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SUMMARY - Hill sheep production systems are extremely important in the UK. They are the dominant land use in areas of important landscapes and tourism and sheep have major influences on habitats of nature conservation value. There is considerable debate about management to achieve nature conservation objectives. This debate tends to centre on overall reductions in stocking densities. However, other factors influence the impact of sheep on semi-natural pastures. An experiment is described that shows that sheep fed compounded pellets daily show different grazing and social behaviour compared to sheep offered *ad libitum* feedblocks.

Key words: Sheep, semi-natural pasture, grazing behaviour, supplementary feed.

RESUME - *"Impact des méthodes d'élevage sur la problématique environnementale liée aux systèmes britanniques d'élevage en collines". Les systèmes de production des moutons de colline sont d'une extrême importance dans le Royaume-Uni et ils dominent l'utilisation des terres dans des régions où les paysages et les attraits touristiques sont importants. Les moutons ont une influence majeure sur des habitats naturels protégés. Un débat important existe concernant la façon dont ces objectifs de protection peuvent être pris en considération, cependant ce débat se focalise généralement sur la réduction de la densité des troupeaux. Cependant, d'autres facteurs peuvent aussi réduire l'impact des moutons sur des pâturages semi-naturels. Une expérience sera décrite démontrant que si les moutons sont alimentés quotidiennement avec des boulettes composées, ils développent des comportements sociaux et de pâturage différents de ceux observés chez des moutons alimentés avec des blocs compacts d'aliments.*

Mots-clés : *Moutons, pâturages semi-naturels, comportement de pâturage.*

Introduction

Of the twenty million breeding ewes in the United Kingdom, approximately 40% are kept in hill farms within the Less Favoured Areas using a high proportion of unimproved, semi-natural pasture as the main grazing resource. The hill and uplands of the UK cover some 50% of the land area (Milne, 1996). The regions where these sheep systems are found are frequently classified as landscapes of outstanding natural beauty, are very important for tourism and contain a significant proportion of land designated for nature conservation protection. There is very considerable concern on the impact of grazing by sheep on these semi-natural habitats. There are strong views that sheep production is causing a loss of biodiversity, is leading to habitat change and loss of valued habitats. However, the current matrix of these landscapes and habitats has been created by, or for, hill sheep production and associated practices. Much of the debate, and actions taken by the UK's agriculture and nature conservation agencies, have revolved around sheep numbers and stocking rates. However, sheep management also has a considerable impact and needs to be understood if a range of environmental, economic and social objectives are to be met. This paper will review some of the more important husbandry effects. Then it will discuss some previously unpublished studies on the impact of supplementary feeding method on grazing behaviour.

Grazing systems for hill sheep in UK

Hill sheep throughout the British Isles are kept as free-ranging animals without the presence of a shepherd. They are retained within specific areas of land by shepherding, by long-term selection for home range behaviour, and by some fencing. The special hill breeds tend to graze in a dispersed manner and individual sheep retain a home range, within the larger home range of the management

flock (Hunter and Milner, 1963). This behaviour is called hefting. It is maintained by selection of female breeding replacements only from young animals bred on the home range, by shepherding straying sheep back to their home-range and by culling straying sheep. Many areas of grazing are unfenced or poorly fenced and the sheep remain on the semi-natural hill grazings throughout the year. This is a harsh environment with poor grazing nutrition especially in winter (Waterhouse, 1996).

Semi-natural habitats and landscapes associated with sheep production

Grazing can both prevent succession towards woodland and can lead to changes that are generally seen as detrimental, for example from heather moorland to grassland (Miles, 1985). Fire can also have a large impact on plant community change. There have been considerable changes in upland agriculture in the past two centuries that have used these forces to change landscape and affect biodiversity. In the North West Highlands major social and agricultural changes are described by Millman (1975). Firstly large areas of woodlands were clear felled for industrial uses in the 1700's. Through the 1800's the establishment of large scale 'sheep-walks' occurred. The subsistence farming population either emigrated or moved to small coastal townships. Late in the 19th Century many of the large sheep farms changed yet again and managed deer estates became the fashion. These changes have created a landscape with few trees, as 'tooth and fire are invincible' (Darling, 1955), with a very low population and where sheep farming is the dominant agricultural land-use. Darling (1955) has referred to this as a 'wet desert'. In the rest of the UK, recent changes were perhaps less pronounced. Large sheep populations were typical for large areas of Wales (Hester, 1996) and for other areas of Britain. A landscape has been created with intensively managed pastures divided by walls or hedges in the valley bottoms rising to an open moorland.

