Effects of grazing management on *Bothriochloa macra* (red grass) in a native pasture

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Abstract

Red grass is an indigenous species that is commonly found in native pastures in the higher rainfall zone of New South Wales. A grazing experiment was conducted near Cookardinia in southern NSW to determine if simple grazing management strategies could be imposed to maintain and/or increase this species in native pastures dominated by exotic annual species. From September 2003 to April 2006, five treatments were imposed: 1) continuous grazing (year round grazing at 5 DSE/ha); 2) grazing exclusion; 3) high spring utilisation (as with set stocking but increasing to 23 DSE/ha for 6 weeks in spring); 4) high spring utilisation with strategic lock-up over summer, and 5) strategic lock-up over summer. Strategic summer lock-ups were designed to encourage seedling recruitment and were imposed in response to rainfall after seed fall in late summer-early autumn. Treatments were applied in plots (15 x 15 m), replicated four times, communally grazed by Merino wethers. Initially, red grass was a minor component (8% of biomass) of the pasture, which was dominated by broadleaf weeds and annual grasses. By April 2006, the basal cover of red grass was significantly higher in the two treatments that included strategic lock-up over summer (treatment 4 : 8.9% and treatment 5: 10.7%) compared with continuous grazing (3.7%). In contrast, exclusion of grazing over the experimental period had no significant effect compared with continuous grazing. In conclusion, grazing management, in this case summer-autumn rest, may be an effective low-cost tool to increase the proportion and basal cover of *Bothriochloa macra*.

Keywords

Strategic grazing, red grass, perenniality

Introduction

"Unimproved" pastures on the slopes and tablelands of southern NSW and northern Victoria vary greatly in botanical composition from those dominated by native species with minor exotic content, to those in which exotic (usually annual) species dominate with native grass species relatively sparse. As a simplification, it is reasonable to refer to all such grassland communities as 'native pastures' where the major perennial species is a native (Crosthwaite and Malcolm 2001). The relative abundance of native grasses within these pastures is critical for functioning with respect to natural resource management in particular, reducing deep drainage and maintaining ground cover (Virgona et al. 2003). In these landscapes, it is either uneconomical and/or not feasible to introduce new perennial species. Therefore manipulation of existing native pastures has more potential for increasing the "perenniality" of the landscape than introducing either exotic species or domesticated native species (Virgona et al. 2003).

The results of a recent survey of native pastures from central NSW to north eastern Victoria showed that the most common native perennial grass species in southern NSW were *Bothriochloa macra, Austrodanthonia spp., Austrostipa spp. and Microlaena stipoides* (Virgona, Li, Mitchell, Ridley, Dowling, King, unpublished data). Of these, *Bothriochloa macra* (hereafter – *Bothriochloa*) was the most common, but usually at very low frequencies. It is possible that a range of management strategies could be used to increase the relative abundance of this species but, given the low productivity of these pastures, expensive options such as use of herbicides, increased use of fertiliser or subdivision would have very low rates of on-farm adoption by graziers. In contrast, grazing management, a relatively cheap technology, could be used to cost-effectively increase *Bothriochloa* content in these pastures and be more readily adopted by graziers. The experiment reported in this paper describes the effects of simple grazing management treatments on the abundance of *Bothriochloa* and other components of the pasture.

Methods

A native pasture near Cookardinia in southern NSW (annual average rainfall 650 mm) with soil P (Olsen) of 11.9 and pH ($CaCl_2$) of 4.7 and typically low levels of *Bothriochloa* (7.6% of above ground biomass; hereafter, biomass) was selected for the study. From September 2003 to April 2006, five treatments were imposed:

1) *Continuous* grazing (year round grazing by wethers at 5 sheep/ha),

2) *Exclusion* – no grazing,

3) *High Spring Utilisation* (*HSU*) – as for *Continuous* + increase to 23 sheep/ha for 6 weeks in spring,

4) *HSU* + *Strategic* exclusion late spring to mid autumn + pulse grazing over summer (at 23–31 sheep/ha) after major rainfall events),

5) *Strategic* (as for (4), but without *HSU*).

All treatments were grazed at the same stocking rate as the continuously grazed treatment, except when otherwise specified. Each treatment was split for an application of herbicide (MCPA) to be imposed in winter to control broadleaf weeds, but only results from the unsprayed treatments will be considered here. The aim of the *HSU* treatment was to reduce biomass to <1000 kg/ha. Strategic summer lock-ups were designed to encourage seed set and seed fall and seedling recruitment. Grazing was excluded from these treatments from mid November to mid April–May each year, except for a brief period (normally 7 days of high intensity grazing at 23-31 sheep/ha), following a major summer-autumn rainfall event. Treatments were applied in plots (15 x 15 m), replicated four times, and communally grazed by Merino wethers at 5.3 wethers/ha.

