

The independent effects of sward height and bulk density on the bite parameters of Romney ewes and Red deer hinds

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ABSTRACT

The independent effects of sward height (1, 2, 3, 5 and 8 cm) x bulk density (0.65, 1.30, 2.90 mg DM/cm³) variation on the ingestive behaviour of Romney ewes and Red deer hinds were examined in seedling swards which simulated a leafy grass sward of low shear strength. Depth of penetration, horizontal area of herbage severed

per bite, weight of each bite and the rate of intake all increased with increasing height, while the rate of biting decreased ($P < 0.001$). In contrast, animals reduced their depth, area and rate of biting as swards became more dense, although the weight of bites and rate of intake still increased ($P < 0.02$). Bite parameters changed linearly (or nearly so) in relation to height or bulk density except for rate of

intake and bite area, which increased at a declining rate the taller or taller and denser the sward, respectively. Sheep and deer penetrated swards to similar depths; however deer had higher bite rates and their bite areas, bite weights and rates of intake increased more rapidly with height. Despite these trends, the rate of intake per kg LW^{0.75} of sheep was much higher than for deer, although this difference declined rapidly with increasing height.

KEYWORDS: sward height, sward bulk density, bite dimensions, sheep, deer

INTRODUCTION

The height and bulk density of the leafy zone of the sward are major determinants of bite weight and the consequent daily herbage intake of the grazing ruminant (Hodgson 1985). Sheep appear able to maximise daily herbage intake when swards are dense and more than 6 cm high (Penning 1986) but the individual effects and relative importance of height and bulk density on ingestive behaviour, particularly the spatial dimensions of the bite (depth and area), are not well understood. This study aimed to clarify the effects of simultaneous yet independent changes in leafy sward height and bulk density on bite parameters (i.e., bite depth (BD), bite area (BA), bite volume (BV), bite weight (BW), bite rate (BR) and rate of intake (RI)) over a critical range of heights and a wide range of bulk densities for Romney sheep and Red deer.

METHODS

Four 27-month-old Romney ewes (6 tooth) and four 33-month-old Red deer hinds (full mouth) housed indoors in metabolism crates were each allocated 15 height x bulk density treatment combinations (1, 2, 3, 5, 8 cm x 0.65, 1.30, 2.90 mg DM/cm³). Sheep were fed over 2 consecutive days in November 1990 and deer in August 1991 when facilities became available. The 30x18 cm (surface area) swards were grown in seed trays using a wheat seedling technique (Mitchell et al. in prep.) to keep height and bulk density variation independent and largely unconfounded with other sward structural variations such as leaf age, size, strength; leaf to stem ratio; and dead matter. Animals were allowed to graze for at least 20 bites while BR was estimated; BD and BA were determined from the grazed sward (Mitchell et al. in prep.). These direct measurements plus the known sward bulk densities were used to calculate BV, BW and RI (Mitchell et al. in prep.). Bite parameter data in relation to height and bulk density were analysed by analysis of variance and covariance.

