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The influence of sheep and cattle on the grazing preference of red deer

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ABSTRACT

Two experiments examined the effect of sheep and cattle on the grazing preference of red deer. In the first experiment deer initially showed a significant ($P < 0.01$) preference to graze on areas of ryegrass/white clover previously grazed for six weeks by cattle (77% of observations) rather than by sheep (23% of observations). However, 14 days later, deer grazing was equally distributed between cattle- and sheep-grazed areas (52% and 48% of observations respectively). In a second experiment deer, on pastures grazed by deer, showed no preference to graze close to cattle (48% of observations) or sheep (52% of observations). The strong but short-lived preference of deer for areas previously grazed by cattle cannot be explained by botanical composition, because although cattle-grazed areas contained a higher percentage of clover (22% with cattle, 16% with sheep), this difference was maintained for the later observation period when there was no difference in deer grazing preference. We conclude that any short-term preference shown by deer to graze with cattle rather than sheep is more likely to be due to their respective faeces/urine than their respective presence.

Keywords: deer; sheep; cattle; diet preference**.**

INTRODUCTION

A recent survey (W.M. Griffiths, Unpublished data) found that integrating sheep and cattle with deer, to be a common feature on a high proportion (67%) of deer farms. A number of potential benefits for adopting integrated livestock management have been identified (Nicol *et al*., 2007b). Many of the benefits focus on matching pasture supply with demand and on maintaining pasture quality. However there is little formal quantification of such benefits although Nicol *et al.,* (2007a) recently showed that the liveweight change of hinds and their fawns was not differentially affected by the co-grazing of sheep or cattle when pastures were well controlled to a height of 6 to 7 cm.

Pastures prepared by cattle-grazing generally contain higher clover content than those grazed by sheep (Yarrow & Penning, 1994; Wright *et al*., 2001) and deer will graze almost as close to cattle dung pats as sheep will (Trotter *et al*., 2006). Anecdotal evidence suggests that feral deer prefer to graze with cattle rather than with sheep, but it is unknown whether any such preference is based on the animal species *per se* or the pasture on which they are grazing. Two experiments were conducted to answer this question. The first experiment recorded the preference of deer to graze on pastures previously grazed by sheep or cattle and the second measured the preference of deer to graze in the vicinity of sheep or cattle.

MATERIALS AND METHODS

The experiments were conducted on the Lincoln University Deer Research Farm. No animal ethics approval was required.

Experiment 1

Two ryegrass/white clover paddocks, (2- to 3-year-old) were each split into four 0.30 ha plots. Three to five yearling steers (344 kg live weight) and 15 to 20 mixed sex yearling sheep (42 kg live weight) were each assigned two plots (replicates) in each paddock which they grazed continuously for six weeks. A variable stocking rate, adjusted by the removal and addition of animals, was used to achieve similar mean pasture height between each cattle and sheep treatment, and to ensure pasture availability was maintained above 1,200 kg DM/ha. Animals within each plot had access to drinking water.

At the end of six weeks continuous grazing, the cattle and sheep were removed from each plot and the temporary fences dismantled. Paddocks were then spelled for five days before 18 yearling hinds (74 kg live weight) were introduced to a complete paddock. Observations were made over a 30 minute period of the number of deer on areas previously grazed by cattle or sheep. Observations consisted of a total count of the number of deer in each respective plot every five minutes throughout a 30 minute period. There were 18 deer in total with 6 records collected per 30 minute observation. At the end of the first 30 minute period deer were removed and immediately given access to the second paddock for a repeat of the observations. They were then removed to a non-observational paddock until the next observation period. Observations were repeated twice each morning and afternoon for each paddock over a period of three consecutive days during Week 1, starting 6 May 2009, and again for three days, 14 days later during Week 3, starting 20 May 2009 giving a total of 48, 30-minute observation periods, with six recordings in each period. The order in which paddocks were used was alternated during observations.

Pasture mass was estimated indirectly through use of a rising plate meter (Filips folding plate pasture meter, Jenquip, Hamilton, New Zealand) on a weekly basis during the six week preliminary grazing and experimental periods. Botanical composition measured as the proportion of grass, clover, weeds and dead material, of each treatment area was estimated from randomly pasture samples cut to ground level at the beginning and end of the six week preliminary grazing period and before and after each of the two observation periods.

The proportion of land area within each treatment area covered with faeces was determined at the end of the pre-grazing period from records of the number and area covered by faeces measured in 10 quadrats (1 m^2) on all plots.

Experiment 2

A ryegrass/white clover paddock (1.16 ha) previously grazed by deer intermittently for over a year at a pasture mass of approximately 900 kg DM/ha was nominally split into four 0.29 ha plots. Ten sheep and three cattle were temporarily retained behind an electric fence in an area of approximately 10% of the plot, in opposite corners of each plot. Eighteen yearling hinds were introduced to the plot and observations of the number of deer in the proximity of cattle or sheep followed the same procedure as used Experiment 1 with five minute observations for a period of 30 minutes. After each 30 minute observational period the deer were rested in a non-treatment area before subsequent observations. Observations were repeated twice each morning and afternoon for three consecutive days, beginning 27 May 2009 and ending 29 May 2009 with a total of 24, 30 minute observation periods over six recordings in each period. Areas containing sheep and cattle were alternated between observation periods to give replication.

