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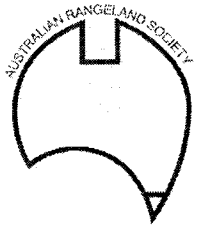

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A COMPARISON OF THE EFFECTS OF CELL GRAZING AND CONTINUOUS GRAZING ON BOTANICAL COMPOSITION

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ABSTRACT

Sites were established on three grazing properties on the northern tablelands of NSW to determine the comparative effects of cell and continuous grazing on the botanical composition of pastures. Basal diameter of indicator species, percentage ground cover and percentage contribution to dry weight were among the measurements used to assess changes in the pasture. Preliminary results show that at all sites cell grazing has had a positive effect on percentage ground cover and on the persistence of the most desirable components of the pasture relative to continuous grazing. No statistically significant changes in botanical composition were recorded at the plant community level. Possible reasons for this result are discussed.

INTRODUCTION

To achieve a sustainable level of animal production in any environment, a grazing regime should aim to encourage three primary factors. These are: i) improve the persistence of perennial grasses, particularly those species considered to be desirable; ii) maximise vegetative ground cover; and iii) encourage a high level of biodiversity. Conventional grazing systems implemented on the northern tablelands of NSW have been unable to maintain desirable perennial grasses, in particular introduced species, without the constant addition of high levels of non-renewable resources such as fossil fuels, fertilisers and herbicides. Combined over- and under-grazing (patch grazing) is widespread and has in many cases resulted in an increase in bare ground and its subsequent invasion by weeds.

Cell grazing evolved from consideration of the four basic ecological processes; water cycling, nutrient cycling, the flow of energy and community dynamics (Savory 1988) and the need to improve their functioning in pasture ecosystems. It is a relatively new form of grazing management in Australia and involves the concentration of livestock to achieve high stock density on relatively small areas for short periods of time. The most critical aspect of this management regime is that the rest period be of sufficient length to enable physiological recovery of grazed plants. The length of time required will vary with seasonal conditions. Graze periods are varied according to the required rest period but should be short enough to prevent repeated defoliation of tillers. The aim of this study was to use several different methods of vegetation assessment to evaluate the comparative effects of cell grazing and conventional grazing on botanical composition.

METHODS

Three predominantly native pasture sites on which a 'cell' had recently been established were selected on commercial properties situated on the northern tablelands of NSW. A summary of site descriptions is presented in Table 1.

The 'Strathroy' cell consisted of 28 paddocks encompassing an area of 730 ha. A 28 ha cell grazed paddock and an adjacent continuously grazed 15 ha paddock were monitored. At 'Lana' a 40 ha paddock within a 35 paddock cell and a 140 ha 'control' paddock were compared. The 243 ha cell at 'Green Hills' had been subdivided into 26 paddocks and monitoring was conducted on an 8.7 ha cell paddock and a 3.5 ha continuously grazed control. At all sites the paddocks compared were originally contained within a single larger paddock. At Strathroy and Green Hills the continuously grazed areas were stocked with the same class of livestock and at the same rate as that rotating in the cell. At Lana this was not possible, due to the development of internal parasite problems in the set stocked paddock.

Table 1. Site descriptions for the three properties at which the study was conducted.

	Strathroy	Lana	Green Hills
Ave. rainfall (mm)	730	780	870
Ave. stocking rate - cell (DSE/ha)	5.9	5.1	7.8
Ave. S. R. - conventional (DSE/ha)	6.0	3.3	7.9
Soil type	granite	granite	basalt
Soil pH (H_2O)	5.1	5.3	5.6
Available P (Bray) (mg/kg)	2.6	4	8

Vegetation Monitoring

To evaluate the effects of cell grazing and conventional grazing on botanical composition three paired sites were established along stratified gradients at each location. At each site permanent fixed point transects were established and four non-destructive sampling methods used to assess changes in the vegetation. It was considered that more than one method would be needed to assess adequately the effects of different management regimes. The three methods detailed in this paper are:

i) basal diameter of four dominant perennial grasses at each site;
ii) percentage ground cover (plant bases, litter, bare ground, dung and stone);
iii) percentage contribution of species to total dry weight.