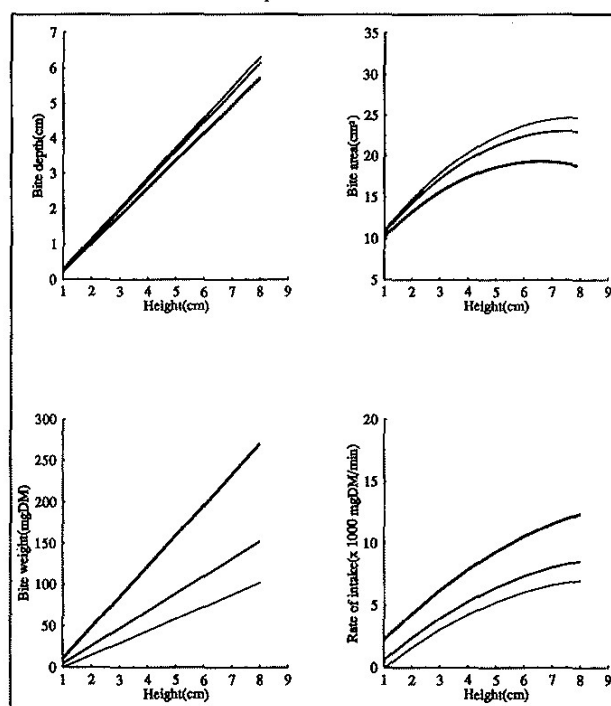
RESULTS

While 1 cm swards were barely grazable (sheep) or ungrazable (deer), high bulk density 8 cm swards allowed extremely high rates of intake for sheep (264 mg DM/kg LW per min.) and deer (181 mg DM/kg LW per min).

BD and BW increased and BR (above 2-3 cm) declined, linearly with increasing height ($P < 0.001$), while the rate of increase in RI and BA declined with increasing height or height and bulk density, respectively (Fig. 1, Table 1). BD, BA and BR declined while BW and RI increased ($P < 0.02$) in a linear or close to linear fashion with increasing bulk density. Bulk density had little effect upon BD or BR, but more influence upon BA, BW and RI, although the influence of height on all bite parameters was still greater.

Response trends of sheep and deer were broadly similar for all bite parameters, and little emphasis was put upon absolute species

Figure 1 The effects of independent changes in sward height (1, 2, 3, 5 and 8 cm) and bulk density (0.65, 1.30, or 2.90 mg DM/cm³) (line through heavy lines respectively) on the bite depth, bite area, bite weight, or rate of intake of sheep.



differences because of the temporal, age and seasonal differences in when they were fed. The BD of sheep and deer was very similar, yet the BA of deer increased much faster (19%) with increasing height than that of sheep and these trends were reflected in the bite weights. BR was 10% higher on average for deer than sheep. Reflecting the trends for BW and BR, RI was similar for shorter swards but increased almost 50% faster for deer with increasing height.

DISCUSSION

The very high and increasing BD/height ratios (with increasing height) indicated that sheep and deer were trying to maximise sward penetration (the major spatial component of the bite). Evidently they were readily able to achieve deep penetration on these juvenile leafy swards, as indicated by their high bite rates. The current study shows that BA can increase appreciably with increasing height on shorter swards, especially when bulk density is low to moderate, but the higher the bulk density the slower the rate of increase and the lower the height at which BA will plateau. The apparent insensitivity of BA to changing height in previous studies (Burlison et al. 1991; Hughes et al. 1991; Mitchell et al. 1991) probably reflects the range of height and bulk density variation examined, the use of less sensitive measurement techniques and other intra- or inter-sward structural differences. Despite the direct positive effect of bulk density on BW, the effect of height was on average greater, because both BD and BA

Table 1 The mean bite dimensions^x of sheep and deer (combined) in relation to independent sward height and bulk density variation

Bulk density	Units mg DM/cm ³	0.65 (sparse)			2.90 (very dense)			s.e.m. ^y
		Height cm	2	5	8	2	5	
Herbage mass	mg DM/cm ²	1.3	3.3	5.2	5.8	14.5	23.2	
Bite depth	cm	1.3	3.9	6.6	1.3	3.4	5.9	0.1
Bite area	cm ²	15.8	25.7	27.3	13.0	16.9	18.8	0.1
Bite weight	mg DM	9.0	55.8	103.7 ^z	40.9 ^z	147.9	282.7	4.6
Bite rate	bites/min	84.8	72.4	66.7	81.6	67.8	47.1	2.5
Rate of intake	g DM/min	771	4029	6972	3286	9948	13458	408

x least square means
y standard error of least square means
z despite a 10% lower herbage mass, bite weight was 154% higher on sparse 8 cm v. very dense 2 cm swards, illustrating the relative importance of height and bulk density under these conditions

increase with height, but decline with bulk density, such that on average BV declined by 27% per mg DM/cm³ increase in bulk density. Despite the higher RI of deer on taller, high bulk density swards, in terms of RI per kg LW^{0.75} sheep appeared to have a clear advantage over deer on shorter swards, although this advantage declined rapidly as sward height increased to 8 cm.

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