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SHEEP DISPERSAL PATTERNS ON HILL COUNTRY: TECHNIQUES FOR STUDY AND ANALYSIS

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SUMMARY

A technique for recording the positions of over 50 sheep accurately each 5 minutes for periods of two hours and longer has been developed. Even rapid sheep movement can be successfully recorded. The resulting data are the input to the computer programme PRS1 which produces information about the area occupation, dispersion and movement of thé flock. Such data have been used to differentiate sheep breed differences in relation to dispersal and movement patterns, the flocking tendency and density characteristics, and can help to elucidate the pattern of pasture utilization in hill country. In both short trials, Cheviots moved further and dispersed more rapidly than the other breeds studied.

INTRODUCTION

Although it is common practice to speak of stock densities in terms of so many sheep per hectare on both flat and hilly country, it has been observed for years that actual sheep dispersion patterns, especially in hill country, are far from uniform. Hill country farmers rely on the natural dispersion of their sheep to utilize pockets of scattered grass. It has been suggested that there are significant breed differences in dispersal and, consequently, in pasture utilization. Thus, while Merinos are reputed to keep together, Cheviots and Romneys spread out considerably by comparison. Such breed differences, if they exist, should be recorded and analysed.

As part of an overall programme to record movement patterns of sheep in steep hill-country and to look for breed differences in the rate of dispersion, this paper describes the techniques developed, their use and some preliminary results from two pilot trials.

SELECTION OF THE OBSERVATIONAL PADDOCK

To select a typical section of steep hill-country which will still allow full observation of all stock movement is difficult. After an examination of the available paddocks at Whatawhata, one was selected with the following features:

(1) A range of slope from very steep to relatively flat.

(2) A boggy area, some dry areas and several eroded faces.

(3) Clear of most visual impediments except rushes and weeds.

(4) Ridge-fenced.

(5) 2.15 ha (5.3 acres).

(6) Two main spurs which meant that sheep could disperse to the point where they could lose visual contact with the main mob.

(7) All observations could be carried out from a knob directly across a ravine sufficiently close that individual animals could be identified using binoculars, yet far enough away so that observers did not upset natural behaviour patterns.

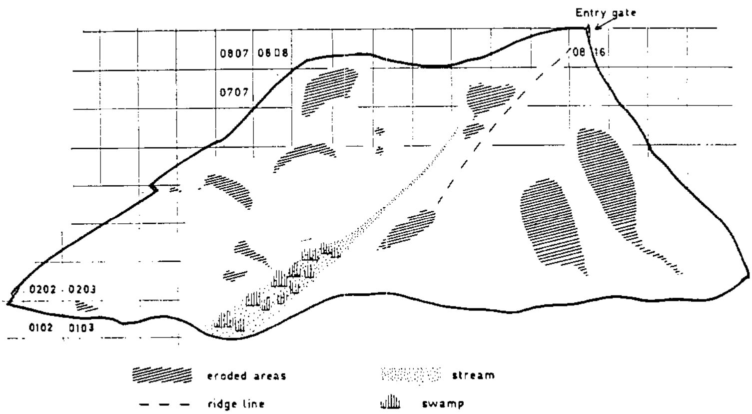

FIG. 1: *Paddock outline showing topography and numbered grid system.*

This paddock was arbitrarily divided by a grid of 8 $\times$ 19 squares (Fig. 1). The gully and ridges in this paddock meant that the actual ground size of the arbitrary squares were not constant. A random selection of these squares for size measurements provided a mean and S.D. of 15.6 $\pm$ 4.8 m.

APPARATUS AND PROCEDURE

To observe and accurately record the position of a flock of sheep in the observational field, a window frame 41 $\times$ 51 cm glazed with 6 mm perspex was constructed. A second unglazed frame was positioned against it with enough clearance to allow a sheet of cellulose acetate to be drawn between the frames from left to right. An adjustable eyepiece containing a 3 mm hole could be locked into position once observation had commenced. The whole of this portable apparatus was screwed on to two legs driven into the ground. These legs were left in position so that the angle of observation was identical from one day to the next. A marker pen was used to outline the paddock boundary and to dot on to the cellulose acetate the position of each sheep. The binoculars were used to confirm the positions of sheep partly obscured by weed or rushes.

In the initial autumn trial, three different coloured pens were used to cover each 15 minutes (three observations at 5 minute intervals), before the acetate was pulled across and a new paddock outline was drawn. In the summer trial, the grid squares and the paddock outline were drawn permanently on a thick sheet of acetate and each day this sheet was fixed in the correct position according to the paddock outline. Sheep in each grid square were then counted and recorded directly in the final form ready for the punch-card operator.