The line intercept method was used to determine changes in the basal diameter of the four indicator perennial grass species selected at each site. At Strathroy and Lana the species monitored were *Eragrostis leptostachya*, *Sporobolus creber*, *Stipa scabra* and *Aristida ramosa*. The species at Green Hills were *Phalaris aquatica*, *Bothriochloa macra*, *Sporobolus creber* and *Poa sieberiana*.

A square 100 point quadrat with pins located 10 cm apart was used to estimate plant basal cover. Within each treatment 1600 fixed points were measured at each property. The species of plant occurring under the pin was recorded when the point of the pin contacted a rooted portion of a living plant, or if no plant base was present the presence of litter, bare ground, dung or stone under a point was recorded. Hits occurring on dead tillers which persisted on a plant were classified as part of the litter fraction.

Each spring and autumn species contribution to pasture dry weight was measured at each site using the dry-weight-rank (Botanal) technique in thirty 50 cm^2 permanent quadrats within each treatment.

RESULTS

The pasture species considered to be the most desirable for animal production at Strathroy and Lana was *E. leptostachya* and at Green Hills *P. aquatica*. Over the experimental period the basal diameter of these species was maintained or increased under cell grazing but declined dramatically under continuous grazing (Fig. 1). Conversely the basal diameters of the less desirable components of the pasture, *A. ramosa* and *P. sieberiana*, were reduced under cell grazing but changed only slightly under continuous grazing. Changes in the basal diameter of other species were not significantly different.

The percentage ground cover of plant bases increased over time under cell grazing compared with conventional grazing at all sites (Table 2). At Strathroy plant basal cover declined in both systems during the drought (T_0-T_1) but increased again following spring rainfall (T_2), with a significantly greater increase ($P<0.05$) recorded in the cell grazed treatment. At Lana plant basal cover remained relatively stable over time under cell grazing while decreasing under continuous grazing. At Green Hills plant basal cover increased at a relatively constant rate under cell grazing while declining under continuous grazing. *Eragrostis leptostachya* at Strathroy and Lana and *P. aquatica* at Green Hills contributed to a significantly higher percentage of plant basal cover ($P<0.05$) under cell grazing at the final measurement than under continuous grazing.

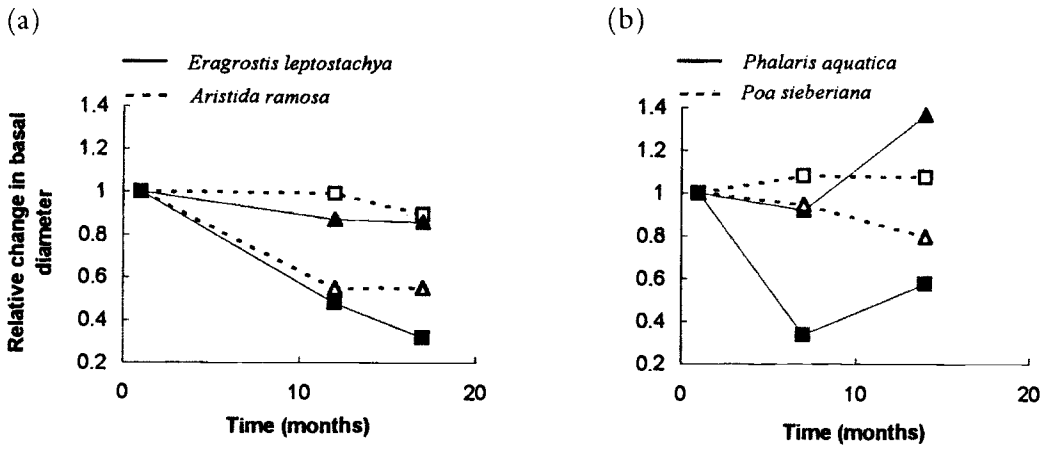

Figure 1. Relative change in the basal diameter of two species at (a) Strathroy and (b) Green Hills under cell grazing (Δ) and continuous grazing (□).

