STRIKE THE MATCH, STRIKE THE BALANCE?: CATTLE, TREES AND FIRE IN THE GULF SAVANNAS OF NORTH QUEENSLAND.

D.M. Nicholas[1,] A.C. Grice [1], L.V. Whiteman[1], J. Kernot[2]

[1] CSIRO Sustainable Ecosystems Davies Laboratory, Townsville, Qld 4814
[2] Dept Primary Industries & Fisheries, Mareeba, Qld 4880

Email: Mike.Nicholas@csiro.au

INTRODUCTION

Grassy savannas in northern Australia have been reported to be becoming increasingly shrubby, probably as a result of altered grass/fire dynamics following herbivore activity associated with pastoralism (Sharp & Whittaker, 2003; Burrows *et al*, 2002; Neldner *et al*, 1997; Crowley & Garnett, 1998). Anecdotal and photographic records (Lewis, 2002) support this idea.

Increasing woodiness of the northern Gulf savannas has led to increasing mustering and management costs for producers (McLay *pers comm.,* Keough *pers comm.)* and reduced grass biomass in wooded areas. This has been associated with reduced profitability and increasing grazing pressure on adjacent, more open areas of the woodlands. Inevitably these areas become overgrazed and degraded, compounding the capacity of the landscape to provide for sustainable grazing.

In an attempt to shift the rangelands away from a woody under-storey towards a grass dominated layer a series of controlled late season high intensity fires were planned. At a series of meetings with pastoralists of the northern gulf savannas, they indicated which under-storey species were considered to be increasing in density and creating management difficulties. A multitude of native species, including members of the genera *Eucalyptus*, *Acacia*, *Terminalia*, *Melaleuca* and *Erythrophleum*, were suggested as reaching undesirable densities. However, the native species gutta percha (*Excoecaria parvifolia*) and breadfruit (G*ardenia vilhelmii)* were considered to be the species about which there was the most concern.

The producers provided sites at which to investigate the use of fire as a means of reducing the density of the shrubby under-storey and imposed fires according to their management requirements. These sites were large enough to provide realistic and achievable prescribed burns appropriate to pastoralist’s expectations.

MATERIALS & METHODS

Research sites were selected on five properties ranging from north of Georgetown to west of Normanton in eucalypt woodland with an under-storey dominated by either G*ardenia vilhelmii* or by *Excoecaria parvifolia*. One gutta percha site at Normanton did not have a eucalypt over story.

At each site a minimum of eight 50x4 m transects were randomly located within an area of a paddock to be burned with a further eight transects located in an adjacent section of the paddock that was not to be burned. Prior to the imposition of any prescribed fires, the following data were collected from every individual tree or shrub present on the transects:

(i) location, as distance along and distance away from the mid-line of transect
(ii) diameter of each stem, measured 30 cm above the ground
(iii) number of stems
(iv) height of each stem, measured to the highest living leaf categorized by height-class 0-49cm, 50-249cm and >250cm.

The double-rank sampling technique BOTANAL (Tothill *et al.*, 1992) was used to estimate grass biomass annually in the mid dry season and species composition was recorded at the final assessment in 2007. The sites were either destocked or lightly stocked specifically to preserve grass as fuel for burning and were not restocked until the wet season following fire. Grass yields immediately prior to prescribed burning were not estimated because decisions to burn were dependant on local weather conditions and producer work schedules and researchers could not always be present.

Fire treatments were imposed by producers in the transition period at the end of the dry season and immediately prior to the onset of the tropical monsoon season generally following a substantial rainfall event.

Table 1. Times of burning at research sites.

Site / Year	**2002**	**2003**	**2004**	**2005**	**2006**
Abingdon Downs	-	January	November	December	December
Delta Downs	-	-	-	January	December
Forest Home	August	October	-	-	
Oakland Park	December	October	-	-	November
Woodview	December	-	November	December	November

RESULTS

After the first fire treatment in 2002/2003, 79% of *G. vilhelmii* shrubs were less than 50 cm high compared to the unburnt sites where 5% of shrubs were below 50cm. Following subsequent fires (2004–2006) 89% of shrubs were less than 50 cm high compared to the unburnt treatment where 39% were less than 50 cm high. Shrubs in the >250 cm class changed from 18% to 4% while the unburnt plots averaged 32% of the population.

