

final report

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Woodland management and woody weed control for Queensland beef pastures

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Woodland management and woody weed control for Queensland's beef pastures.

Project Final Report

MRC Project: NAP3.210

Duration: 01/07/96 to 30/6/01

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Project Objectives

1. To refine and modify integrated whole property management systems for the sustainable and economically viable use of the grazed eucalypt woodlands. This to be achieved by:-
 - Increasing our understanding of the dynamics and ecology of eucalypt woodlands by monitoring change in both undeveloped and 'cleared' situations.
 - Developing control techniques for specific emerging native woody weeds.
 - Further development of the decision support package 'Woody Weed Adviser'
 - Finalising the 'TRAPS' (Transect Recording And Processing System) manual and supporting software and promoting its use as a long term woodland monitoring tool.
2. To implement an effective communication strategy to achieve the industry goal.

Project Summary

About 60 M ha of Queensland's 76 M ha of woodland communities ('forest') are grazing lands that remain amenable to various degrees of responsible development. This could conceivably increase beef cattle carrying capacity by 1-2 M head and reduce turn-off times. Development principles derived should also be relevant to the Northern Territory's top half. This Project has provided a comprehensive set of quantitative data, as well as testing the methodology necessary, for a soundly based woodland management policy for these woodlands through:

- detailed descriptive studies of woodland structures
- by evaluating traditional and innovative development strategies
- by cataloguing available control measures for native and exotic woody weeds
- by testing new products, establishing field trials and using contemporary technology for data collection and processing, information exchange and decision support.

Project Final Report

1. Woodland Management and Ecological Studies of Eucalypt Woodlands:

(a) Eucalypt clearing strategies trial, "Wandobah", Dingo.

The core woodland development site at "Wandobah" near Dingo in Central Queensland has provided data on the effectiveness of a number of woodland development strategies and woody plant regrowth rates since the investigation commenced in 1987.

The experimental site was situated on "Wandobah", a beef cattle grazing property in the Dingo area of Central Queensland (Lat. 23° 36.4'S, Long. 149° 25.22'E). The woody vegetation is a *Eucalyptus populnea* dominant woodland in association with *E. tereticornis*, *E. crebra*, *E. papuana*, *E. clarksoniana*, *Flindersia dissosperma*, *Casuarina luehmannii*, *Ventilago viminalis* and *Acacia excelsa*.

Rainfall for the site (mean AAR 694mm) was below average in the establishment year, 1987, average or slightly above average for 1988-90, then well below average for the years 1991-97. Three above average years have followed this drought.

Six woodland management strategies were imposed in 1987. They are:

1. All woody plants above waist height killed by stem injection with Velpar L[®] (a.c. 250g/L hexazinone).
2. 80% of all trees (>7m tall) and all shrubs above waist height killed by stem injection with Tordon Timber Control Herbicide[®] (a.c. 50g/L picloram plus 100g/L triclopyr). The remaining 20% of trees left scattered as evenly as possible throughout the plot (savanna treatment).
3. All woody plants above waist height killed by stem injection with Tordon Timber Control Herbicide[®] in 80% of the area with the remaining untreated 20% of the plot retained as clumps.
4. 80% of the area treated with the aerially applied, root absorbed herbicide Graslan[®] pellets (a.c. 200g/kg tebuthiuron in a clay pellet) with the remaining untreated 20% of the area retained as strips.
5. All the trees in the plot pulled over using two bulldozers pulling a heavy chain between them. The treatment plots were then divided in two with one half fenced to exclude stock and burnt 30 months after pulling.
6. Untreated control.

The results of these initial treatments are given in Table 1.

An economic assessment model looking at these various strategies was developed in conjunction with Bill Holmes, Agricultural Economist with the DPI at Townsville. It allows comparisons to be made between the different woodland development options over time. The model demonstrates, for instance, the 'penalty' of retaining scattered trees while there is little difference in returns between clearing 100% of a wooded paddock and leaving 20% as intact woodland areas (Table 2).