Fifty-three ewes (25 sheep/ha) were drafted off from several breed groups (Romney, Dorset-Romney, Cheviot, Perendale, Merino-Romney, Border Leicester) and rested overnight in a raceway. They were let through a top gate into the observational paddock at 9 a.m. each day on a visual signal from the observers. Observations were made at 5 minute intervals for up to 2 hours Two trials (each trial consisting of one session of observations for each breed group) were possible, one while the breeds were separated for tupping in autumn 1974 (termed the autumn trial) and the other while the breed groups were separated for shearing in summer 1974 (summer trial). As less than 2 hours of grazing was allowed for each group, grazing conditions were considered similar during each trial. Identical handling procedures for each group were strictly maintained; the same shepherd and dogs were used for driving the mobs each day.

DATA ANALYSIS

In recent years specialized computer programmes to analyse both human (Herron 1971) and animal (Friend and Polan 1974) spatial interactions have appeared. A general FORTRAN programme (PRS1) has been written to analyse sequential co-ordinate data to produce information about the movement and interaction of subjects in a variety of behavioural studies at Ruakura. The experimental observational field is divided into as many as 200 squares and the position of the subjects with reference to this grid is recorded for each observation. The observation field is not required to be a square itself — just so long as a suitable grid can be placed over it and the edge distortion (where squares are intersected by the field boundary) do not significantly alter the results. If the length of the side of the square is entered into the programme then calculated distances are scaled accordingly. Otherwise the results are in terms of unit squares. A four-digit number is used to describe the appropriate square; the first two digits are the Y co-ordinate and the second pair the X co-ordinate.

The programme can analyse such data not only for a group of subjects, treated as subjects per observation square, but also in experiments where individual subjects are identified (see Syme *et al.*, 1975).

The output of PRS1 is a listing of the movement, territorial occupation and interaction of the observed subjects. The programme is capable of calculating all or any combination of the following parameters:

(1) Mean group co-ordinate position.

(2) Subject density. Taken as the area of the occupied squares divided by the total number of animals.

(3) Aggregation of the group about the mean position (1). The sum of the distances from each subject to the mean position divided by the total subject number.

(4) Aggregation of the group about specified points. Up to four points may be specified by the user. Calculated as the sum of the distances from each subject to the specified point divided by the total subject number.

(5) Distance moved by the mean co-ordinate.

(6) Frequency of occupation of each square by all subjects.

RESULTS AND DISCUSSION

The sum of the frequency of square occupation (as defined by the grid pattern) of each breed of sheep provides a ready visual array of similarity or difference between the dispersal of the breed across trials and the variations of dispersal between breeds. It also indicates if any sheep are outside the paddock boundaries so some check is made of gross errors. An example of the greatest divergence of occupancy and the greatest similarity of occupancy is given in Fig. 2. The autumn spread of the Dorset-Romneys covered only 27 squares while in the summer trial they had been recorded in 84 squares within 1¼ hours after entering the paddock. Perendales, in contrast, occupied 61 squares in autumn and 67 in summer. It appears that the Dorset-Romneys were reluctant to

PERENDALE

GRID NUMBERS (Y — AXIS)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
8								7	14	31	58	23	3	3			entry gate		
7							4	44	21	13	47	47	9	10	2				
6						16	33	36	22	13	19	41	15	4	1				
5					19	22	20	8	9	5	9	9							
4			2	7	8	7	6	10	6	4	3	2							
3		3	3	3	4	2	7		16	5									
2				3	2	2	7	10	6	3									
1							3	2											

Autumn trial = 61 squares

GRID NUMBERS (Y — AXIS)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
8								2	4	6	2		8	35	64	113	entry gate		
7							2	29	18	13	48	20	5	4	8	9			
6							15	36	10	15	8	28	5	2					
5					9	20	15	6	5	7	25	34		2	5	1			
4					12	5	5	9	5	3	10				5				
3				1	1	4	4	1	9	8	3								
2	8	5	2	1	7	4	5	2	12		1								
1					11	7	4	1											

Summer trial = 67 squares

DORSET-ROMNEY

GRID NUMBERS (Y — AXIS)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
8								10	79	64	99	33	29	28	52	29	entry gate		
7								30	13	13	41	67	18	31	31	30			
6								8	13	5		13	2	16	18	8			
5								2											

