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Long term effects of different grazing strategies on productivity, profitability and land condition in a variable climate

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Abstract. Inter-annual rainfall variability is a major challenge for sustainable and profitable grazing management in northern Australia. Results are presented from a large, 13 year grazing trial on the relative performance of five stocking strategies in managing for rainfall variability. Strategies are compared in terms of their impacts upon animal production, profitability and pasture condition. The results show that recommended strategies such as moderate stocking, varying stock numbers in response to forage availability and moderate stocking with wet season spelling are not only more sustainable, they are also far more profitable than heavy stocking. It is suggested that managers apply some form of flexible stocking around long term carrying capacity with stock numbers changed in a risk-averse manner as rainfall varies between years. Some form of wet season spelling also appears important to maintain pasture condition.

Introduction

The inherent variability of rainfall in northern Australia is a major challenge to sustainable and profitable beef production. A number of grazing strategies such as stocking to long-term carrying capacity or varying stock numbers with available forage are recommended to manage for climate variability. However, these strategies have not in general been tested at a scale relevant to the grazing industry. In particular, the relative impacts of different strategies on profitability have not been objectively quantified, limiting adoption by managers. To address this issue, a large, long term trial was established with the specific objectives of (i) empirically quantifying the effects of different grazing strategies on a range of variables including animal production, profitability and land condition and (ii) providing a practical demonstration of the impacts of these strategies on these variables. This paper presents results from the first 13 years (1998-2010) of this ongoing trial.

Methods

The Wambiana grazing trial was established in 1997 in the *Aristida-Bothriochloa* pasture community (Tothill and Gillies 1992**)** in *Eucalypt* savanna near Charters Towers (mean annual rainfall: 650 mm), north Queensland. Paddocks are large (93-117 ha) and spatially heterogeneous with similar proportions of three different landtypes in each. Strategies tested were (i) *moderate stocking* (MSR), stocked at the long-term carrying capacity (LTCC) of about 8 ha/animal equivalent (AE= 450 kg steer), (ii) *heavy stocking* (HSR), stocked at about 4 ha/AE, (iii) *variable stocking* (VAR) - stock numbers adjusted according to end-of-wet season pasture availability (range: 4-12 ha/AE), (iv) a *Southern Oscillation Index* (SOI)-variable strategy – stock numbers adjusted in November according to available pasture and SOI seasonal forecasts (range: 4-12 ha/AE) and (v) *rotational wet season spelling* (R/Spell), initially stocked at 6.5 ha/AE (1998-2003) and at 8 ha/AE thereafter. Paddocks were stocked with Brahman-X steers; treatments were replicated twice (O'Reagain *et al.* 2010). 3-P grass (palatable, productive and perennial) densities and the % contribution of 3-P grasses to pasture yield were measured annually in the late wet season. Data was analysed using ANOVA with paddocks as replications. Accumulated gross margin (AGM) was calculated from the annual value of beef produced less variable and interest (7.5%) costs (O'Reagain et al. 2011).

Results and discussion

Rainfall varied markedly over the trial period with good rainfall in the first four years followed by six relatively dry years of below average rainfall. Good, well distributed rainfall occurred from 2008 onwards (Figure. 1). Heavy stocking at twice LTCC gave good economic and animal performance in the initial wet years but profitability fell in subsequent dry years through high costs and reduced carcass value. The HSR was also unsustainable; stocking rates had to be reduced in dry years while perennial grass density and basal area declined (Orr and O'Reagain, 2011). In later, good rainfall years, profitability recovered but after 13 years was still by far the lowest of the five strategies. Although ground cover increased (data not shown), 3-P grass density did not recover in later, wetter years (Table 1), indicating that pasture condition had not recovered.

Table 1: Key indicator variables for the Wambiana grazing trial after 13 years. These are mean live weight gain (LWG) per ha, mean LWG per animal, mean dry season (DS) LWG and the number of years drought feeding was required. 3-P grass density and % contribution to yield are 2010 values.

STRATEGY	HSR	MSR	R/Spell	SOI	VAR	F-prob
LWG/ha (kg/ha)	22 c	15 a	15 a	17 b	18 b	*0.002*
LWG (kg/year)	98 a	122 b	112 b	114 b	111 b	*0.046*
LWG DS (kg)	-3 a	20 b	17 b	13 b	14 b	*0.018*
Years of drought feeding	4	0	0	0	0	-
3-P grass density 2010 (plants/m^2)	1.75 a	5.15 b	4.77 b	3.50 ab	3.87 b	*0.040*
% 3-P grass contribution 2010	21 a	51 d	46 cd	34 bc	40 b	*0.004*

NB: Means with same subscript are not significantly different at the P = 0.050 level

In contrast, moderate stocking (MSR) at LTCC, gave relatively consistent economic returns due to good individual animal production, meatworks price premiums and low costs. Overall the MSR was far more profitable than the HSR and of similar profitability to the VAR, SOI and R/Spell strategies. The MSR also maintained perennial grass density and, with the R/Spell, had the best pasture condition (Table 1). Experience at the trial nevertheless indicates that the MSR strategy would benefit from wet season spelling as well as some stocking rate flexibility as seasonal conditions changed.