Every 5–7 weeks from September 2003 to May 2006, biomass and botanical composition were measured on each plot. Biomass was measured in 15 quadrats evenly spaced along a fixed transect using a falling plate meter (e.g. Li *et al*. 1998) up to April 2004 and thereafter a visual assessment technique (Haydock and Shaw 1975). Botanical composition was assessed using the dry-weight rank technique as modified by Jones and Hargreaves (1979) on the same quadrats used for measurement of biomass. At the commencement of the experiment, frequency and apparent density of *Bothrichloa* were measured in each plot in 20 quadrats ($0.25m^2$) per plot. These measurements were also made at the conclusion of the experiment, as well as a calibrated visual estimate of basal cover (McIvor 2001). For the latter, visual estimates on undisturbed samples were calibrated against basal cover by cutting samples to a height of 25 mm and placing a gridded quadrat [measuring 300 x 300 mm (with 25 x 25 mm mesh – giving 144 cells)] over it. Each cell was scored for cover – which was positive if at least half of the cell was covered by the base of *Bothriochloa* plants. The relationship between the visual cover score (y) and actual cover (x) was $y = 14.0x$ with $r^2 = 0.95$ ($P < 0.001$). Botanical composition, density, frequency and basal cover data were subjected to analysis of variance. Effects of treatments on biomass and *Bothriochloa* as a proportion of total biomass through time were analysed using linear mixed models (Orchard et al. 2000).

Results

Rainfall over the term of the experiment was markedly lower than the median as obtained from a patch-point data set for the site (http://www.longpaddock.qld.gov.au/silo/). Annual rainfall from 2003–2006 was 529, 529, 667 and 216 mm, respectively, compared with the long term median of 642 mm. It is worth noting that conditions were especially dry throughout each autumn with none of the autumn months in 2004–2006 having median rainfall.

Treatments had significant effects on predicted biomass throughout the experiment (Fig. 1). Predictably, biomass of the *Exclusion* treatment was significantly higher than the *Continuous* treatment from

December 2004 onward and was 8800 kg/ha by April 2006 (data not shown in Fig.1). Predicted biomass of the *HSU*

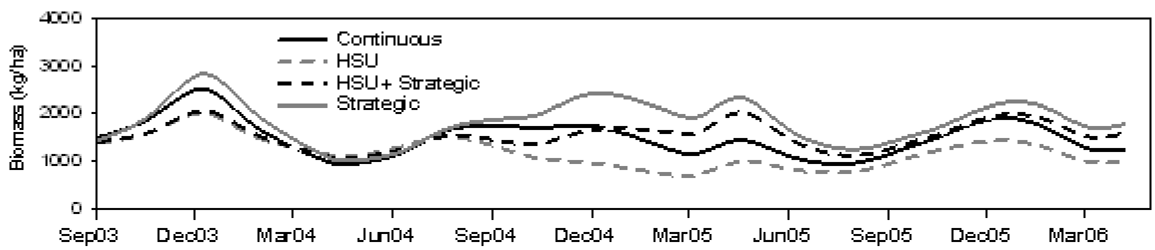

Figure 1. Predicted biomass (from linear mixed modelling) as a proportion of total biomass (backtransformed from analysed natural log transformation) over time under four management regimes. For statistical differences among treatments, refer to text.

treatment was significantly lower than the *Continuous* treatment in spring 2004 and 2005 and consistently less than the *HSU+Strategic* and *Strategic* treatments from spring 2004 onward. Despite the increased grazing pressure in spring, the *HSU+Strategic* treatment had lower predicted biomass than the *Strategic* treatment in spring 2004 only.

Initial botanical composition (September 2003) varied markedly across the plots, with a median values (range in brackets) of *Bothriochloa* 7.1% (1.6–30.1), broadleaf weeds (mainly *Carthamus lanatus*, *Arctotheca calendula* and *Hypocheris radicata*) 76.5% (34.6–93.4), annual grasses (mostly *Vulpia spp. Bromus mollis* and *Hordeum spp*.) 2.1% (0.6–11) and annual legume (primarily *Trifolium subterraneum*, *T. glomeratum* and *T. campestre*) 5.5% (0–33.3). Apparent density and frequency of *Bothriochloa* were not significantly affected by any of the treatments imposed (Table 1).

