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Diet selection by goats and sheep on hill country

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ABSTRACT

Four scrub-pasture associations containing different proportions of grass, white clover and gorse were developed by grazing with different ratios of goats and sheep. The ratios were: 100% goats (Goat 100), 66% goats and 34% sheep (Goat 66), 33% goats and 67% sheep (Goat 33) and 100% sheep (Sheep 100). These associations were then grazed by oesophageally fistulated goats and sheep in each season for 2 years. Grass was the principal feed of sheep in all associations (77% of diet) and of goats (62%). Sheep ate white clover in proportion to its presence in the sward (14%) whereas it was rejected by goats (2%). Gorse was a preferred feed for goats (20%) but the principal feed only when gorse > 10% of the association; sheep ate very little gorse (0.1%).

Dietary overlap between goats and sheep was greatest on the Goat 66 association (0.89), which was grass dominant. It was less on the Goat 100 (0.69) where sheep ate more legume, and the Goat 33 (0.66) where goats ate more gorse. On the Sheep 100 association it was the lowest (0.12) because goats ate mainly gorse and sheep mainly grass and white clover.

INTRODUCTION

Goats have long been used in New Zealand for scrub weed control (Kirton and Ritchie, 1980). Batten and Moorhouse (1979) have given preference rankings of feed by goats and Lambert *et al.* (1981) have speculated on the possible complementary relationship between sheep and goats.

New Zealand has 657 000 ha of gorse-infested pasture (Blaschke *et al.*, 1981) which might be more productive if gorse was controlled by grazing a combination of sheep and goats. This study compares the diet selection of sheep and goats grazing pasture associations containing different proportions of grass, clover, gorse, thistles and dead matter.

EXPERIMENTAL

Diet Selection

In April 1979 an experiment was started on scrub weed control at "Ballantrae", Grasslands Division's hill country research area near Woodville. Grazing treatments and details of procedure, site history and pasture are given in Lambert *et al.* (1981).

Diet Selection

Three feral wether goats and 3 Romney ewes fistulated at the oesophagus were used to sample the scrub-pasture associations developed by grazing treatments (Table 1), in November, February, May and August in 1979/80 (periods 1 to 4) and 1980/1 (periods 5 to 8). An area of 0.1 ha within each treatment was temporarily enclosed and the 6 fistulated animals grazed for 3 days; samples were collected in late morning of the last 2 days on each treatment.

Animals were fasted for 2 to 3 hours before sampling for 30 min into plastic collection bags. A subsample for botanical composition was washed through a fine sieve to remove saliva and discolouration and duplicate sets of 200 points estimated by a flotation technique (Chamrad and Box, 1964). The categories identified were: green grass, green clover (mainly *Trifolium repens*), gorse (*Ulex europaeus*), rushes (*Juncus* spp.), thistles (*Cirsium arvense*, *C. palustre* and *C. vulgare*), weeds and dead matter.

Composition of Forage on Offer

Composition of forage on offer was estimated in each treatment immediately before sampling in each period. Five hundred point estimates were made on a 'first hit' basis using a 10-point frame at 50 sites located systematically across the sample area.

Data Analyses

Data on the botanical composition of diet samples were analysed as an unbalanced factorial experiment with 2 breeds x 4 scrub-pasture associations. To establish differences in preference the relationship between diet and sward components was examined by regression analyses, constrained through the origin, of both years data. A preferred feed is one that is present in greater proportions in the diet than in the sward; a principal feed is one that makes the greatest contribution to the diet. Kulczynski's similarity coefficient (Oosting, 1958):

$$S = \frac{2W}{a + b}$$

was calculated for each scrub-pasture association and sampling period to estimate the degree of dietary overlap.

Each diet component (%) is compared between sheep and goats and the lower value in each case summed to derive 'w'.

a = sum of the diet components (%) for sheep

b = sum of the diet components (%) for goats.

Both a and b are 100 for these data. $S = 1$ indicated complete similarity of diet and $S = 0$ complete dissimilarity.

RESULTS AND DISCUSSION

Association Composition

Composition changed rapidly after the treatments were imposed. White clover increased and gorse decreased as the goat: sheep ratio increased (Fig. 1). By August 1981 the Goat 100 association consisted of mainly grass and white clover with gorse plants < 10 cm high; the Goat 66 association was similar except for a lower white clover content. The Goat 33 association had gorse 15 cm high while the Sheep 100 association had gorse > 1m high and very prostrate white clover.

Diet Selection

Selection of grass, white clover and gorse by sheep and goats in 1980/1 is summarised in Table 1. Differences were less marked in 1979/80 because the associations had insufficient time to diverge and the data are not presented here. Grass was always a principal feed for sheep. It was a principal feed of goats except when they had access to gorse or thistles.