Table 2. Changes in components of percentage ground cover over time at three sites.

Property	Grazing	Plants			Litter			Bare		
		T_0	T_1	T_2	T_0	T_1	T_2	T_0	T_1	T_2
Strathroy	Cell	11.6	7.1	21.0	85.6	81.4	76.9	1.5	8.4	1.2
	Conventional	12.1	6.1	16.3	84.9	80.2	77.6	0.7	10.6	2.2
Lana	Cell		17.8	17.5		63.6	81.2		16	0.6
	Conventional		16.2	12.2		70.0	83.5		12	4.1
Green Hills	Cell	19.0	21.6	23.7	72.5	71.2	71.3	2.5	1.3	0.1
	Conventional	19.8	19.5	18.0	72.3	71.7	73.5	2.4	3.2	3.1

The analysis of the relative contribution of plant species to total dry weight (as determined with the Botanal procedure) yielded no statistically significant treatment effects. Given the short duration of the trial, seasonal variation was likely to have played an important part in this result. Despite the lack of statistical significance, there was a trend in the data for the desirable species to contribute a greater percentage to the available feed on offer under cell grazing. The most notable change was observed in *P. aquatica* at Green Hills. The contribution of this species declined from 25% of the total dry weight at the initial measurement to less than 1% after only 7 months of continuous grazing. Under cell grazing the contribution of *P. aquatica* to dry weight increased over time. Grazing treatment had little effect on the total number of species recorded at any site although annual species contributed a higher percentage to the total dry weight in the continuously grazed paddocks.

DISCUSSION

Booysen (1969) defined two types of rest required to achieve improvement of pastures; rest for seeding and rest to increase plant vigour. He postulated that in the latter case, rest replenished energy levels, maintained the volume of the root system and allowed the development of shoot apices for increased growth of individual crowns and the canopy. The time required for each of these objectives to be satisfied will obviously vary between species and in different environments. The more paddocks available in a rotation the longer the rest period will be for each paddock and the greater the degree of flexibility available to the grazier. This flexibility is of particular importance when seasonal influences are unpredictable.

When comparing the relative merits of grazing systems many workers have concentrated on the effects of treatment on the botanical composition or on functional groups within the pasture (Dormaar *et al.* 1989, Ralphs *et al.* 1990, Taylor *et al.* 1993). Problems in assessment arise when individuals of

some species lose vigour but remain in the pasture, hence while still being recorded as present they are contributing only a small amount to the total biomass. Heterogeneous pastures also confound comparisons between grazing systems due to the variable spatial distribution of species over a site. This study addressed these problems by monitoring the response of indicator species as well as changes in botanical composition. The measurement of plant basal diameter and species contribution to percentage ground cover over time provided an indication of both the persistence and the vigour of individual species.

The ultimate criterion for evaluating the relative merits of any grazing system will always be animal production. Gammon (1978) noted that the possible reasons for the failure of grazing management experiments to reveal potential differences in animal production were small paddock sizes which altered grazing behaviour, discrepancies in stocking rate, rigid graze and rest periods which ignored basic plant and animal physiological requirements and unrealistically short experimental periods. Few experiments have been of sufficient duration to test the intuitive notion that improving the botanical composition of a pasture will result in increased animal production in the longer term.

CONCLUSION

In the short period of this trial marked effects on individual species have been recorded although grazing treatment has not had a statistically significant effect on the actual composition of the plant community. Under continuous grazing the vigour, as determined by plant basal diameter, of desirable species declined at all sites and the persistence of these species was reduced. Under cell grazing the more palatable species increased in basal diameter over time, plant basal cover was higher, and the percentage of bare ground was reduced.

It is hypothesised that the rest periods which are an integral part of the cell grazing regime were the primary influence which resulted in increased dry matter production and persistence of the more desirable components of the pasture. The effects of these changes on animal production were not assessed.

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