Autumn trial = 27 squares

GRID NUMBERS (Y — AXIS)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
8									11	20	42	1	4	8	19	34	entry gate		
7							1	6	8	13	49	53	11	18	18	51			
6						4	11	3	4	5	8	15	5	7	47	7	8		
5					5	7	8	6	9	14	9	1	1	1	12	9	4		
4				4	3	9		6	7	2						4	4		
3		4	3	1	1	5	3	5	16							6	5		
2	9	3	4	8	8	1	6	10	5	1			6	2	11	4	20	1	
1					4	7	6	9							1	1	3		

Summer trial = 84 squares

GRID NUMBERS (X — AXIS)

FIG. 2: *Frequency of occupancy of grid squares by two sheep breeds in autumn and summer trials.*

leave the ridge top in autumn despite the rather limited feed supply at the time.

The mean Y and X co-ordinates of the group gives an estimate of the position of the flock for each observation. Taking the same two breeds again, the mean position of the Dorset-Romneys moved from 0811 at the first observation to 0712 at the last observation in autumn. The Perendales moved from 0709 to 0510 over their observation period. The corresponding figures for the summer observations were 0814 to 0410 for the Dorset-Romneys and 0815 to 0508 for the Perendales.

By using the entry gate (square 0816) as a reference point the computer printout provided the average distance in metres of the flock from the gate. The results for Cheviot, Perendale, and Dorset-Romney are plotted for each 5 minutes observation for both the autumn and summer trials (Fig. 3). Although the dis-

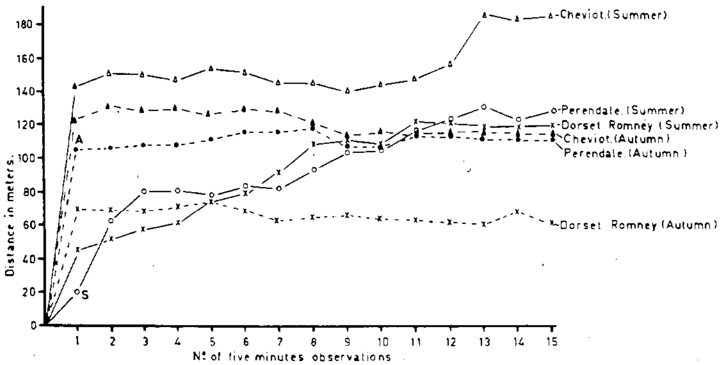

FIG. 3: *Dispersion of sheep from the point of entry according to time, season and breed.*

tance varies, the maximum average distance from the gate in autumn has been covered by the first observation and each of the breed groups remained in an epicentre around this point, the Dorset Romneys at about 66 m, the Perendales about 110 m and the Cheviots about 120 m from the gate. In the summer trial the Cheviots showed a rapid movement and a plateau at about 142 m for one hour followed by more movement away from the gate. The other two breeds showed a much slower movement pattern away from the entry gate. This may be a reflection of the greater amount of pasture which was available in the summer trial.

The data on group aggregation about the mean group co-ordinate are a measure of flock dispersion and provide answers about any differences in dispersal among breeds. The Dorset-Romneys reached their mean dispersal distances within three-quarters of an hour of entry, the Perendales within half an hour, and the Cheviots within one-quarter of an hour. Maximum dispersal distances were reached in the Dorset-Romneys in 65 minutes, the Perendales in 70 minutes, and the Cheviots in 50 minutes. For all breeds over both trials the spread averaged 36.5 m.

The average density (taking the area of occupied squares only into account) for the whole experiment was 85 m^2 per sheep. The Cheviots reached their average density in 17 minutes, compared with 30 minutes for the Perendale and 37 minutes in the Dorset-Romney.

CONCLUSIONS

Sufficient data have been collected from these trials to show that a useful data collection technique coupled with computer analysis dealing with social behaviour parameters provides a new tool for sampling and defining the breed patterns of dispersal, as well as the daily rhythms of flock movement and territorial occupation. As the programme has allowance for the tracking and analysis of up to 30 individual subjects within the group, a close examination of individual sheep reactions to difficult environmental conditions is possible.

The limited data gathered seem to substantiate the claim that Cheviots travel further and more rapidly than other breed groups under hill country conditions; that some breeds may even limit their movement when feed conditions are poor, though showing good dispersal patterns when feed is plentiful.

In conjunction with other behavioural observations, the recording and analysis of spatial parameters have wide application to the study of social behaviour and to the management of domestic animals.

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