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Sheep Management on Improved Hill Pastures

F. E. T. SUCKLING, Grasslands Division, D.S.I.R.

IN 1948 the Te awa grazing trials (1) were commenced in collaboration with the Soil Conservation Council to study the various aspects of pasture and stock management in relation to sward improvement. The Grasslands Division's prime concern lay in the establishment of high production pastures in the belief that soil conservation measures could not be applied on hill country unless carrying capacity, and hence nett profits, was increased. Similarly it was considered that the more vigorous the pasture cover the greater the soil stability and the faster the infiltration rate.

An area of 130 acres was subdivided in order to carry out pasture improvement and stock management treatments. The trials consisted of two main grazing treatments.

1. rotational grazing or mob stocking, and 2. set stocking.

The rotational grazing trials were conducted on 8 five-acre paddocks for each of two flocks, and during the first five years the flocks were run parallel as simple replicates. At the end of this period in 1953 one flock was rotated continuously throughout the year, as previously, and the second flock rotated from weaning to mid August, just prior to lambing, when they were drafted into "earlies" and "lates" and set stocked until the lambs were weaned in late December or early January. The set stocked flocks were not moved from the paddock except for monthly weighing, dipping, shearing, etc.

Coupled with the two main grazing treatments were additional treatments on the pasture side.

- (a) Oversowing and topdressing.
- (b) No seed or fertiliser, i.e., control.

In March 1949, 113 acres out of a total of 130 acres was oversown with a mixture of:

- 2 lb. white clover.
- 2 lb. Montgomery red clover.
- 2 lb. Subterranean clover (1 lb. Mt Barker, 1 lb. Tallarook).
- $\frac{1}{2}$ lb. Lotus major.

6 $\frac{1}{2}$ lb. per acre.

leaving two paddocks, one of 10 acres and the other 7 acres as control paddocks. At approximately the same time the oversown area was top-dressed with 2 cwt. per acre of superphosphate. Subsequently, the area has received a total of 14 cwt per acre over the 7-year period in annual 2 cwt dressings.

Pasture Response to Stock Treatments.

As the treatments outlined have now been in operation for 7 years it is possible to give a general picture of the pasture responses under the various treatments.

Large changes have occurred in pasture composition since 1948. As an example, analyses have shown that there is 3 times as much ryegrass in autumn 1955 as there was in autumn 1948. Similarly there is over 5 times as much white clover as well as large quantities of red clover, subterranean clover, and Lotus major which were not present in 1948.

The general outcome of all this increased clover content is that production and carrying capacity have risen markedly. There has also been a reduction of normal periods of food shortage, i.e., growth continues further into the winter and further into the summer than previously. Similarly, growth starts earlier in the spring and autumn.

Pastures on the control paddocks have improved with subdivision alone. Closer subdivision has enabled us to fully utilise all pasture growth and to stock up to the improvement. Here again, pasture composition has changed through management without any oversowing or topdressing. Botanical analyses on the untreated pastures in 1955 show an increase in ryegrass content of 1.3 more than was present in 1948 while white clover has increased by 3 times. Although no oversowing has been done on these paddocks, after 7 years cattle have transferred seed from oversown areas and we now have a small sprinkling of subterranean clover and Lotus major in the sward. These pastures are slow in coming away in the spring, dry out early in the summer, and are slow in responding to autumn rains.

Sheep Production from Various Pastures.

A summary of the overall carrying capacity for the 130 acre area is shown below.

				Average/acre
1947	Estimated	195 ewes + cattle		1.5
1948	Actual	209 "	"	1.6
1949	"	263 "	"	2.0
1950	"	266 "	"	2.0
1951	"	458 "	"	3.5
1952	"	464 "	+ 55 wethers + cattle	3.6
1953	"	464 "	+ 55 "	3.6
1954	"	586 "	+ 25 cattle	4.5
1955	"	600 "	+ " "	4.6

A steady increase in carrying capacity has been possible as the pasture has improved through subdivision, topdressing, oversowing and full utilisation. A further interesting comparison in annual live weight averages for the various groups is shown in Table I.

In the first three years of the trial the ewes in the control paddock were comparatively heavy. This is due to the fact that dry ewes were drafted into the area in the first year and this was reflected in their heavy weight over the remaining two years.

In the heavy set-stocked, oversown and topdressed areas (5½ ewes per acre) in spite of steadily increasing ewe numbers, weights have been maintained at a high level except during the 1954 season where it appears that a maximum had been reached, the average ewe weight being 129 lb. Weights are tending to decline compared with the lenient set-stocked (4½ ewes per acre) group where the average weight was 136 lb. Lenient set-stocking on improved pasture has resulted in large, well grown ewes, but a relatively high incidence of bearing trouble has resulted. The rotationally grazed ewes have been consistently low in live weight average compared with heavy set-stocking on improved pasture, and only slightly heavier than on the control areas.

