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The effects of fire on grazed Mitchell Grass pastures in the East Kimberley: a case study

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Abstract

Mitchell Grass pastures are valued for their high carrying capacity and traditionally there has been some reluctance to use fire in their management. The effects of fire in a cattle grazing context were documented on Flora Valley station, in the East Kimberley region of Western Australia.

Two sets of sites (0.13 ha), paired on either side of an access track, were established within each of two 'black soil' paddocks. These were subject to normal station management. Plant frequencies were monitored in most years over 1995-2010, using a protocol similar to that for grassland sites in the Western Australian Rangeland Monitoring System (WARMS). Pasture composition and total standing dry matter (TDSM) were also estimated.

The number of fires at individual sites varied from one to seven; timing of fires varied from August to November. Most had no detectable effect on the frequency of two key perennial species – *Astrebla pectinata* (Barley Mitchell Grass) and *Chrysopogon fallax* (Ribbon Grass). Ribbon Grass frequency increased over the study at five of six sites where it was initially recorded. At one site, a reduction in Ribbon Grass frequency following a small-scale fire appeared to be associated with heavy post-fire grazing. There was some evidence that fires in one year may have reduced the subsequent frequency of Flinders Grass (*Iseilema vaginiflorum*), a useful annual. Values of TSDM at sites burnt in the previous year were extremely low in two years with below average wet-season rainfall, highlighting the need for careful assessment of risks when planning fire management for these pastures.

Introduction

We present initial results from a case study conducted on Flora Valley station, in the East Kimberley region of Western Australia, between 1994 and 2010. It was one of a number of studies by the Department of Agriculture and Food (DAFWA), working cooperatively with pastoral lessees and managers. The general aim was to explore the effects of fire, and its interaction with cattle grazing, on important Kimberley pasture types. On Flora Valley station we studied grasslands on alluvial cracking clays ('black soil'), characterised by the presence of Mitchell grasses (*Astrebla* spp.). These pastures have relatively high carrying capacities when in good condition and are highly regarded for pastoralism. Traditionally, managers have been reluctant to deliberately burn these pastures but interest has increased in using fire to remove rank growth, improve grazing distribution, and reduce losses and disruption caused by wildfires.

Methods

Study sites were chosen opportunistically within two paddocks (Mullalangg and Rocket) where fires started by lightning in late 1994 had left burnt and unburnt areas separated by access tracks. Two sets of paired sites (0.13 ha, initially burnt and unburnt) were established in each paddock, at 3-5 km from permanent water. Data collection began in June 1995. Site layout and sampling procedures were similar to those for grassland sites of the Western Australian Rangeland Monitoring System, which provides district-level information on trends in frequencies of perennial plants. Additional sampling was undertaken to estimate pasture composition, total standing dry matter, and species richness.

When monitoring, the fixed end-points of five parallel 50 m transects, 6.5 m apart, were marked with poles carrying flags. The observer walked from the start pole towards the end pole of each transect, placing a 70 cm square quadrat on the ground at paced intervals of *c.* 2.5 m, generating 20 samples per transect.

The following were recorded at each position:

- Species names of rooted living plants
- Species ranked 1-3 by estimated dry weight
- Recent grazing and dung

The frequency of a species (%) was defined as the number of times it was recorded in the 100 samples taken. Samples were treated as independent random and the statistical significance of differences was tested by applying chi-squared tests at the 5% level.

Total standing dry matter was estimated by clipping, oven-drying and weighing material from 15 quadrats, placed in a systematic-random manner within the plot. Areas within 1 m of each transect were excluded to minimize any effects on subsequent frequency samples.

Sites were visited yearly although there were some gaps in data collection. In 2005, a lack of growth precluded frequency sampling at two sites burnt in the previous year.

The occurrence of fire was inferred from changes in site appearance and in the condition of indicators – short lengths of plastic twine attached to steel pegs and pickets. The likely timing was arrived at through discussion with the manager and by referring to the North Australian Fire Information website. The number of fires at individual sites varied from one to seven; timing of fires varied from August to November. Cattle numbers in the study paddocks varied according to station requirements.

Initial Results

Barley Mitchell Grass (*Astrebla pectinata*), a perennial highly regarded for animal production, was common only at the Mullalangg sites. Sites F1 and F2, situated 2 km from water, experienced different numbers of fires (4 *vs* 1) but in neither case were frequency changes statistically significant (Fig. 1). Data for F1 in 2008 and 2009 are missing because heavy grazing made it difficult to distinguish between Barley Mitchell and Weeping Mitchell (*Astrebla elymoides*). A small increase in frequency was discernible from about 2003 onwards

at F3 (5 fires) and F4 (2 fires), which were further from water (5 km). Frequency ranking within paired sites remained stable during the study.

