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# Tactical grazing: an evaluation in eastern semi-arid woodlands

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## Abstract

Transition from an open wooded grassland state to a shrubby woodland state, and the reverse, is driven by the agents of prolonged rainfall events, drought, fire and grazing. We altered the grazing regimes over a 10-year period at 10 widely spaced sites in the north west of the Murray Darling Basin, to examine whether a transition can be achieved by resting from grazing alone. The three grazing regimes were: tactical grazing, continuous grazing and no grazing. Statistically significant year x treatment interactions for grass density were found at only three sites and for shrub density, at six sites. Provisional conclusions from the data are that tactical grazing has a role in the transition to grass dominance in semi-arid woodlands but the change is equivocal.

## Introduction

Graziers use mixes of strategies to manage paddocks for sustainable animal and forage production in the semi-arid woodlands (Heywood et al. 2000). Each property is unique and no one particular strategy can meet all situations across the semi-arid woodlands. Graziers modify and adapt various elements to achieve their grazing management outcomes. By far the most important element is the selection of optimum grazing pressure (Wilson et al. 1988). However, in semi-arid woodlands, where forage vegetation lacks resilience, knowing when to rest landscapes from grazing is a challenge for management, as it is not intuitive. An

approach to the required management was developed (Hodgkinson 1992) and named tactical grazing (Hodgkinson 1994).

Simulation of the financial returns from and forage production for a wether sheep enterprise nominally at Cobar, indicated that tactical grazing based on agistment early in droughts, would outperform continuous grazing, especially at higher stocking rates (Hodgkinson et al. 1999). Research at CSIRO's "Lake Mere" site (south-west of Bourke) identified grazing height and rainfall as the main drivers of perennial grass mortality and these led to development of the death-trap model, where the "trap" is set by grazing and sprung by drought (Hodgkinson 1995, Hacker et al. 2006). This model underpinned the tactical grazing system, defined as the deliberate resting of a paddock when certain criteria are reached to achieve a desired improvement in, or maintenance of, forage potential. The approach is tactical; seizing opportunities to change vegetation for the better and avoiding the hazard of losing palatable grass during critical times (Westoby et al. 1989). Initial thinking on the implementation of tactical grazing at a property level indicated that the system could be applied (Hacker and Hodgkinson 1995).

Here we introduce an evaluation of the effects of tactical grazing, absence of grazing, and continuous grazing, on palatable perennial grasses and shrubs in dysfunctional landscapes at ten locations in eastern semi-arid woodlands.

## Methods

### *Site selection*

Ten sites were selected (Fig.1) in the northwestern quarter of the Murray-Darling Basin. Criteria for selection were; domestic sheep to be a herbivore in the paddock, distance from permanent and/or temporary waters in the paddock not to exceed 5 km, soil type to be red earth, a rain gauge to be within 5 km of the site and regularly read, site rainfalls to span the N-S gradient of summer-dominant to non-seasonal rainfall and the W-E gradient of 300 to 500 mm of annual rainfall, either one or both of the perennial C3 grasses *Monachather paradoxa* and *Thyridolepis mitchelliana* to be present, the linked "run-off" and "run-on" zones of the landscape to be available, landscapes to be moderately to severely dysfunctional (Ludwig and 1995), poorly capturing, retaining and utilising scarce resources

(water and nutrients) within the “linked” landscape (Tongway and Ludwig 1997) and property owners to be interested in, and committed to, a research partnership for 10 years.



*Fig.1. Pastoral properties (solid circles) selected for standardised grazing treatments. Boundary of the Murray-Darling Basin, two major towns in the north-west of the Basin (open circles) and major rivers are shown.*

### *Grazing treatments*

At each site, three grazing treatments were established in 1996:

1. no grazing (exclusion of large-herbivores),
2. tactical grazing (rested from large-herbivore grazing when drought begins) and
3. continuous grazing (open to multi-species large-herbivore grazing).

Treatments were adjacent and 3000 m<sup>2</sup> (30 x 100 m) in area. Long axes were orientated down the slopes. Species of large herbivores common to each site were domestic sheep, feral goats, and kangaroos; cattle, rabbits and pigs sometimes grazed at sites.