A comment on stock health at this point is appropriate. The death rate of ewes on the area has been low, the lowest being 0.6 per cent. as 4-tooths, and the highest figure, as six year olds, being 6.0 per cent. of the whole flock. No particular treatment has shown significantly higher death rates than others. However, the lenient set stocked ewes on improved pastures produced a high incidence of bearing trouble, particularly during the spring of 1953, and some sleepy sickness was experienced with 6 and 7-year-old ewes in winter, 1955. The main losses have been through lambing troubles, bearing trouble, milk fever, and circling disease. It is of interest to note that the death rate has not greatly increased with increased stocking although trials of this nature must be continued over a long period at high sheep intensities before definite figures could be quoted.

Table I: Carrying Capacity and Average Ewe Weight 1948-54.

	Average 1948 to 50		Average 1951 to 54	
	Ewe weight lb	Ewes per acre	Ewe weight lb	Ewes per acre
Control: No seed or manure: Set stocking	131	2.8	113	3.0
Improved pasture: Seed + manure: Heavy set stocking	138	3.0	124	4.6
Improved pasture: Seed + manure: Light set stocking	119	2.5	124	3.3
Improved pasture: Seed + manure: Rotational grazing	122	2.6	115	3.9
Ewe age	2 tooth to 6 tooth		2 tooth to full mouth	

The rotationally grazed or mob stocked ewes have throughout the whole period shown a marked tendency to scour, particularly during periods of pasture growth, i.e., spring and autumn. This may be the biggest factor in keeping ewe weights at a low level. Records show that on an average the set stocked flocks only require about 10-20 per cent daggings whereas the mob stocked ewes require approximately 80-90 per cent during spring and autumn. This scouring is also reflected in lamb weights and lamb thrift.

Lamb weight averages are shown in Table II. The figures quoted in the table refer to a sample of lambs of similar age selected for weighing purposes throughout the season. They are thus representative of growth rates and weaning weights of lambs born at the peak of the lambing season.

The weaning weights of the control area are consistently lower than on the oversown and topdressed heavy set stocked area. On the other hand, except for the first three years, the lenient set stocked improved pasture produced the heaviest lambs of all treatments. But it must be remembered that at this stage the carrying capacity in this area had been built up to 3-4 ewes per acre. While the pasture was understocked at 2-3 ewes per acre the lambs were less thrifty. This may be attributed to the fact that improved pasture which is understocked grows away from the ewes and lambs and rushes to unpalatable roughage and seed head.

On the rotational grazed area, both the daily gain and the weaning weights are considerably poorer than on the improved pastures. Similarly the lambs under rotational grazing were poorer even than those from the unimproved pastures.

An interesting trial was carried out during 1953 and 1954 with one of the rotational grazed flocks. Instead of both flocks rotating continuously throughout lambing, one flock was set stocked from lambing to weaning. The results equalled those of the heavy set stocked improved pasture and indicated that an immediate improvement in daily gain and weaning weight was achieved from this set stocking practice. This was also reflected in heavier ewe weights on these pastures than on the continuously rotated area.

It is apparent that lamb thrift is adversely affected by regular shifts, and fluctuating planes of nutrition causing scouring and general dietetic upset. On the other hand, it can be stated that set stocking at moderately heavy rates, 3-4 ewes per acre, produced strong healthy lambs. At the same time one must consider the economics

TABLE II: Daily gains in lamb weight and their weaning weights on various treatments obtained during the last month before weaning.

	Average 1948 to 50		Average 1951 to 54	
	Daily gain lb.	Weaning wts. lb.	Daily gain lb.	Weaning wts. lb.
Control: No seed or Manure: Set Stocking	.22	56	.39	56
Improved pasture: Seed + Manure: Heavy set stocking	.26	61	.42	59
Improved pasture: Seed + Manure: Light set stocking	.28	60	.44	60
Improved pasture: Seed + Manure: Rotational grazing	.24	56	.33	53
Ewe age	2 tooth to 6 tooth		2 tooth to full mouth	

of heavy set stocking when the difference between whiteface store lambs grazed with ewes at 3-4 per acre as in lenient set stocking on improved pastures, is only 1lb. more per lamb than when stocking at 5-5½ ewes per acre in the case of heavy set stocking on improved pasture. The overall gain is heavily balanced in favour of high set stocking rates in terms of lamb numbers and total lamb weight per acre.

