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Resting strategies for recovery of pasture

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Abstract
Reduced condition of pasture and soil is common in pasture communities across northern Australia where desirable perennial grasses are the cornerstone for profitable and sustainable beef production. Resting pasture from grazing over the summer growing season is a key grazing land management recommendation. Trials to quantify the response of native pastures to differing resting regimes were conducted. Two sites with poor condition grazing land in priority pasture communities in central and north Queensland, Australia were studied. Detailed recordings were made on plant lifecycles, pasture attributes and soil seed banks.

The recovery of 3P (palatable, perennial, productive) grasses appears to be limited by a small viable seedbank. Resting management to achieve pasture recovery will require time frames in the order of 10 years before there will be an obvious impact on land condition and productivity. A moderate stocking rate when grazing is necessary for these improvements to accrue. During drought, adjusting stock numbers to the amount of forage available is critical to avoid reducing land condition and further prolonging recovery. Other essential management includes stocking around long-term carrying capacity, and avoiding high grazing pressure on the paddocks around the rested paddock.

Background
Reduced condition of pasture and soil is evident in most pasture communities across northern Australia and is demonstrated through a decline in density and growth of desirable perennial grasses. These areas of 'C' condition pasture have effectively reduced their carrying capacity by 50% or more (McIvor *et. al*. 1995), and are also a major risk for erosion and downstream impacts on water quality (Bartley 2014). Resting grazing land to maintain or improve land condition is a key recommendation for improved grazing management across northern Australia, especially for accelerating recovery of pasture that has declined in condition (Hunt *et al*. 2014).

The purpose of the study was to improve the evidence base underpinning recommendations for resting pastures to recover poor condition grazing land. We report the response of native pasture in priority pasture communities to different durations of pasture resting. There were minimal benefits from resting in our measured pasture parameters.

Methods
The primary studies were on the use of growing season, or 'wet season' resting to recover the pasture and soil condition of paddocks of native pasture that were in 'C' (poor) condition in the Burdekin catchment. We studied a combination of timing, duration and frequency of resting, interactions between seasonal conditions and the effect of resting treatments under a moderate and a high stocking rate.

Trials were conducted at two sites; Monteagle near Clermont and the Wambiana Grazing Trial near Charters Towers. Monteagle had two years of very good rainfall followed by three very dry years. The Monteagle site had to be destocked over the 2012/13 summer following a wildfire through the trial paddock and very dry conditions. The Wambiana site had one year of average rainfall followed by two very dry years.

For this paper we report on full wet season rest applied annually. Treatments were compared against non-rested areas in the same paddock. At the Wambiana site, the trials were conducted under both moderate and high stocking rates (O'Reagain *et al*. 2014).

Plots were 20m x 20m and replicated four times. Pasture yield, species composition, ground cover and soil surface characteristics were recorded, and land condition categorised. Population dynamics of the 3P grass Desert blue (*Bothriochloa ewartiana*) and non-3P wiregrass (*Aristida* spp.) were mapped in permanent quadrats. Soil cores were taken each spring to determine readily germinable seed reserves of pasture species.

Results

Monteagle

There was an encouraging trend for improving Desert blue density and yield with resting under a moderate stocking rate which occurred during the first two very wet years. The other treatments which are not presented followed a similar trend. Pasture parameters were more affected by seasonal conditions than treatments. The viable seedbank of Desert blue is very small and suitable recruitment events to drive land condition improvements did not occur during the study (Table 1). Wiregrass density was not affected by spelling treatments and yield decreased with dry conditions.

Table 1. The effect of resting strategies on key pasture parameters at Monteagle*.

Stocking rate	Pasture parameter	Grass taxon	Date	Treatment	
				Grazed	Full wet season annual resting
Moderate	Density (plants/m2)	Desert blue	Oct 2010	2.00	2.17
			May 2015	4.12	6.17
		Wiregrass	Oct 2010	16.80	12.30
			May 2015	14.10	13.60
	Yield (kg/ha)	Desert blue	Oct 2010	625	905
			May 2015	508	879
		Wiregrass	Oct 2010	866	1160
			May 2015	444	615
				All treatments	
	Seed bank (seed/m2)	Desert blue	Sep 2011	5	
			Sep 2014	30	
		Wiregrass	Sep 2011	22	
			Sep 2014	171	

*No significant differences between treatments were detected

Wambiana
Pasture parameters all declined with the very dry seasonal conditions. Desert blue and wiregrass yields and density were higher with a moderate stocking rate. The viable seedbank of Desert blue was very small and suitable recruitment events to drive land condition improvements did not occur during the study (Table 2).