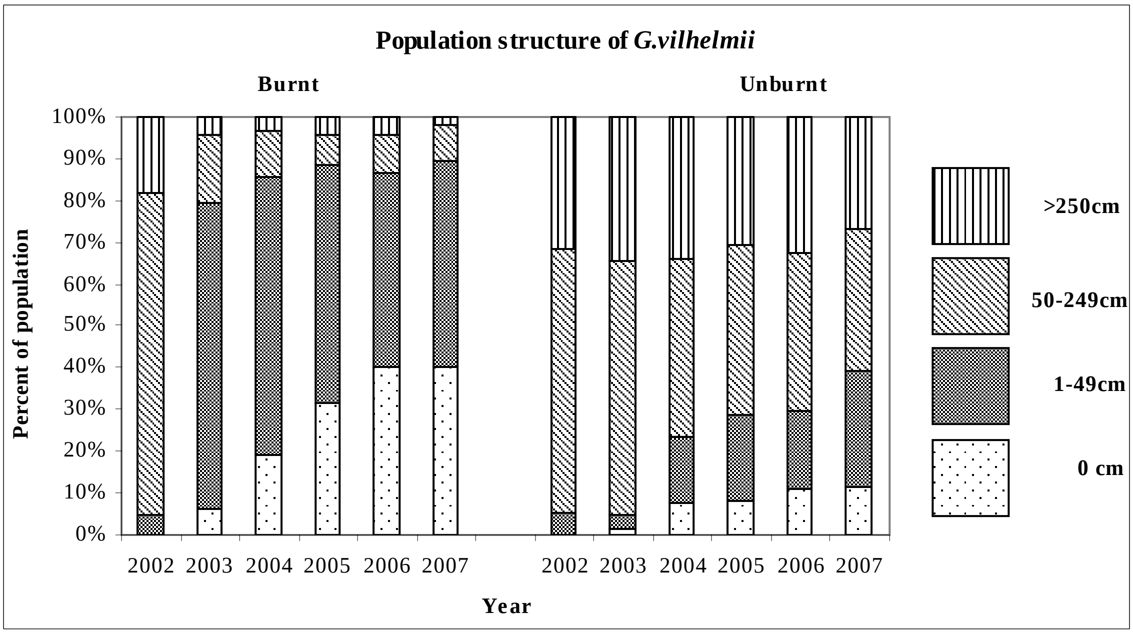

Figure 1 Changes in population structure of G*ardenia vilhelmii* following the imposition of controlled burns.

After fire treatments were imposed between 2002 and 2006 mortality in the *E parvifolia* population changed from 33% in 2003 and rose to 74% in 2007. During the same period shrubs in the 50 -249 cm class reduced from 45% to 5%, while shrubs in the greater than 250cm class reduced from 55% to 20% of the population. The unburnt plots maintained a stable population structure until 2005. However a wild fire burnt a portion of the control plots in December 2004 thus increasing mortality in the unburnt plots.

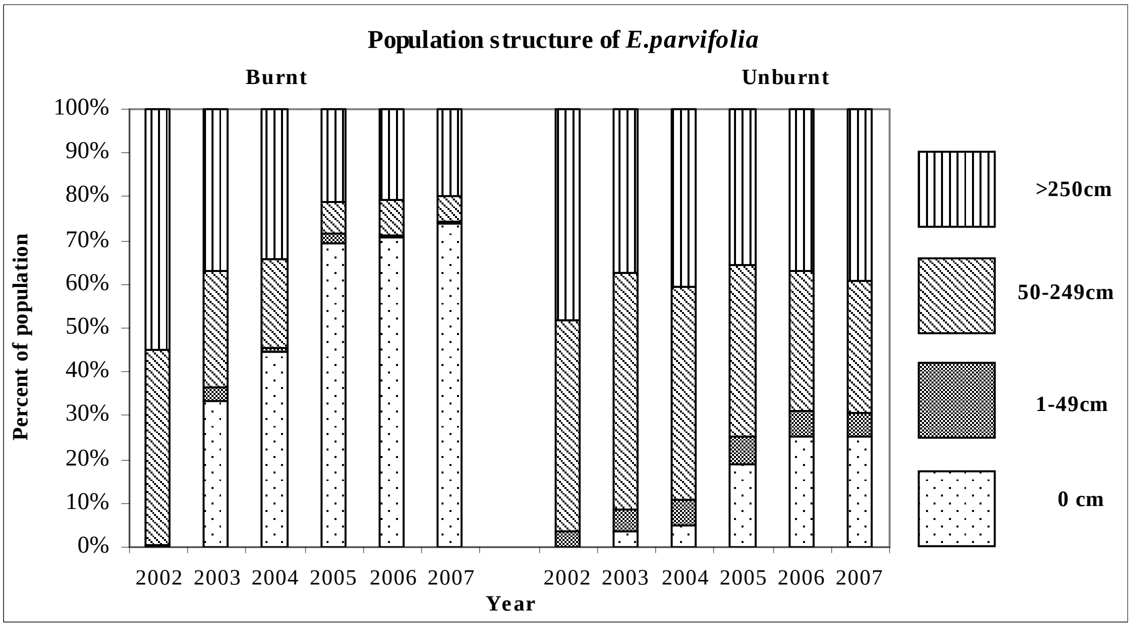

Figure 2. Changes in population structure of *Exocaria parvifolia* following the imposition of controlled burns.

Grass yields were consistently higher following fires and subsequent wet seasons across all locations compared with unburned plots. They were 568 kg/ha higher in 2003, 540 kg/ha higher in 2004, 63 kg/ha higher in 2005, 854 kg/ha higher in 2006 and 537 kg/ha higher in 2007.
Grass species composition altered following fire with an increase in *Heterpogon contortus* from 7% in the unburnt site to 23% in the burnt sites. After fire, *Hyptis suaveolens* made up 18% of above-ground biomass on unburnt plots compared with 3% on the burnt treatment.