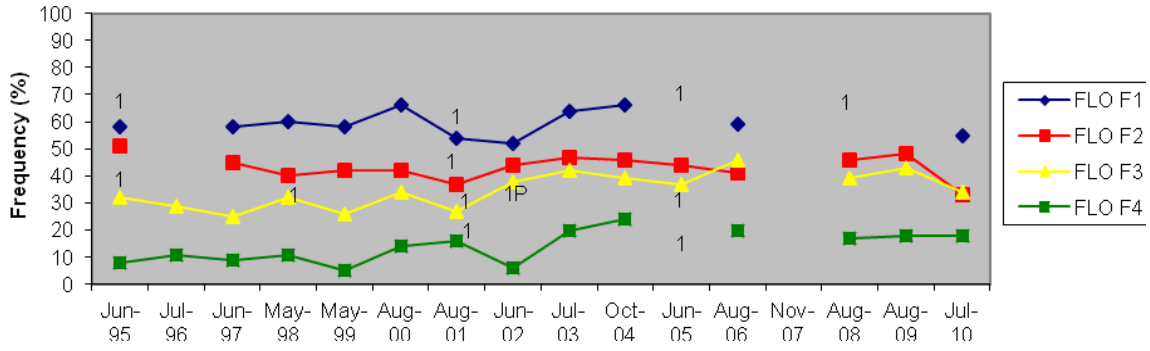

Fig. 1. Frequency of Barley Mitchell Grass at Mullalangg sites. Data label '1' indicates one wet season since fire, 'P' that fire was patchy.

Ribbon Grass (*Chrysopogon fallax*), a grazing- and drought-tolerant perennial of moderate palatability, was common at two Mullalangg sites and all Rocket sites (Fig. 2, 3). Its frequency increased over 1995-2010 at five of these sites, which experienced between one and seven fires. The proportion of Ribbon Grass in the stand, estimated from dry-weight ranks, also tended to increase, for example at site F8 (Fig. 4); the downward fluctuation in 2006 was associated with a temporary increase in annual sorghum.

Most fires had no detectable effect on Ribbon Grass frequency. One fire that probably did have an effect occurred at site F1 in 2007. Frequency there declined from 97% in 2006 to 81% in 2010. In contrast, it remained stable over this period (non-significant increase) at the paired unburnt site (F2). The manager reported the occurrence of a few spot fires in Mullalangg paddock in October 2007, ignited during a storm. It is assumed that F1 was affected by one such small-scale fire. This site had been heavily grazed when visited in 2008 and 2009 (August); recent grazing (irrespective of species) was noted in 99% and 98% of quadrats respectively. High frequencies of *grazed* Ribbon Grass were also observed (79% and 83%). Grazing at F2 was deemed 'insignificant' and 'very light' on these occasions. It is suggested that a concentration of stock on the regenerating area is likely to have contributed to the decline observed at site F1.

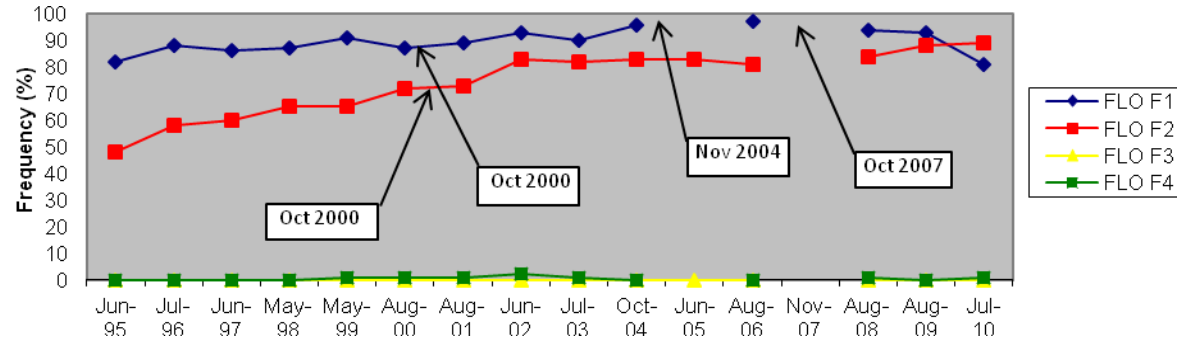

Fig. 2. Frequency of Ribbon Grass at Mullalangg sites, showing fires at F1, F2.