Pasture availability was indirectly measured with the rising plate meter at the beginning, during, and end of this experiment. Botanical composition of the sward was also determined from pasture samples taken prior to observations.

Statistical analysis

Statistical analyses of observational data used a mixed linear model in association with residual maximum likelihood (REML) link in Genstat (VSN International, Hemel Hempstead, Hertfordshire, UK). This model included fixed effects of previous animal species grazing and time (Week 1 and Week 3), and random effects of paddock, plot and paddock/plot interaction on the response variate of the number of deer found within each plot. Significance of observations with time for each 30 minute observation, during Week 1 of Experiment 1 was analysed using REML variance components analysis. This model included fixed effects of previous grazing, time for each five minute interval within the 30 minute observation period and previous grazing x time interaction, and random effects of main paddock/plot interaction on the response variate of the number of deer found within each plot.

Pasture composition was analysed using a general linear mixed model (GLMM) with a binomial error distribution. This model included fixed effects of herbage component and previous animal species grazing and random effects of paddock number and plot. Pasture availability was estimated by a linear regression analysis. This was used to determine the standard error (SE) associated with each prediction of pasture mass. The model included pasture mass as the response variate, and plate meter clicks as the explanatory variate.

RESULTS

In Experiment 1, pasture availability for both the cattle- or sheep-grazed area treatments was maintained within ± 100 to 120 kg DM/ha of each other during the observational period (Table 1). Pasture composition did not differ significantly between the sheep-grazed or cattle-grazed plots either before or after the deer grazing observations, although there was a consistent trend of approximately 6% higher clover content on cattle grazed treatments.

In the first period of observations during Week 1, five days after removal of the sheep and cattle, deer showed a highly significant (P = 0.002) preference to locate on areas previously grazed by cattle (Figure 1) such that 77% of observations recorded deer on areas previously grazed by cattle compared with only 23% on areas previously grazed by sheep.

TABLE 1: The mean pasture mass (kg DM/ha) and pasture composition (proportion) before and after observations of deer grazing on areas previously grazed by cattle or sheep. Least significant difference for pasture mass = 100; Least significant difference for pasture composition = 0.065.

Measurement	Species previously grazing area			
	Cattle		Sheep	
	Before	After	Before	After
Pasture mass	1,208	1,211	1,181	1,230
Pasture composition				
Grass	0.74	0.77	0.80	0.79
Clover	0.22	0.20	0.16	0.14
Weeds	0.03	0.02	0.02	0.06
Dead material	0.01	0.01	0.2	0.01

FIGURE 1: The mean number of deer (± standard error of mean) observed within areas previously grazed by cattle or sheep during Week 1 (hatched bars) and Week 3 (open bars) of observations in Experiment 1.

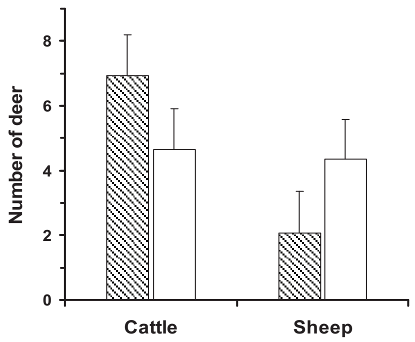
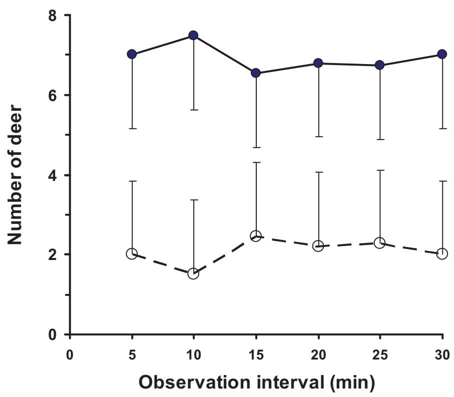


FIGURE 2: The mean number of deer (± standard error of mean) observed within areas previously grazed by cattle or sheep at each five minute interval during 30 minute observational periods in Week 1. Solid line represents cattle pre-grazing treatment and the dashed line the sheep pre-grazing treatment.



This observation was consistent at every 5 minute interval over the entire 30 minute observation periods. There was no significant (P = 0.925) interaction between preference and time within the 30 minutes of observation (Figure 2).

In contrast, during the second observation period in Week 3 (Figure 1), there was no significant difference (P = 0.807) in the number of deer observed on areas previously grazed by cattle (52% of observations) or sheep (48% of observations).

Areas pre-grazed by cattle and sheep had a similar proportion of area covered by faeces at 10.3 and 12.6% respectively. Sheep faeces were more dispersed with smaller faecal areas multiplied by a greater number of defaecations than with cattle faeces.