Nevertheless, these are areas of considerable nature conservation value. There are unique assemblages of birds in British uplands (UK Biodiversity Action Plan 1994), large areas are being designated under the EU's Natura 2000 proposals (Habitats and Species Directive). The Environmentally Sensitive Area Scheme, covering 15% of the agricultural land area (Swash, 1997) is also dominated by upland sites, where sheep production is very important.

Effects of sheep production on the environment

The wide range of impacts of sheep production in the British uplands have been summarized recently by Milne *et al.* (1997), Hester (1996), and Fuller (1996). Broadly, some plant species prosper under certain levels of grazing, some are grazing intolerant. Grazing modifies plant community structure and composition, in turn having an impact on the whole ecosystem. It is accepted that grazing is usually essential but there is debate about preferred intensities. One problem is that different habitats are likely to have different optimal grazing thresholds, but yet occur side by side. Another problem is that even on the same grazing unit there may be a number of factors influencing the actual grazing intensity and it is typical to see the same habitat grazed at different intensities. In addition to the direct impacts, hill sheep production has a wide number of other impacts on the environment. These less direct impacts include:

(i) Changes to the type of forage grown on lower altitude pasture, i.e., the recent major change from hay to silage which has led to more intensive pasture management and earlier cutting dates.

(ii) Burning, reseeding, liming, fertilizer, herbicide applications.

(iii) The creation of features such as hedges, walls, wooded shelter belts.

(iv) Avermectin anthelminthics which create insecticidal dung, reducing dung-feeding fauna.

(v) Control of predators of sheep and the availability of carrion from dead carcasses (Fuller, 1996).

(vi) The disposal of waste sheep dip into water-courses.

Grazing and the other factors above can be influenced by farmers through; removal of sheep from semi-natural to improved pastures or housing; choice of grazing resource available to the sheep;

breed of sheep; age of sheep. Spatial distribution of sheep within the grazing unit will also be influenced by a number of 'natural' factors; weather, exposure and shelter; altitude and presence of irritating flies; plant species and their relative abundance. Supplementary feeding is another important influence on grazing impact, and this will now be discussed.

Supplementary feeding practices

Supplementary feeding of hill ewes during pregnancy is now an important part of management. Earlier this century it was an uncommon practice in many regions. However, following considerable research work, as reviewed by Robinson (1985), hill sheep receive supplementary feed in ever more sophisticated fashion. With improved vehicular transport and new feeds (big bale silage and feedblocks), there are now many feeding options for farmers.

Supplementary feeding for hill ewes may be classified by division into two broad groups. Firstly, there is feed offered *daily* in the form of compounded pellets or small quantities of hay. Secondly, there are feeds offered on an *ad libitum* basis in the form of feedblocks, liquid feed from lick feeders and silage. To the farmer these latter feeds have the benefit of reducing daily labour requirement. Feedblocks, which are compacted blocks of cereals, distillery by-products and molasses, are dispersed over the grazing range. The sheep nibble or lick small amounts at each visit so each feedblock, typically 22 kg, can provide a subset of ewes within their own heft with supplementary feeding for over five days. Some studies have highlighted the effect that social behaviour has on feedblock intake (Lippert, 1985), but little is known about foraging behaviour.

Effect of supplementation method on grazing behaviour of hill ewes

This study was carried out in three, 3 ha (50 m x 600 m) paddocks side by side, rising steeply in altitude from 280 m to 490 m.a.s.l. In Plot 1, 11 hill ewes each received 150 g of pelleted molassed sugar beet feed at 10 am each day. In Plot 3, 11 ewes had *ad libitum* access to a single cereal/molasses feedblock. Plot 2 remained empty, providing both distance and a partial visual barrier to reduce social contact between the two treatments. Each paddock was divided with markers into 15 vertical divisions of 40 m wide. Individual ewe behaviour was recorded by an observer sited outside the plots in a small hide between 9 am and 4 pm.

Figure 1 below shows how each treatment group moved throughout one day. For the 11 sheep in each treatment, the first and third quartile for the 15 field division positions has been plotted, to provide an indication of spread of the groups.