The perimeters of the no grazing treatments were permanently fenced to a height of 2 m to exclude all large herbivores, especially high-jumping kangaroos. The tactical grazing treatments were fenced in the same manner except the 30 m long end fences were not permanently erected but were capable of being raised or lowered by one person to open or

close the treatment area to herbivore grazing. The continuous grazing treatment was unfenced and always available for grazing by herbivores.

Any one of three rules was used to decide whether to close to grazing the tactical grazing treatment:

1. rainfall total over the previous 3 months was below 75 mm and remained below 50 mm for the next 2 months (see Hodgkinson and Muller 2005) or
2. the average grazed height of palatable perennial grasses reached or fell below 10 cm or
3. there had been sufficient rain for the grasses to flower and set viable seed.

The opening of the area to grazing was based on the total rainfall over the previous 3 months exceeding 75 mm or that perennial grasses had regrown to a height of at least 15 cm or the seed had ripened and was mostly shed.

#### *Plant density and composition estimations*

The density and botanical composition of the grasses and shrubs in each treatment were estimated, annually or biennially, in the spring.

The density and botanical composition of the shrubs and grasses were estimated by the joint point and nearest-neighbour technique (Batcheler 1971). In each treatment plot, three 100 m long transects, parallel and 7.5 m apart, were laid downslope.

Distances were measured from sample points 5m apart along the line transects, to the nearest member of the populations of grass and shrubs, from that member to its nearest neighbour in the same population. The point - to - nearest member was used to estimate density, which is characteristically unbiased if the population is random, but biased if the population is uniformly or contagiously distributed. The bias was corrected by an exponential function of the sum of the distances divided by the sum of the nearest-neighbour distances. The distances provide an index of departure from randomness.

The species of shrub or grass plants closest to each point along the lines, was used to estimate the botanical composition of the populations of grasses and shrubs at each grazing treatment area

## Results

### *Site characteristics*

Distances from treatments to permanent water ranged from 0.3 to 4.7 km and to temporary water ranged from 0.03 to >3.3 km. The dominant trees at a site were either *Eucalyptus ochrophloia*, *E. opaca*, *E. populnea*, *Geijera parviflora* or *Grevillia striata*. The dominant shrubs at a site were either *Acacia aneura*, *A. tetragonophylla*, *Eremophila gilesii*, *E. mitchellii*, *E. sturtii*, or *Senna artemisioides*. The dominant grasses at a site were either *Austrostipa scabra*, *Aristida contorta*, *A. jerichoensis*, *Digitaria brownii* or *Thyridolepis mitchelliana*. Slopes, proportions of landscape zones, soil textures and other attributes, differed between sites.

### *Rainfall*

Depicted in Fig. 2 is the 3 monthly running rainfall totals for the two most eastern sites (“Alice Downs” and “Woodlands”) and the most western site “Moble”. Although there were differences in seasonal patterns of rainfall, the variability in space and time was considerable. The large spatial variation in the histories enables an interpretation of vegetation changes at sites based on spatial differences in rainfall.