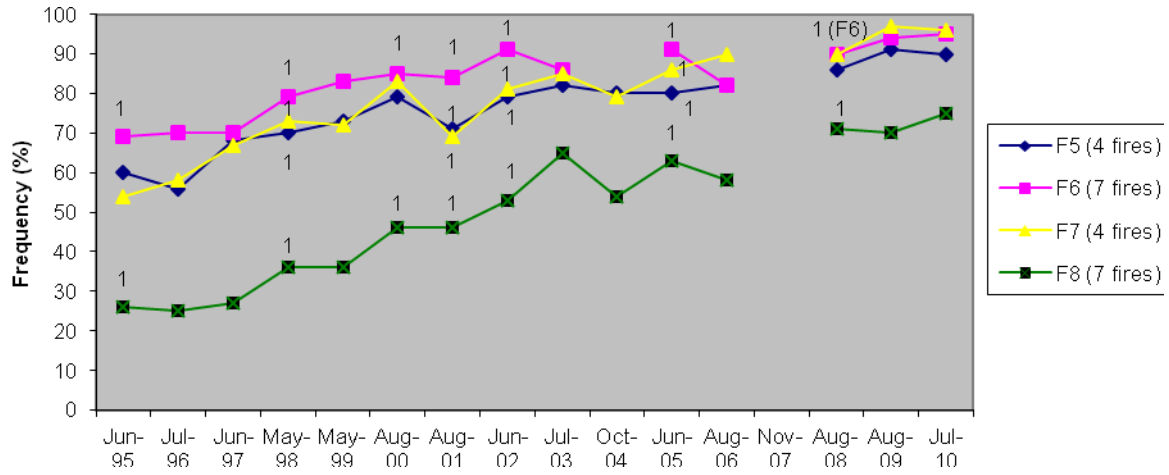

Fig. 3. Frequency of Ribbon Grass at Rocket sites. Data label '1' indicates one wet season since fire.

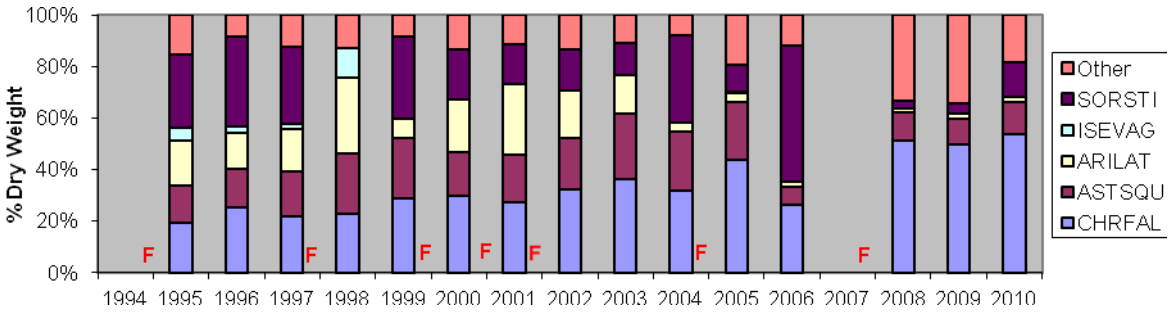

Fig. 4. Pasture composition at site F8, showing fires (F). Species are: *Sorghum stipoideum, Iseilema vaginiflorum, Aristida latifolia, Astrebla squarrosa* and *Chrysopogon fallax*.

Flinders Grass (*Iseilema vaginiflorum*) is a palatable annual with high levels of protein in young growth, considered useful by pastoralists. As expected, its frequency varied more from year to year than was the case for the main perennial grasses. For example, in Mullalangg there were large declines at sites F3 and F4 between 1997 and 1998 (Fig. 5). Since only F3 was affected by an intervening fire (November) it seems likely that poor seasonal conditions over the 1997/98 wet season were mainly responsible for these declines. Frequency at both sites recovered strongly over the next two years, following wet seasons with above-average rainfall.

Although no unburnt sites were available for comparison, it can be speculated that fires occurring in late 2000 had a negative effect on Flinders Grass abundance in Mullalangg, particularly at sites F2 and F4, where frequencies fell sharply in 2001 despite high wet-season rainfall (998 mm) and very light grazing. Declines were observed at the other two Mullalangg sites (also burnt), but not until the following year. By 2003, Flinders Grass frequencies had fallen to ≤10% at all sites and showed only limited recovery thereafter.

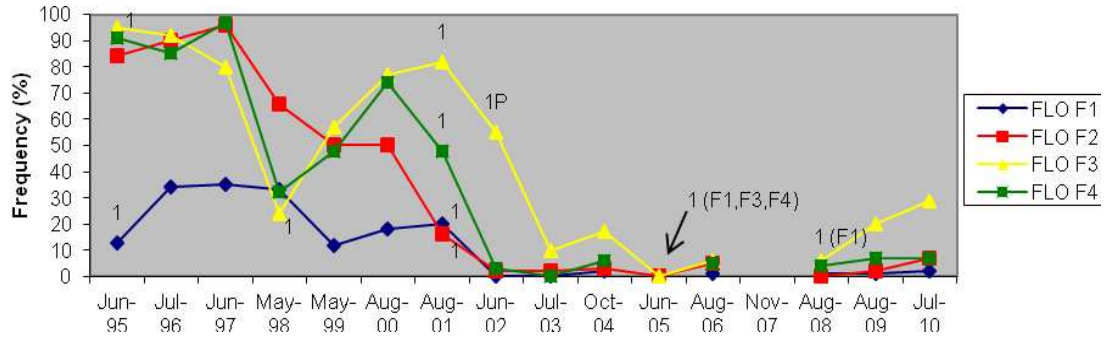

Fig. 5. Frequency of Flinders Grass at Mullalangg sites; data labels as for Fig.1.