In Experiment 2, deer showed no significant preference (P = 0.364) to graze within the physical presence of cattle (mean 4.28 ± 0.37; 48% of observations) or sheep (mean 4.72 ± 0.37; 52% of observations) and grazed evenly over the entire treatment area.

DISCUSSION

The initial results of Experiment 1 support the hypothesis that deer, when given the opportunity to select between pastures grazed by cattle or sheep, will prefer pastures grazed by cattle as deer initially spent 77% of their time on previously cattle-grazed areas. However, this preference was short lived and 14 days later deer showed no preference for cattle-grazed pastures over those grazed by sheep.

Although others (Wright *et al*., 2001) have shown pasture pre-grazed by cattle contained more clover, the difference between sheep and cattle-grazed pasture was not significant in the current work so it cannot be argued that the preference of deer for cattle-grazed pasture was a response to pasture composition. This is substantiated by the marked change in grazing preference of deer from Week 1 to Week 3, a period over which little change in pasture composition occurred.

There was a significant rainfall of 91.2 mm between the first and third week of observations which may have created a more homogeneous grazing environment between sheep- and cattle-grazed areas for subsequent deer grazing.

Based on the results of Experiment 2, in which deer distributed their grazing time on previously deer-grazed pasture, equally between areas adjacent to cattle or sheep, we conclude that deer do not distinguish between the physical proximity of cattle and sheep. This is contrary to the results of Abeyesinghe and Goddard (1998) who showed deer chose to graze with sheep rather than cattle. It should be noted that the current experimental design did not allow deer to mix with the sheep or cattle, only to graze in their vicinity, so that a firm conclusion that deer graze equally mixed with cattle and sheep cannot be drawn.

The six week preliminary grazing period resulted in contamination of the areas with faeces and urine from either cattle or sheep; two possible factors involved in the subsequent grazing preference/aversion of deer. It is less likely, but not proven in this case, that urine distribution could have explained the initial preference for cattle-grazed pastures. Unless the total volume of urine voided by the groups of sheep and cattle had been markedly different, the major difference between sheep- and cattle-grazed areas would have been a greater number of, and smaller area of urine patches on the sheep-grazed areas, as measured for faecal contamination of the respective areas. This difference in urine distribution would be unlikely to influence deer preference given that as a liquid containing highly volatile substances, urine rapidly evaporates and/or soaks into the ground. Furthermore, rather than being avoided by animals, the subsequent higher nitrogen content of herbage from urine patches is commonly preferred over adjacent vegetation (Day & Detling, 1990). This preference for urine patches has been found to occur almost immediately after deposition and can last for a period of two to four months (Ledgard *et al.,* 1982).

Faecal contamination of pasture, on the other hand, is widely acknowledged as a cause of aversion by grazing animals (Forbes & Hodgson, 1985; Hutchings *et al.*, 1998). Animals will avoid faeces of other species as well as that of their own species. Moe *et al.* (1999) compared the response of reindeer to herbage contaminated with sheep or reindeer faeces and found that reindeer exhibited the same degree of aversion to faecal material from either sheep or reindeer. Others have shown that faecal avoidance depends on the source of the faeces. For example, sheep graze closer to cattle dung pats than cattle do (Forbes & Hodgson, 1985). Smith *et al.* (2008) found that cattle showed no aversion to rabbit faeces, slight aversion to deer and cattle faeces, and strong aversion to badger faeces, thereby concluding that the specific grazing response from each faeces type relates to the relative risk, in their case exposure to bovine tuberculosis, associated with the different host species. This aversive behaviour is believed to be a mechanism by which animals avoid the intake of parasites and other diseases transmitted via the faecal-oral route (Hart, 1990; Lozano, 1991). As herbivores have difficulty detecting the presence of parasites in an environment, faeces may be used as a cue for the potential existence of parasites (Cooper *et al.*, 2000). This idea is supported by Hutchings *et al.* (1999) who showed that sub-clinical parasitism in sheep resulted in increased rejection of faecal contaminated swards, reduced bite rates and grazing depth compared with non-parasitised animals.

Our results suggest that red deer may respond differently to the faeces of sheep compared with the faeces of cattle. It is unlikely that a stronger level of aversion by deer to sheep faeces could be due to a greater number of common sheep-deer parasite species than deer-cattle compatible species (Pomeroy, 1997). Although the proportion of the area covered by faeces was similar between sheep- and cattle-grazed areas, the size of contiguous uncontaminated areas would have been greater in the cattle-grazed areas due to the fewer larger pats, thus decreasing the risk of deer grazing closer to cattle dung pats than sheep faeces. Further work would be needed to disassociate the effect of faeces *per se* and their distribution. No measurements were made of feed intake in this work but given the results of Aoyama *et al.* (1994) who showed that when a forage contaminated with an aversive faeces extract was offered as a sole diet, ingestive behaviour was no different to that of uncontaminated forage, it is unlikely that the long term productivity of deer would be significantly lower on sheep-grazed than on cattle-grazed pastures of similar pasture mass and composition.

We conclude that the short-term preference shown by deer for pasture previously grazed by cattle rather than sheep is probably due to their respective faeces not their respective presence.

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