A summary of lambing percentages for the period 1948-54 is shown in Table III.

Lambing percentages were low in both 1948 and 1951 when two tooth flocks were run on the area. However, it will be seen that on the improved set stocked pasture a satisfactory figure was obtained. Generally, the position may be summarised by stating that the heavy set stocked improved area has consistently produced a high lambing percentage. The more leniently stocked improved pasture has pro-

Table III: Lambing percentage of groups calculated on number of ewes put to ram and lambs weaned.

	Average 1948 to 50		Average 1951 to 54		Lambing % 7 year average
	%	Ewes per acre	%	Ewes per acre	
Control: No seed or manure; set stocking	101	2.4	87	3.0	91
Improved pasture: Seed + manure; Heavy set stocked	104	3.0	102	4.6	103
Improved pasture: Seed + manure: + light stocking	121	2.4	93	3.3	106
Improved pasture: Rotational grazing	102	2.6	95	3.9	97
Ewe age	2 tooth to 6 tooth		2 tooth to full mouth		

duced the highest number of lambs, particularly in 1950 when a very high percentage was recorded. Unfortunately this area was seriously affected by bearing trouble in 1953 when a very low lambing percentage was recorded.

The rotational grazed area has given a consistently low percentage largely due to shifting stock during lambing with consequent mismothering, etc.

A summary of ewe fleece weights is set out herewith.

Average annual weight of wool for 7-year period.	Wool weight per acre 1954/55: 5-year-old ewes.
Control: No seed or fertiliser	10.7lb.
Improved + Seed and Manure.	28.5lb.
Heavy set stocked	11.5lb.
Improved + Seed and Manure.	53.3lb.
Lenient stocking	10.7lb.
Rotational grazed + Improvement	41.7lb.
	10.8lb.
	41.8lb.
	Average per ewe 9.9lb. over whole flock.

Over this period it is apparent that the heavy set stocked sheep have produced more wool per year. The high average weight is due in part to the fact that all flocks were shorn twice yearly for the first five years. The fleece weights shown include "bellies" but not pieces or crutchings, etc. The figures for the 1954-55 season show wool weights from wool grown over 370 days since last shearing.

Lamb fleece weights have shown a similar trend to those recorded for the ewes. On the control area the average has been 2.1lb., on the heavy set stock and improved pasture the figure has been 2.5lb., while the rotational grazed flock produced 2.3lb. average.

In summarising the results from these various treatments it can be stated:—

1. Rotational grazing during lambing on this hill country area has a detrimental effect on lamb weight, lambing percentage, wool weight, and general thrift.

2. Heavy set stocking on improved pastures has produced satisfactory lambs, good wool weight, and healthy stock.

3. Lenient stocking on improved pasture has given heavier ewe weights, heavy lambs, and good lambing percentages. However, bearing trouble has been a problem in ewes on this treatment.

4. Set stocking on unimproved pastures produces lower lambing percentages, lower wool weight, and lighter ewes, than improved pastures at heavier stocking intensities.

It should be noted that the ram lambs from the Te Awa area are raised for sale as two-tooth rams. Therefore, it is necessary to send off forward lambs for this purpose. In the opinion of the landowner, the rotationally grazed lambs are backward at weaning and therefore difficult to winter. The ewe lambs are kept for replacement purposes and likewise are difficult to bring through the hogget stage if poor in condition at weaning.

Management of Flocks.

(a) **Rotational Grazing:** It would be unfair to say that rotational grazing is a difficult practice. Apart from some difficulty in shifting two tooth ewes in the first few months before they are accustomed to a regular movement, we have experienced little trouble with the actual rotation of sheep on the area, particularly when the ewes are without lambs. The period from lambing to weaning, however, has presented some problems, not in the actual shifting of the sheep, but from the point of view of the lambs. Rotational grazed ewes become so ac-

customed to shifts that they are in a state of constant unrest and are ready to move at the slightest disturbance. This is of little consequence except when the lambs are newly born and are unable to travel. I have observed on many occasions, with ewes left to drift quietly through to the next paddock, that the sleeping lamb is left behind or the weakest twin is unable to follow and thus mis-mothering is a constant worry on the rotationally grazed areas. In my opinion a set stocked ewe is a more contented one and a better mother: hence mis-mothering is cut to a minimum.

A further feature of rotational grazing which has become apparent is the increased incidence of footrot in the flocks over and above that experienced in the set stock areas. This may be due to an increase in scald because of the longer grass. Although the spell between grazing each paddock is sufficiently long to result in the death of the footrot organism, carriers in the flock perpetuate the complaint in spite of frequent attention to the feet.

