SPRING GRAZING TO MANIPULATE THE COMPOSITION OF A RE-CREATED SPECIES RICH GRASSLAND HABITAT

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ABSTRACT
Botanical diversity in species rich grasslands re-created on restored opencast coal sites may be threatened by aggressive growth from the legume component. A previous study indicated that this aggressive legume growth may be suppressed by spring grazing with sheep. A detailed study was conducted to determine the effect of spring grazing on the two most abundant legumes within the community; white clover (*Trifolium repens*) and lesser trefoil (*Trifolium dubium*). The results obtained suggested that the control of legumes was apparently mediated principally through the suppression of white clover, with lesser trefoil growth actually being increased by grazing. Spring grazing was also accompanied by an increased abundance of associated grasses. These results suggest that any improvement in the community's botanical composition that followed spring grazing was due in the main to suppression of the aggressive white clover.

KEYWORDS
Species-rich, grassland, grazing, white clover, lesser trefoil

INTRODUCTION.
Species rich meadows, with their high levels of biodiversity and visually attractive appearance, are becoming a popular end use for land restored following opencast coal mining in the UK. The diversity of these communities may, however, be endangered by aggressive growth from the legume component, induced by the low soil nitrogen availability of these sites (Chapman and Younger, 1995). Previous work has demonstrated that spring grazing with sheep may significantly suppress the overall growth by the legume component in these communities (Chapman *et al.,* 1996). That experiment, however, failed to detect a suppression of any individual legume species by spring grazing. Thus, in order to elucidate the mechanisms involved, a detailed study was conducted to determine the response to spring grazing by the two most common legume species within such a community.

MATERIALS AND METHODS
This experiment was conducted in 1994 on the former Acklington Opencast Coal site in Northumberland, UK. The soil, which prior to mining had been a clay loam of the Dunkeswick series, had been replaced in 1986. A species rich grassland community had been established from a commercial seed mixture in 1988. Further details regarding soil characteristics and the establishment and composition of the seed mixture are given elsewhere (Davies *et al.,* 1992 and Chapman and Younger, 1995).

In 1994 the site as a whole was grazed in spring with ewes from 18th April, after legume growth had become apparent, until it was closed on 26th April for the production of a hay crop. Two treatments, grazed or ungrazed, were each applied to six $1m^2$ microplots, randomly located across the site. The grazing treatment was applied by allowing the sheep free access to the microplots. The ungrazed treatment was imposed by excluding the sheep from the microplots with wire mesh exclusion cages.

In the previous hay crop, the two most abundant legumes had been white clover and lesser trefoil. At the start of the grazing treatments, 3 stolons of white clover and three branches of lesser trefoil were marked in each microplot. The net leaf accumulation for each species over the grazing period was determined on 26th April. Leaf accumulation was again measured 3 days later, and henceforth at weekly intervals until 20th May. The abundance of each individual species were determined on 14 June. From this the community content of grass, forb and legume components were calculated and the treatment effects on diversity were expressed with Simpson's diversity and equitability indexes (Begon *et al.,* 1986).

RESULTS
Although not significant, the trend was for spring grazing to slightly increase both Simpson's diversity and equitability indexes (Table 1). The spring grazing treatment had the anticipated effect of reducing the community's legume component, while increasing the grass content (Table 1). The response by the forb component was not significant.

White clover leaf production was significantly reduced during spring grazing (Figure 1). This loss was not recovered during the subsequent hay crop production. In contrast, lesser trefoil lost few leaves during spring grazing. Furthermore, the subsequent leaf accumulation rate for lesser trefoil was very much greater under the grazed treatment. Thus net leaf accumulation for lesser trefoil was ultimately very much greater following spring grazing.

DISCUSSION
The two legumes studied displayed very different responses to spring grazing; white clover leaf number was markedly reduced during grazing while there was only a slight loss of lesser trefoil leaves. The preferential defoliation of white clover from within a multi-component sward was as expected (Frame and Newbould, 1986). The lack of effect on lesser trefoil may have been due to the low spring growth rate of this species (Grime *et al.,* 1988) causing the leaves to be located low in the canopy profile, and therefore less susceptible to grazing.

The initial suppression of white clover by grazing persisted beyond the defoliation period, whereas lesser trefoil growth was stimulated following grazing, suggesting that it might otherwise have been suppressed by the aggressive growth of white clover.

Grazing reduced the legume ground cover in June because the better growth of lesser trefoil did not compensate for the reduced white clover growth. Although the abundance of forbs were not affected, grasses increased their presence in the community following grazing; suggesting that the grass component was also suppressed by the aggressive growth of the white clover. This change in species composition slightly increased the Simpson's diversity and equitability indexes which, although not significant, were consistent with the findings from a previous experiment (Chapman *et al.,* 1996).

Spring grazing therefore improved the botanical composition of this species-rich grassland through the suppression of the otherwise aggressive legume component. This effect was mediated principally through the suppression of the white clover. The lesser trefoil was, if anything, enhanced by the spring grazing treatment.

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Table 1
The effect of spring grazing on Simpson's diversity and equitability indexes, and on the botanical composition (percentage of legumes, grasses and forbs) of the community.

	Grazed	Ungrazed	SED	Significance
Diversity	6.32	5.35	0.62	NS
Equitability	0.357	0.313	0.0212	NS
Legume content	42.8	61.4	3.71	P<0.01
Grass content	45.8	31.4	3.18	P<0.01
Forb content	11.43	7.18	1.951	NS

NS: Not significant.

Figure 1
Net leaf accumulation from 18 April until 20 May 1994 for a) lesser trefoil and b) white clover.