i> spp. lady's-mantle	R		O	O	R
<i>Centaurea nigra</i> common knapweed	F	A	A – F	A	A
<i>Filipendula ulmaria</i> meadowsweet		R	O	O	
<i>Galium verum</i> lady's bedstraw			R	R	
<i>Lathyrus pratensis</i> meadow vetchling			O	F	F
<i>Leucanthemum vulgare</i> oxeye daisy			R	R	
<i>Lotus corniculatus</i> bird's-foot trefoil			O		R
Orchidaceae orchid spp.					R
<i>Potentilla erecta</i> tormentil			O – R	R	
<i>Primula veris</i> cowslip				R	
<i>Rhinanthus minor</i> yellow rattle			O	F	O
<i>Succisa pratensis</i> devils'-bit scabious			F		R
<b>-ve indicator species</b>					
<i>Cirsium arvense</i> creeping thistle	O	F	O – F	F	F
<i>Equisetum arvense</i> field horsetail				F	R
<i>Galium aparine</i> cleavers	R			O	O
<i>Urtica dioica</i> stinging nettle			O		R
<i>Holcus lanatus</i> Yorkshire fog	A	A	F	A	A
<i>Phleum pratense</i> timothy					R
<i>Trifolium repens</i> white clover		O		O	R
<i>Dactylis glomerata</i> cock's-foot	F	O	O	A	A
<b>Mean sward height (cm)</b>	27.0	33.0	28.0	45.0	56.0

Fleecefaulds Unit 3 DAFOR monitoring summary					
	2003	2004	2005	2008	2009
<b>Positive indicator species/taxa</b>					
<i>Alchemilla</i> spp. lady's-mantle			O	O	R
<i>Carex</i> spp. ( <i>C. flacca</i> , <i>C. nigra</i> , <i>C. panacea</i> )				R	F
<i>Centaurea nigra</i> common knapweed	R		A	A	A
<i>Filipendula ulmaria</i> meadowsweet			O	O	R
<i>Galium verum</i> lady's bedstraw					R
<i>Lathyrus pratensis</i> meadow vetchling	F		F	A	A
<i>Leucanthemum vulgare</i> oxeye daisy				A	R
<i>Lotus corniculatus</i> bird's-foot trefoil			O – F	A	A
Orchidaceae orchid spp.			R	A	R
<i>Potentilla erecta</i> tormentil			O		R
<i>Rhinanthus minor</i> yellow rattle			O – F	A	A
<i>Succisa pratensis</i> devils'-bit scabious			F – A		R
<b>Negative indicator species</b>					
<i>Cirsium arvense</i> creeping thistle	F	F	O – F	F	R
<i>Equisetum arvense</i> field horsetail				A	O
<i>Senecio jacobaea</i> common ragwort					R
<i>Holcus lanatus</i> Yorkshire fog	A	A	F	A	A
<i>Phleum pratense</i> timothy		R	O		
<i>Trifolium repens</i> white clover			O	O	A
<i>Dactylis glomerata</i> cock's-foot	A	F	O	O	R
<b>Mean sward height (cm)</b>	35.0	36.4	25.0	25.0	26.0

Fleecefaulds Unit 4 DAFOR monitoring summary					
	2003	2004	2005	2008	2009
<b>Positive indicator species/taxa</b>					
<i>Alchemilla</i> spp. lady's-mantle			R	R	R
<i>Carex</i> spp. ( <i>C. flacca</i> , <i>C. nigra</i> , <i>C. panicea</i> )				R	
<i>Centaurea nigra</i> common knapweed	F	F	O – F	F	O
<i>Filipendula ulmaria</i> meadowsweet			F	F	R
<i>Galium verum</i> lady's bedstraw			R	R	
<i>Lathyrus pratensis</i> meadow vetchling			O – F	O	R
<i>Lotus corniculatus</i> bird's-foot trefoil			O		
Orchidaceae orchid spp.				R	R
<i>Potentilla erecta</i> tormentil	F	A	O	O	R
<i>Primula veris</i> cowslip		R		R	
<i>Rhinanthus minor</i> yellow rattle					R
<i>Succisa pratensis</i> devils'-bit scabious			O		
<b>Negative indicator species</b>					
<i>Cirsium arvense</i> creeping thistle	A	O	F	A	A
<i>Equisetum arvense</i> field horsetail					R
<i>Galium aparine</i> cleavers			R	A	O
<i>Senecio jacobaea</i> common ragwort			R		
<i>Urtica dioica</i> stinging nettle				R	R
<i>Holcus lanatus</i> Yorkshire fog	A	A	F	A	A
<i>Trifolium repens</i> white clover	R			O	R
<i>Arrhenatherum elatius</i> false oat-grass				R	
<i>Dactylis glomerata</i> cock's-foot		F	O	R	R
<i>Deschampsia cespitosa</i> tufted hair-grass				O	R
<b>Mean sward height (cm)</b>	38.6	15.8	30.0	35.0	45.3

<b>Lielowan DAFOR monitoring summary</b>					
	<b>2003</b>	<b>2004</b>	<b>2005</b>	<b>2008</b>	<b>2009</b>
<b>Positive indicator species/taxa</b>					
<i>Alchemilla</i> spp. lady's-mantle					R
<i>Centaurea nigra</i> common knapweed	O	R	O	A	O
<i>Filipendula ulmaria</i> meadowsweet	A	A	O	F	A
<i>Lathyrus pratensis</i> meadow vetchling	A	A	O	F	F
<i>Lotus corniculatus</i> bird's-foot trefoil					R
Orchidaceae orchid spp.				R	
<i>Potentilla erecta</i> tormentil				R	
<b>-ve indicator species</b>					
<i>Cirsium arvense</i> creeping thistle	A	A	F - A	A	A
<i>Equisetum arvense</i> field horsetail		R	O	O	R
<i>Galium aparine</i> cleavers		R		R	
<i>Urtica dioica</i> stinging nettle	O	O	O - F	F	R
<i>Holcus lanatus</i> Yorkshire fog	A	A	F	A	A
<i>Lolium perenne</i> perennial rye-grass				O	
<i>Trifolium repens</i> white clover			O	F	R
<i>Arrhenatherum elatius</i> false oat-grass		A	O - F	A	O
<i>Dactylis glomerata</i> cock's-foot	A	F	O - F	A	F
<i>Deschampsia cespitosa</i> tufted hair-grass	R	R	R		R
<b>Mean sward height (cm)</b>	37.6	26.2	25.4	25.0	15.2

<b>Bo'Mains DAFOR monitoring summary</b>	
	<b>2009</b>
<b>+ve indicator species/taxa</b>	
<i>Alchemilla</i> spp. lady's-mantle	R
<i>Carex</i> spp. ( <i>C. flacca</i> , <i>C. nigra</i> , <i>C. panicea</i> )	O
<i>Centaurea nigra</i> common knapweed	A
<i>Hypochoeris radicata</i> cat's-ear	O
<i>Lathyrus pratensis</i> meadow vetchling	A
<i>Leontodon</i> spp. hawkbit	R
Orchidaceae orchid spp.	O
<i>Potentilla erecta</i> tormentil	R
<i>Rhinanthus minor</i> yellow rattle	A
<b>-ve indicator species</b>	
<i>Cirsium arvense</i> creeping thistle	O
<i>Holcus lanatus</i> Yorkshire fog	F
<i>Arrhenatherum elatius</i> false oat-grass	R
<i>Dactylis glomerata</i> cock's-foot	R
<i>Deschampsia cespitosa</i> tufted hair-grass	R
<b>Mean sward height (cm)</b>	18.1