Rotational grazing throughout the year has for various reasons proved unsatisfactory from a stock thrift point of view. One of the main reasons for the failure of rotationally grazed pastures on hill country to support stock satisfactorily is the suppression of grass tillers due to the rotational or spelled pasture system. Pastures grow quickly during the spring and autumn seasons with the result that the shading of the base of the grass plants prevents tillering in a rotationally grazed pasture. In periods of little growth, i.e., summer and winter, the result is that the pastures open up and fail to respond between grazings. On the other hand the set-stocked areas, being constantly more uniformly grazed and usually at a fairly low level, are ideally suited to promote maximum tillering with the result that a dense mat is formed which clothes the soil, and produces a large number of leaves per unit area.

Measurements undertaken by Dr. Mitchell with regard to tiller density of various pastures (2) has shown that the Te Awa improved set stocked pastures have an average tiller density of 3,200 tillers per sq. ft., while a good flat land sheep pasture of dominantly ryegrass averaged 1,800 tillers. On the other hand in good quality ryegrass white clover dairy pastures the figure is 720 tillers per sq. ft. and for short rotation ryegrass which had opened up somewhat tillers were as few as 150 per sq. foot.

This illustrates the point that improved hill pastures form a dense mat under constant grazing and give continued production, because of the large number of tillers which are present, even though the amount of growth from each tiller may be small, total production remains high.

Another point which might be mentioned is the poaching and fouling of pasture which occurs during wet weather when large numbers of animals are shifted regularly from paddock to paddock. A large proportion of the pasture is trampled down and rendered unfit for consumption.

It is of interest to note that Dr. Barnicoat, working on wear in sheep's teeth (3), showed statistically significant results in favour of rotational grazed ewes at Te Awa compared with set stocked ewes.

Briefly the figures obtained from five-year-old ewes were $\frac{3.8\text{in.}}{10}$ above the gum for rotational grazing and $\frac{2.0\text{in.}}{10}$ for set stocked ewes. Sheep's teeth at Te Awa have on the whole presented little problem with regard to excessive wear. During the 1955 season six and seven-year-old ewes were wintered satisfactorily with a 6% mortality.

(b) **Set Stocking.** Although set stocking on the Te Awa area appears to be the most satisfactory management system, it is nevertheless subject to many weaknesses from a stock and pasture point of view. Some of these factors may be listed.

1. Ewes become too fat at certain times of the year for recognised best stock husbandry practice.
2. Ewes are subject to bearing trouble, sleepy sickness, milk fever, etc., when pasture growth is not fitted to animal requirements. It is obvious then that the animal is subjected to periods of feed shortages and surpluses. Thus there are no food reserves for summer drought or for winter shortages. It is apparent therefore that we must compromise.

(c) **Compromise Management.** One of our aims at Te Awa has been to reach a high carrying capacity as a means of achieving full utilisation of all the feed that is grown on the area and it is of some concern to us that we should endeavour to tie in both pasture production and animal requirements. To do this no one simple system of management will prove entirely satisfactory. Hence, it is necessary to look for a modification in management technique to cater most satisfactorily for both animal and pasture.

Under lowland conditions experiments have shown that intermittently grazed pastures produce more than set stocked pastures. The results obtained at Te Awa, however, do not entirely support this theory. Climate, altitude, aspect and botanical differences all have a bearing on the matter. In periods of shortage, one finds that rationally grazed flocks over-bare the pasture, open up the sward, thereby reducing earth temperatures during winter, and increase them in summer. Growth at these periods is so slow that there is insufficient recovery of the dominant, slow-growing species to satisfactorily maintain the flock. Similarly in spring the tendency is for spelled pastures to rush up to seed head and thus reduce leaf growth. One must admit, however, that there are other virtues which should be considered, particularly when hill pastures are improved and contain adequate legumes. They then resemble more closely the flat land pastures as far as production potential is concerned. Once having established clovers satisfactorily, and with adequate subdivision, one may commence a planned management programme which would entail the following:—

a) Subdivision into a satisfactory number of paddocks which would enable some flexibility in stock management. No set figure has been worked out, but I would suggest at least 16-20 paddocks for the average 500-1000 acre farm. I consider that subdivision is probably the biggest single factor in increasing production. At Te Awa we have raised the carrying capacity by 100 per cent. by subdivision making a full pasture utilisation programme possible.

(b) A planned programme of pasture improvement aiming at renovating, by oversowing, a limited area each year. This area should be adequately oversown with clover seed and topdressed to make good mineral deficiencies where practicable.