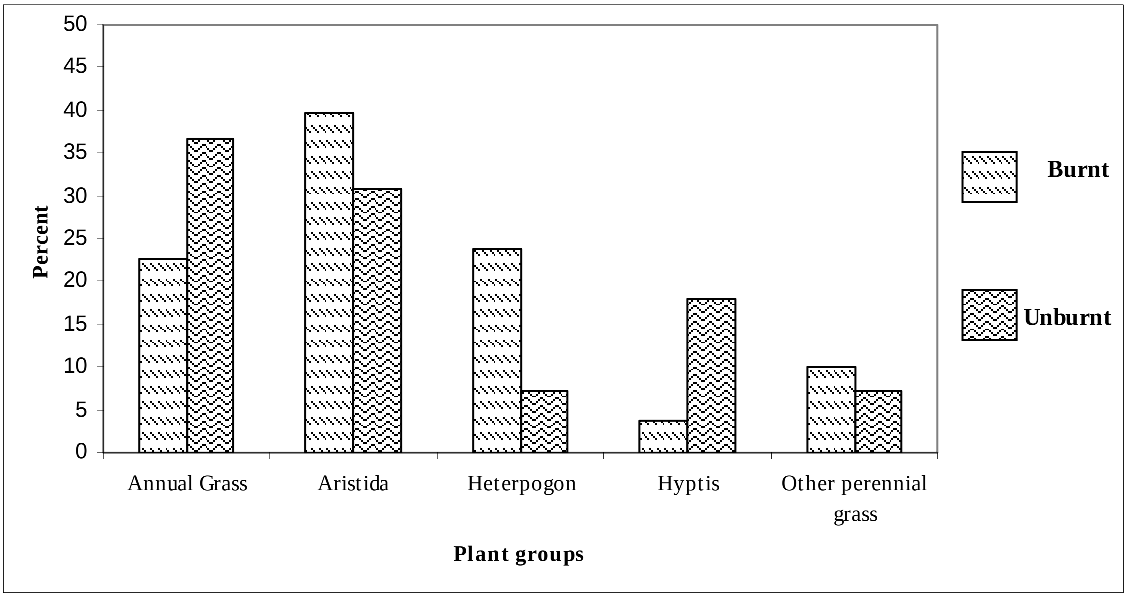

Figure 3. Percentage of plant taxa in above-ground biomass at one site at the final assessment**.**

DISCUSSION

While it is still uncertain how altered fire regimes have changed the shrub dynamics of the Gulf savannas, the data presented here suggest that increases in some woody understorey species can be reversed using late dry season burning. Critical to the effectiveness of this burning strategy is appropriate grazing management to allow for the build up of sufficient grass fuel to ensure a fire of an intensity that will affect shrub populations. Also, grass yield increased and species composition shifted toward perennial grasses following the use of fire. These changes in composition of the woody and herbaceous components of the vegetation may improve the profitability of the pastoral enterprise. Cattle production may increase as a result of increased access to and availability of forage while mustering and other management costs may be lower because of altered vegetation structure. Another potentially important consideration is how these changes may affect greenhouse gas accounting in these systems. It will be important to understand how the balance of woody and herbaceous components influences the carbon cycle and the role that fire plays in this dynamic. The economics of pastoral enterprises will be influenced by carbon trading and so by how fire is used to manage the vegetation. This will be one component of grazing enterprise profitability. The capacity of grazing enterprises to cope with the cost-price squeeze may be improved by increased carrying capacity but must also take into consideration carbon economics.

ACKNOWLEDGEMENTS

The authors would like to acknowledge the Meat and Livestock Australia, Northern Gulf Resource Management Group and Tropical Savannas-CRC for funding and the owners and managers of Abdingdon Downs, Oakland Park, Forest Home, Woodview and Delta Downs for assisting with and allowing the research to be undertaken on their properties.

REFERENCES

W.H Burrows *et al* (2002). Growth and carbon stock exchange in eucalypt woodlands in northeast Australia: ecological and greenhouse sink implications. *Global Change Biology* **8**: 769-784

Darrell Lewis (2002). Slower than the eye can see: Environmental change in the Victoria River District since European settlement, 140 pp. Tropical Savannas CRC, Darwin.

V.J Neldner, R.J Fensham, J.R Clarkson and J.P Stanton (1997). The natural grasslands of Cape York Peninsula, Australia. Description and conservation status. *Biological Conservation* **81**: 121 – 136.

Ben R. Sharp and Robert J. Whittaker (2003). . The irreversible cattle-driven transformation of a seasonally flooded Australian savanna. *Journal of Biogeography* **30**: 783-802.

Tothill, J.C., Hargreaves, J.N.G., Jones, R.M. & McDonald, C.K. (1992). A comprehensive sampling and computing procedure for estimating pasture yield and composition. 1. Field sampling. *CSIRO Division of Tropical Crops and Pastures Tropical Agronomy Technical Memorandum No 78.*