Total standing dry matter (TSDM) varied considerably between years, even at a site burnt only once (F2, Fig. 6). At F1, which was burnt four times, the range was between 5670 ± 555 kg/ha (2000) and 100 ±12 kg/ha (2005). Recovery after a fire was often rapid, with rough similarity in TDSM between a burnt site and its unburnt counterpart after two wet seasons. The TSDM estimates at sites burnt in the previous year were particularly low in 1998 and 2005, in comparison with sites recovering from fire in other years (Fig. 9). The poor responses in these years should be attributed mainly to unfavourable seasons because in each case TSDM recovered strongly with increased rainfall in the following year. Homestead rainfalls over the 1997/98 and 2004/05 wet seasons (November-April) were only 367 and 213 mm, whereas the average during the study was 580 mm.

The slow recovery in TSDM at F1 following the October 2007 fire is noteworthy (Fig. 6). Heavy post-fire grazing at this site in 2008 and 2009 was discussed above in relation to Ribbon Grass frequency. In July 2010, grazing was judged light but grasses were short in stature. Estimated TSDM at two unburnt Mullalangg sites (F2, F4) did not change significantly between 2009 and 2010, suggesting mediocre growth conditions.

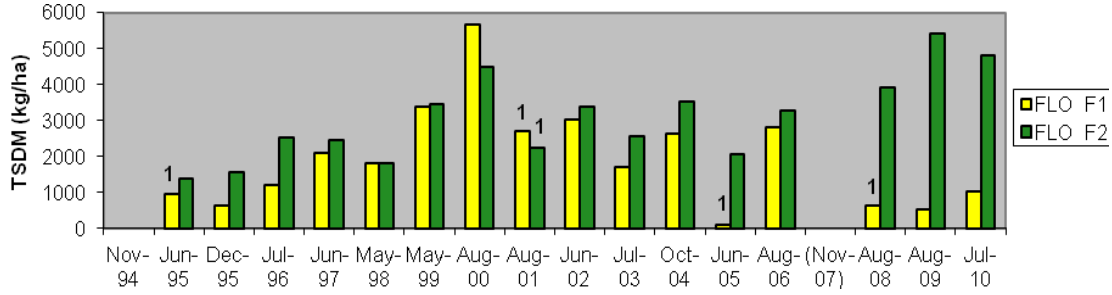

Fig. 6. Total standing dry matter at sites F1, F2. Data labels indicate one wet season since fire.

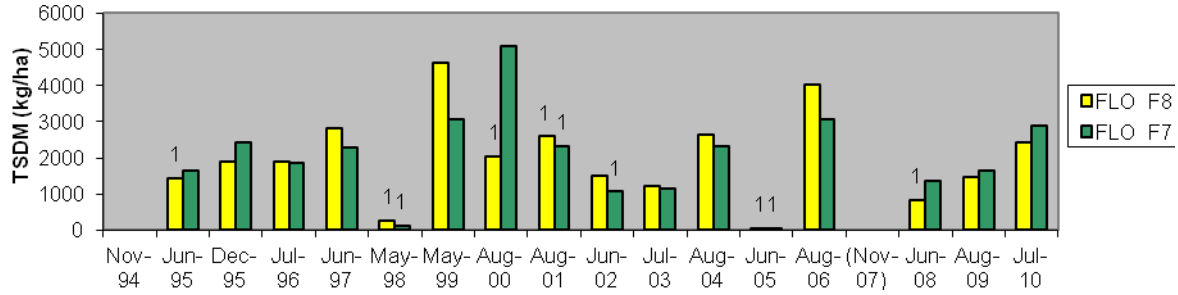

Fig. 7. Total standing dry matter at sites F7, F8.

Conclusion

The results of this study suggest that two important components of Mitchell Grass pastures in the East Kimberley, Barley Mitchell Grass and Ribbon Grass, are resilient to late fires, but also confirm the need to avoid situations where stock may concentrate grazing on small areas of burnt country. The extremely low levels of post-fire regrowth recorded in two of the years studied demonstrate the need for careful assessment of risks when planning fire management for these pastures.

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