(c) Set stocked pastures appear to be more satisfactory in the initial stages of establishment of clovers. However, preparatory to oversowing it will be necessary to mob stock at heavy rates to rapidly bare the pasture for the introduction of seed when conditions are right for sowing.

(d) Once having subdivided, oversown and topdressed a paddock, it is important that the farmer should stock up to the improvement gained. As this can only be done gradually on most farms, the programme of paddock by paddock renovation ties in very well with the raising of additional stock.

(e) When clovers have established and thickened up satisfactorily under set stocking management during the first 1-2 years, mob stocking may be practised during the months between weaning and lambing. This enables the farmer to fit the animal requirements more satisfactorily to pasture production.

(f) Immediately following weaning it should be the farmer's aim to tone down the condition of his ewes in order that he may secure a satisfactory lambing percentage. Lambing percentages are largely governed by the number of eggs shed by the ewe at mating time. Consequently, to encourage the shedding of a maximum number of eggs she must be first reduced to strong store condition in order that she may respond to flushing. Flushing should be commenced about three weeks before the rams are put out and continued for about a month after. Ruakura experiments (4) have shown that this practice ensures a high lambing percentage.

To carry out this programme on hill country one must conserve pastures especially for the purpose. This entails the shutting of improved pastures during the summer months, preferably as late in the summer as possible. At Te Awa we have found the practice of spelling pastures on shady country to be very satisfactory for this purpose. The shady faces do not dry out to the same extent as the sunny faces and if a dense clover stand has been established, spelling at this time can serve a dual purpose: firstly, as conserved pasture for flushing, and secondly, for reseeding the introduced clovers in order to build up a large reserve of hard seed in the soil.

(g) The period between tupping and lambing presents fewer problems. The ewes may be grazed hard without causing trouble with either pastures or ewes. For the first few months of pregnancy the developing lamb does not add greatly to the ewe's requirements. This period usually coincides with the autumn pasture flush and in order to maintain a high carrying capacity it is necessary to conserve as much of this pasture as possible by shutting up paddocks and carrying the feed forward into the winter. In the meantime the flock may be rotated round the remaining paddocks while some growth is still evident and suitably rationed to conserve the declining pasture growth.

The July-August period is usually the hardest one. Pasture growth has almost stopped, particularly on farms which are situated at higher altitudes and also on shady faces where earth temperatures are at least four degrees Fahrenheit lower than on sunny faces. The pasture conserved during the autumn, i.e., April and May, can then be fed to prevent any fall in plane of nutrition as lambing approaches. Any marked reduction in nutrition at this time can easily produce sleepy sickness and milk fever.

(h) While the saved pastures are being grazed the remaining paddocks are automatically spelled, and although pasture is slow, there is a fresh bite available for the ewes when they are set stocked for lambing. In our experience, comparing the set stocked areas with rotationally grazed ones, it is apparent that in the spring the grass component of the pasture tillers better and is kept in a more nutritious and palatable state under set stocking. Under rotational grazing there is a marked tendency for the grasses to run quickly to seed head and roughage early in the season. The high proportion of white clover encouraged under set stocking has been largely responsible for good quality lambs.

It can be seen that this compromise in grazing management can only be practicable where adequate subdivision has been effected. One cannot over-stress, therefore, the need for subdivision as a preliminary step to increased production.

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Discussion

Mr. LYNCH: Mr. Suckling in his trial compares two rates of sheep concentration under set-stocking management but his rotational grazing is at one rate of stocking. I take it that the concentration of sheep in this is at the high rate of set-stocking.

Mr. SUCKLING: In comparing these two management systems we have endeavoured to bring the various mobs to a uniform live weight, by increasing stock numbers on either system until uniformity in ewe weight is achieved. It was found that a rather smaller number of sheep could be carried under rotational grazing. A complication with the 80 acres under rotational grazing is the varied topography, approximately half being sunny face and half shady face. The shady faces under heavy set stocking carried 4½ ewes as against 5½ on the sunny face.

Mr. CLARKE: What is your experience of set and mob stocking on the control of secondary growth?

Mr. SUCKLING: Under set stocking management it is difficult to control secondary growth. Mob stocking on the other hand, enables one to concentrate stock on weedy areas at the appropriate time. Over the summer land can be cleaned up without detriment to stock. I want to emphasise that we must retain flexibility even though we practice set stocking as a basis.

Mr. CLARKE: Is the higher incidence of bearing trouble associated with heavier condition?

Mr. SUCKLING: Over the last seven years at Te Awa that has tended to be the case.