Table 1. Initial and final apparent density, frequency and final basal cover of *Bothriochloa*.

	Initial (2003)		Final (2006)		
Treatment	Frequency (%)	Density (m^2)	Frequency (%)	Density (m^2)	Basal cover (%)
Continuous	91.2	10.4	66.2	6.8	1.55
Exclusion	86.2	10.0	58.8	5.5	2.18
High Spring Utilisation (HSU)	95.0	11.1	66.2	9.2	2.55
HSU + Strategic	87.5	9.1	83.8	10.4	3.24
Strategic	91.2	9.8	80.0	9.7	3.75

LSD (P=0.05)	ns	ns	ns	ns	1.23

There was a significant effect of management on basal cover of *Bothriochloa*, with both treatments that included the *Strategic* regime having significantly higher *Bothriochloa* basal cover than the *Continuous* treatment (Table 1). Consistent with the effect on basal cover, *Bothriochloa* was a significantly higher proportion of biomass in the treatments that included the strategic regime (Fig. 2). For clarity the *Exclusion* treatment was not included in Figure 2, but did not differ significantly from either the *Continuous* or *HSU* treatments. Finally, while there was a significant effect of grazing on the proportion of legume in the pasture, as a result of the *Exclusion* treatment (2.4%) being much lower than all other treatments (20–25%).

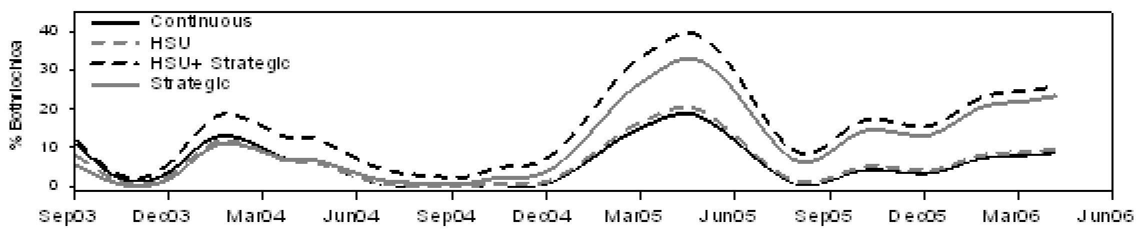

Figure 2. Predicted *Bothriochloa* (from linear mixed modelling) as a proportion of total biomass (backtransformed from analysed square root transformation) over time under four management regimes. The *HSU+Strategic* and *Strategic* treatments were significant greater than the *Continuous* treatment from June 2004 and March 2005, respectively.

Discussion

In a relatively short period, the proportion of *Bothriochloa* in the pasture and its basal cover could be increased by applying a grazing management regime that reduced grazing over the summer-autumn period with or without prior high spring utilisation. As the greater basal cover of *Bothriochloa* in these treatments was not associated with greater frequency and/or apparent density, the differences in basal cover probably resulted from larger individual *Bothriochloa* plants. Interestingly, the basal cover of the *HSU* treatment was not significantly different from the *Continuous* treatment, despite the consistently lower predicted biomass of the HSU plots (Fig. 1) – probably reflecting preferential grazing of the *HSU* treatment throughout the year.

The increase in basal cover of *Bothriochloa* over that of the continuously grazed treatment was not consistent with results of grazing studies conducted by Lodge et al. (2003a, b) on the northern slopes of NSW under more favourable conditions. Lodge et al. (2003a) found rotational grazing and higher stocking rate (with *T. subterraneum* oversown) improved basal cover over continuous grazing at low stocking rates (4–6 sheep/ha). In contrast, at another site where similar treatments were applied, no effects on the cover of *Bothriochloa* were found (Lodge et al. 2003b). The inconsistencies between the results reported here and those found by Lodge et al. (2003a, b) may arise from a number of factors. For instance, *Bothriochloa* may be more responsive to longer rest periods over summer-autumn in southern NSW, where rainfall over these months is less frequent than in the summer rainfall areas of northern NSW. In addition, the levels of *Bothriochloa* (and other native species) in this study were much lower than those reported by Lodge et al. (2003a, b), and there may have been fewer perennial competitors.

Conclusion

These findings provide some evidence that the cover and proportion of *Bothriochloa macra* in native pastures can be increased by reduced grazing over the summer-autumn period. These results can be applied by farmers who wish to increase the levels of perennial species in similar pasture communities using strategic grazing management. However, on-farm the opportunity to increase or decrease stocking rates on targeted pastures will vary depending largely on the availability of livestock, and availability of feed in alternative pastures.

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