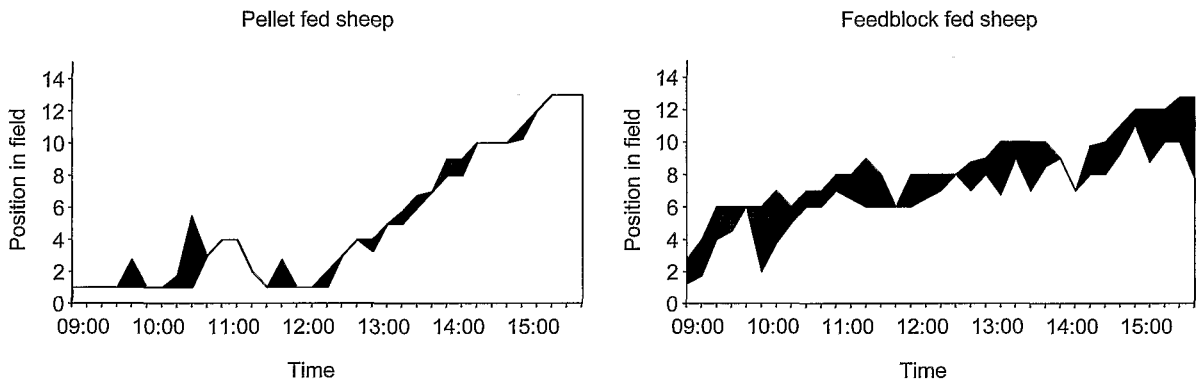

Fig. 1. Movement of sheep throughout the day and their spread. For each group of eleven sheep, the position of the first and third quartile mean has been plotted for pellet-fed sheep (fed at 10 am at position 1) and for feedblock-fed (*ad libitum* access at Position 6). Mean difference between two quartiles; 0.4 divisions for pellet-fed, 1.7 for feedblock-fed, sed = 0.24, $P<0.01$.

Similar patterns of movement were seen on other days, the pellet-fed sheep assembling at their feeding point prior to being fed and then remaining near before grazing upwards as a tight group. By contrast, the feedblock-fed sheep, whilst tending to show a similar pattern of upward movement (as has been described by Hunter and Milner, 1963) did not display the same cohesiveness as a group, with individuals or small groups visiting the feedblock site throughout the day. Figure 2 shows the impact on grass height measured using the HFRO swardstick over the 5 week period. The largest differences between treatments was for the bottom section of the plots where pellet-fed sheep appeared to have grazed heavily but the feedblock-fed did not. There is an indication that feedblock sheep grazed mainly at points altitudinally above the feedblock position.

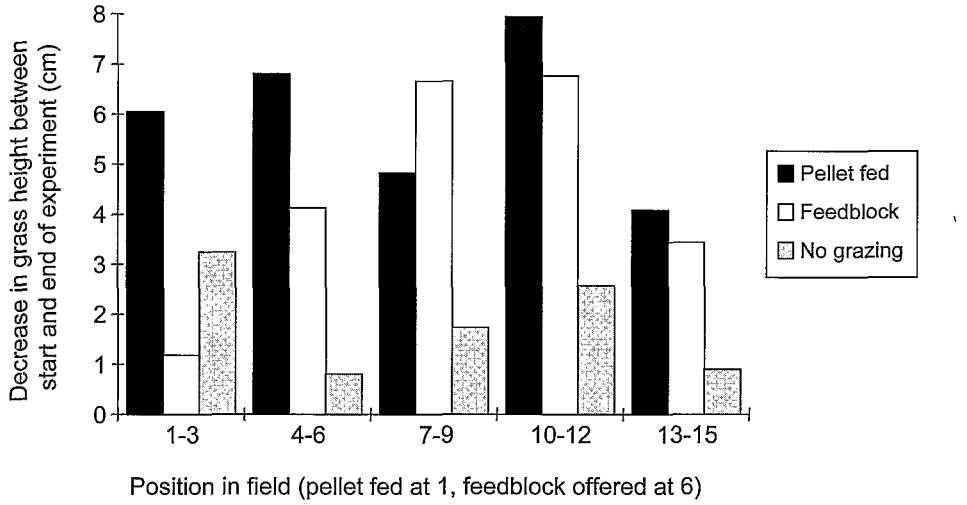

Fig. 2. Decrease in sward height over the experiment.

Conclusions

The results of this study suggest that feeding method has an impact on grazing and foraging behaviour, in terms of movement, grouping of the sheep and in the position of highest utilization of grass. Choice of feeding method is therefore important element of grazing impact and positioning of feeding point may be a useful tool to manage desired levels of grazing intensity during the winter when sheep are fed for pregnancy. The effects of supplementary feeding are only part of a wide a range of factors influencing environmental impact, but unlike simple reductions in stocking density, it is possible to manage feeding to achieve a range of desired production and environmental aims.

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