Table 2. The effect of resting strategies on key pasture parameters at Wambiana*.

Stocking rate	Pasture parameter	Grass taxon	Date	Treatment	
				Grazed	Full wet season annual resting
Moderate	Density (plants/m2)	Desert blue	Nov 2012	3.08	2.25
			May 2015	1.86	2.28
		Wiregrass	Nov 2012	11.5	13.4
			May 2015	15.5	12.9
	Yield (kg/ha)	Desert blue	Nov 2012	51	107
			May 2015	30	88
		Wiregrass	Nov 2012	343	286
			May 2015	169	292
High	Density (plants/m2)	Desert blue	Nov 2012	2.75	1.92
			May 2015	1.68	1.61
		Wiregrass	Nov 2012	15.2	14.4
			May 2015	8.3	13.6
	Yield (kg/ha)	Desert blue	Nov 2012	66	44
			May 2015	7	11
		Wiregrass	Nov 2012	206	224
			May 2015	10 b	28 a
Moderate and high				All treatments	
	Seed bank (seed/m2)	Desert blue	Sep 2012	0	
			Sep 2014	2	
		Wiregrass	Sep 2012	23	
			Sep 2014	44	

*Means followed by different letters are significantly different (*P*=<0.05)

Discussion
The importance of a moderate stocking rate is critical given the modest response to resting. The Wambiana trial showed a rapid and severe decline in Desert blue yield under a high stocking rate and this was exacerbated with drought. Our results reinforce the need to set stocking rate around long term carrying capacity. Resting, in conjunction with a moderate stocking rate, will result in better Desert blue density and also forage reserves. Scanlan *et al.* (2014) has modelled these processes under similar conditions and found that moderate stocking rate and a period of 10 years was necessary for land condition improvement.

The trial has shown the negative consequences on pastures from a high stocking rate. Flexibility in management is required when resting. During drought if paddocks are subject to heavy grazing associated with the resting of other paddocks, the net result can be negative. Stock numbers should be adjusted to the amount of forage available.

A viable seedbank of the desirable perennial grasses (mainly Desert blue) and a subsequent recruitment event are critical for land condition improvement. Neither occurred at either site despite some very wet conditions initially. This appears to be the underlying cause for the lack of a substantial improvement in land condition at both sites. Small improvements in land condition were only recorded under the moderate stocking rate.

Within ‘C’ condition land there are areas of bare soil, however there is also competition from non-3P grasses which potentially prevent an increase in crown cover and composition of the 3P grasses. Both

sites had a high proportion of wiregrasses and varying levels of Indian couch (*Bothriochloa pertusa*), Mountain Wanderrie (*Eriachne mucronata*) and Golden beardgrass (*Chrysopogon fallax*). The reasons for the competition from these grasses vary with the species - wiregrasses because they are mostly not grazed; Mountain wanderrie is long lived and mostly not grazed; Golden beardgrass is long-lived and palatable but has a large underground stem; and Indian couch spreads by runners and produces large numbers of germinable seeds. This competition could restrict increase in crown cover of existing 3P grasses and also the growth of their seedlings. Survival of germinated seeds in this situation is often less than 1% (R. Silcock pers comm 2016).

Based on this research time frames in the order of 10 years are required before resting will likely have an impact on land condition and productivity. Where a viable seedbank is present, and good seasonal conditions prevail for germination and establishment of 3P grasses, this timeframe may be considerably shorter. The ecological processes around episodic climatic events are not fully understood. However, the knowledge that a moderate stocking rate is necessary for these improvements to accrue is an important finding of this project.

The lack of recruitment of Desert blue is the main reason that pasture condition has not improved. A lack of information on the population biology of Desert blue, particularly reproduction by seed and growing points, is seen as a major deficiency in understanding the current results. However, there is strong confidence that land condition will improve with resting and good grazing management, although it will take longer to measure than initially envisaged. Further monitoring and research on the impact of resting on key pasture species to better understand land condition changes under conservative management practice is planned for the Wambiana site.

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