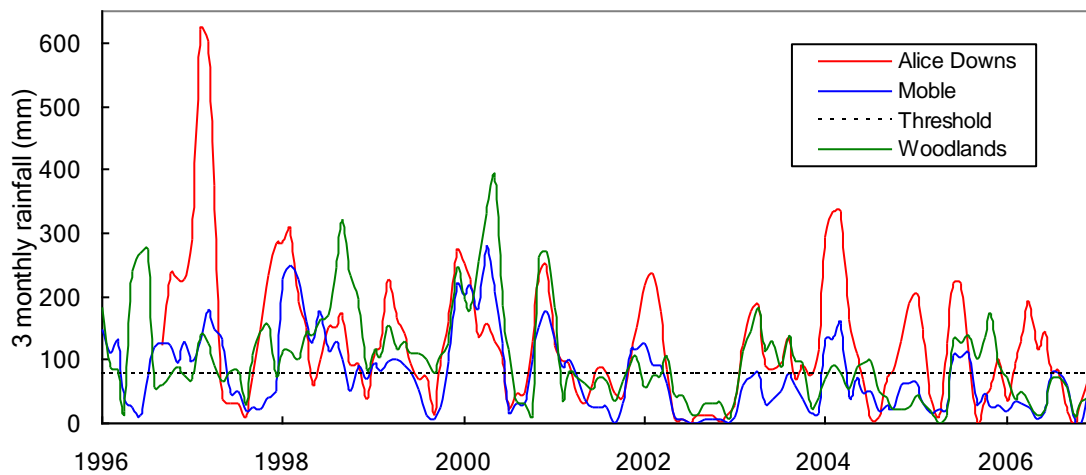


Fig. 2. Rainfall (mm) as a 3-month running total at three sites during the period 1996 to 2006. The dotted black line is the critical threshold below which death of grasses begins – (see Hodgkinson and Muller 2005).

### Shrub density

In 1996, shrub density differed widely between sites (0.4 to 55.4 shrubs/100 m<sup>2</sup>), a 138 fold range. The ANOVA for each site established that at all sites there was significant change in density over time and at six sites there was a significant treatment x time interaction (P < 0.001 for “Alice Downs”, “Autumnvale”, “Bulgoo”, “Wallen”, P < 0.01 for “Glenvue” and P < 0.05 for “Moble”).

### Grass density

In 1996, the grass density varied widely between sites (0.1 to 182.0 grasses/m<sup>2</sup>). The ANOVA for each site established there were significant changes in density over time and at three sites there was a significant treatment x time interaction (P < 0.001 for “Moble” and P < 0.05 for “Glenvue” and “Woodlands”).

### Shrub and grass density change at “Moble”

The rates and trajectories of change in shrub and grass densities (Fig.3) differed significantly. In all treatments shrub density declined after 2002 resulting in a reduction compared with the starting density in both the no grazing and the continuous grazing treatments. Low rainfall reduced grass density to very low levels in all treatments by 2006 but tactical grazing generally resulted in higher densities than continuous grazing.

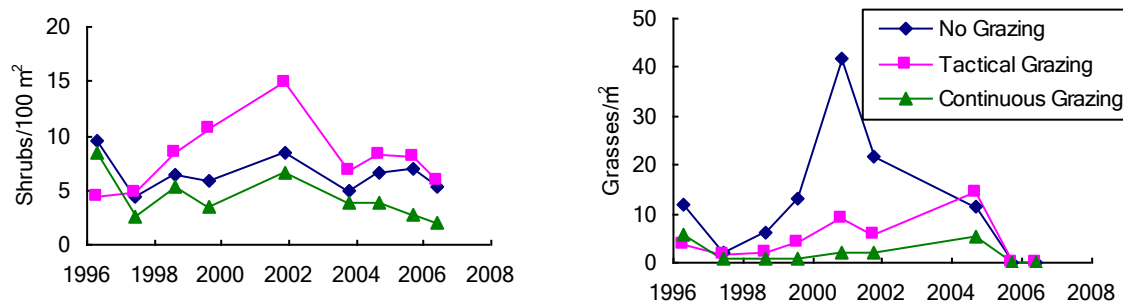


Fig. 3. Shrub and grass densities in three grazing treatments at “Moble” during the period 1996 to 2006.

## Discussion

The preliminary examination of the data described here indicates that the trajectories for the grazing treatments at each of the 10 sites differ, especially for the shrub populations. Although this is not a new insight, the data is from widely spaced sites and detailed statistical analysis should indicate when the trajectories at each site are different. The co-measurement of 10 sites similarly treated, does overcome the criticism that grazing studies at single sites are time and location dependant and therefore of limited value. The criticism that the measurements are not long-term may have some validity however, as transition from shrub to grass dominance is likely to be hysteretic in trajectory.

Vegetation change at the 10 sites will be examined using event- driven or episodic processes that occur on a decade or longer timescale. A caution has been issued (Watson et al. 1996) against thinking that management recommendations must also be event-driven. They conclude that for management purposes, appropriate models of change in rangeland systems should include a balance between the effects of infrequent, unpredictable events and the effects of more continuous processes, measured in timescales of years or less. We will in the near future grapple with the management implications of our findings but it is nevertheless clear that rangeland management will always have both tactical and continuous components, such as continuously building up a seed bank of preferred species to provide the opportunity to alter vegetation when the rains required to germinate and establish new plants episodically arrive.

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