The modest performance of the R/Spell treatment relative to the MSR is unexpected given the accepted benefits of spelling on pasture condition. However, the R/Spell was initially stocked at 6.5 ha/AE i.e. above the MSR; non-spelled sections were thus heavily stocked during the wet season as cattle had access to only 2/3 of experimental area. This, together with an ill-timed fire in 2001 and the subsequent drought, adversely affected profitability and pasture condition. Following a reduction in stocking rate to 8 ha/AE in 2003, pasture condition improved rapidly in the R/Spell and as of May 2012 is probably superior to that in the MSR. These results nevertheless show that (i) wet season spelling does not buffer the impact of higher stocking rates on pasture condition and (ii) that some reduction of stocking rates is important in drought years.

The SOI and VAR strategies were initially very profitable due to the high stocking rates applied but profitability slumped in the first dry year (2001/02) due the sale of poor condition animals as stocking rates were cut (Fig. 1). This sharp reduction in stocking rates avoided the expense of drought feeding and improved animal production, allowing profitability to recover. The variable strategies were far more profitable than the HSR and of similar profitability to the MSR and R/Spell. However, high stocking rates leading into the dry years adversely affected perennial grasses in both variable strategies, reducing pasture condition; an effect still evident nine years later in 2010 (Table 1). Accordingly, variable stocking would be improved by setting upper limits to stocking rate and making stocking rate adjustments in a risk-averse manner. Trial data suggests that the *primary* stocking rate adjustment should be based on forage availability at the end of the wet season with other *secondary* adjustment points in the late dry season (October/November) and possibly, in the early-mid wet season.

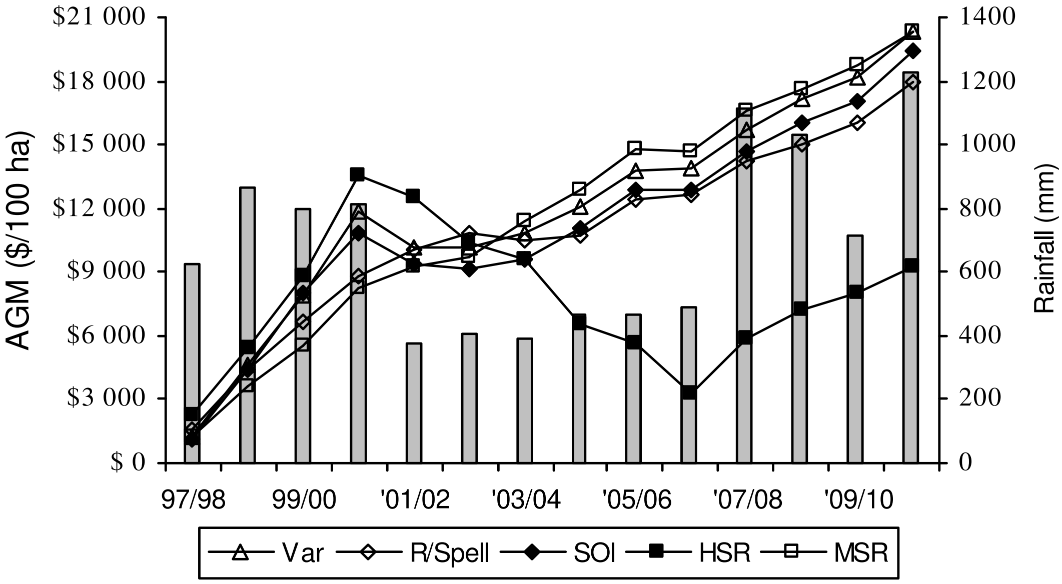

Figure 1: Annual rainfall (bars) and accumulated gross margin (AGM) over 14 years (1998-2011) for different grazing strategies at the Wambiana grazing trial.

It is important to note that the present results were obtained with steers; hence extrapolation to breeders requires caution. Further, experimental paddocks were relatively small compared to commercial paddocks (>2000 ha). The 13-year trial period is also relatively short in relation to rainfall patterns and trial outcomes may have varied given a different sequence of rainfall years. Nevertheless, preliminary modelling of trial results over 25 years of climate data (Scanlan *et al.* 2012) indicates that the basic findings of the trial still hold at the property scale with breeders.

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