Regression analyses of grass in diet (Y_G , %) against grass in sward (X_G , %) gave the following equations:

$$\text{Sheep: } Y_G = 1.36 (\pm 0.04) X_G \quad R^2 = 0.23 \quad n = 32$$

$$\text{Goats: } Y_G = 1.17 (\pm 0.09) X_G \quad R^2 = 0.09 \quad n = 32$$

TABLE 1 Seasonal diet selection of grass, legume and gorse (%) by sheep and goats from swards developed by 4 sheep: goat ratios for 1980/1

Treatment	Season	Grass		Legume		Gorse	
		Sheep	Goats	Sheep	Goats	Sheep	Goats
Goat 100	Spring	72.2	88.9	25.5	7.4	0	0.3
	Summer	42.0	83.1	53.5	7.6	0	0
	Autumn	51.9	70.0	45.7	2.4	0	0
	Winter	84.7	95.2	10.2	1.2	0	0
Goat 66	Spring	95.3	93.0	2.0	2.0	0	0
	Summer	72.7	84.2	24.2	1.8	0	0.8
	Autumn	91.3	93.3	4.7	1.7	0	0
	Winter	91.0	95.7	3.1	2.7	0	0
Goat 33	Spring	90.6	49.5	5.3	1.1	0	48.5
	Summer	75.6	88.0	21.5	4.9	0	0.1
	Autumn	76.1	51.2	11.9	0.9	0	24.3
	Winter	85.9	84.2	3.3	1.0	0	0
Sheep 100	Spring	96.0	6.0	1.1	1.5	0	89.7
	Summer	80.2	2.5	10.1	0.7	0	32.6
	Autumn	81.8	14.7	1.7	0.3	0	32.2
	Winter	52.6	0.3	0.6	0.1	1.5	95.4

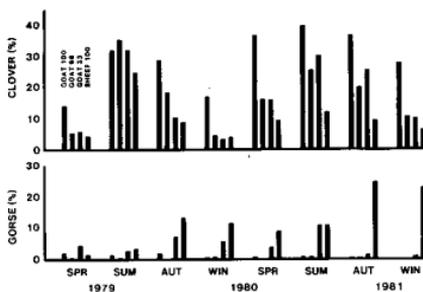


FIG. 1 Seasonal contribution of (a) white clover and (b) gorse to forage on offer on Goat 100, Goat 66, Goat 33 and Sheep 100 associations as estimated by 'first hit' point analysis.

The more variable relationship for goats was probably caused by high gorse intakes on the Sheep 100 association.

Sheep selected more white clover in all seasons ($P < 0.001$). Regression equations of white clover in the diet (Y_C , %) against white clover in the sward (X_C , %) are:

$$\text{Sheep: } Y_C = 0.79 (\pm 0.08) X_C \quad R^2 = 0.59 \quad n = 32$$

$$\text{Goats: } Y_C = 0.16 (\pm 0.03) X_C \quad R^2 = 0.16 \quad n = 32$$

They suggest, firstly, that sheep eat white clover in proportion to that on offer and secondly, that goats reject white clover.

Goats ate more gorse in all seasons ($P < 0.001$). Their diet contained more gorse in winter and spring than during summer and autumn. The availability of

TABLE 2 Seasonal similarity coefficients for goats and sheep grazing associations developed by 4 sheep:goat ratios for 1980/1.

Treatment	November	February	May	August
Goat 100	0.79	0.54	0.56	0.88
Goat 66	0.96	0.70	0.94	0.95
Goat 33	0.53	0.80	0.46	0.85
Sheep 100	0.07	0.05	0.30	0.05

thistle seedheads in summer (60% of diet) may explain the decline in gorse in the Sheep 100 association. Gorse was much less available in the other associations and therefore less was selected. Regression analyses of gorse in the diet (Y_U , %) against gorse in the sward (X_U , %) gave the following equations:

$$\text{Sheep: } Y_U = 0.02 (\pm 0.005)X_U \quad R^2 = 0.26 \quad n = 32$$

$$\text{Goats: } Y_U = 2.78 (\pm 0.42)X_U \quad R^2 = 0.48 \quad n = 32$$

The suggestion that preferred foods are not necessarily eaten in large quantities if availability is low (Petrides, 1975) is supported by the equation for goats. Gorse was sampled by sheep but never made a substantial contribution.

Dead matter was rejected by sheep and to a lesser extent by goats, as a result of a low preference rating and inaccessibility in the base of the sward.

Dietary Overlap

Similarity coefficients for goat and sheep diets are presented in Table 2. Such information is of major importance in calculating to what extent sheep and goats are complementary in different associations.

The Goat 100 association had similarity coefficients of 0.54 and 0.56 in summer and autumn, because sheep ate more white clover than the goats during this period. In winter and spring, coefficients are higher because of less white clover growth, and grass is the dominant diet of both species.

The Goat 66 association had high similarity coefficients in all seasons because the mixed grazing had removed accessible gorse and legume to leave a grass-dominant association in all seasons.

The Goat 33 association had similarity coefficients of 0.53 and 0.46 in spring and autumn respectively because of the increased gorse intake by goats in spring and autumn and the increased white clover intake by sheep in autumn. In summer and winter these components were less acceptable, and grass dominated the diet of both species. The Sheep 100

association was quite distinct from the other 3 associations, a large quantity of accessible gorse giving very high levels in the diet of goats but almost none in that of sheep. Similarity coefficients were therefore close to zero in all seasons except autumn when it rose to 0.3.

CONCLUSIONS

Sheep and goats show complementary diet selection when grazing scrub-pasture associations where gorse is easily accessible for grazing. The optimum economic mix of sheep and goats will vary with: the similarity coefficient; the proportion of gorse to pasture; the relative financial returns from sheep and goats; the cost of other control measures.

Attempts to eradicate gorse from N.Z. hill country have failed. Gorse represents a substantial feed source for goats. Our results suggest that sheep and goats farmed together could control gorse, increase total animal product per unit area and increase the amount of white clover available to sheep.

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