All Woody Plants

Treatment	Woody Plant Number/ha		% Change	Basal Area m ² /ha		% Change
	1987	1994		1987	1994	
Strips Treat only	2075	479	-76.9	7.53	0.24	-96.8
Clumps Treat only	3875	2613	-32.6	9.50	0.59	-93.8
Pull and Burn	3171	2467	-22.2	9.60	0.89	-90.7
Stem Inject All	4211	2707	-35.7	8.61	1.08	-87.5
Pull Only	1880	2104	+11.9	11.90	3.49	-70.7
Strips All Plot	3134	1632	-47.9	8.51	3.32	-61.0
Clumps All Plot	3565	2886	-19.0	9.20	3.96	-57.0
Scattered Trees	2099	2028	-3.4	10.26	6.63	-35.4
Control No Treat	2430	2715	+11.7	8.67	10.46	+20.6

Poplar Box Only

Treatment	Woody Plant Number/ha		% Change	Basal Area* m ² /ha		% Change
	1987	1994		1987	1994	
Strips Treat only	523	55	-89.5	5.94	0.09	-98.5
Clumps Treat only	404	163	-59.7	7.45	0.29	-96.1
Pull and Burn	471	333	-29.3	6.17	0.60	-90.3
Stem Inject All	542	221	-59.2	6.22	0.46	-92.6
Pull Only	608	438	-28.0	11.01	2.78	-74.8
Strips All Plot	567	119	-79.0	5.39	1.62	-69.9
Clumps All Plot	384	219	-43.0	6.19	2.36	-61.9
Scattered Trees	508	417	-17.9	6.17	3.22	-47.8
Control No Treat	544	533	-2.0	6.51	7.99	+22.8

Note: Strips and clumps results are expressed on either a treated area or whole plot basis, which includes 20% of the plot untreated in retained strips and clumps. 20% of trees >7m tall were left in the scattered trees plots.

Table 1. The effect of various clearing strategies on woody plant number 7 years after treatment.

Assumptions:

- Paddock size 1000 ha – Different clearing strategy treatments were applied in 1987
- Stocking rates are determined by the GRASSMAN model (tree basal area resulting from each treatment determines potential pasture production which is stocked so as to consume 30% of the pasture on offer)
- Net Present Value (NPV) and Internal Rate of Return (IRR) are based on a 15 year time span and a 6% discount rate
- The purpose of this analysis is to compare *relative responses* between each treatment – not to prepare a statement of income. Therefore fixed costs are not considered. However interest on herd capital is charged at 10%.
- Steers enter paddock at 180 kg – leave at 450 kg
- Average rainfall is assumed for each year of the 15 year time frame

Treatment	Gross Values		Response relative to Control
	N.P.V.	I.R.R.	N.P.V.
Control (Trees untouched)	\$ 75 000		
Stem inject all trees	\$ 126 500	52%	\$ 51 500
Scattered (retain 20% trees)	\$ 54 000	32%	(\$ 21 000)*
Graslan (7.5kg/ha) 100% area	\$ 95 500	20%	\$ 20 500
Graslan (5kg/ha) 100% area	\$119 000	28%	\$ 44 000
Pull 100% area	\$ 93 000	44%	\$ 18 000
Pull & Burn 100% area	\$ 134 000	48%	\$ 59 000
Clumps (retain 20% trees) – stem inject	\$ 116 000		\$ 41 000
Strips (retain 20% trees) – pull & burn	\$ 122 000		\$ 47 000
Strips (Graslan 5kg/ha) – Retain 20% trees	\$ 110 000		\$ 35 000

* () = negative values

Table 2. Wandobah Tree Clearing Strategies Trial (Poplar Box) – Economic Analysis

Since 1994 regrowth treatments have been imposed on a number of the original treatment plots to reflect commercial practice. This has included stickraking (treatment 1, all 3 reps., treatment 5, reps. 2 and 3 only) in 1995 and stem injection of regrowth in treatments 1,2,3 and 4 in rep.1 only in 2000.

As part of this investigation Dendrometers have been used to accurately measure the growth of trees in the control (uncleared) and scattered trees (savanna) plots since 1987. These data show a strong correlation between increase in tree basal area (and hence biomass) and rainfall and demonstrate the increased tree growth rates that can be expected when competition is reduced through thinning (Fig. 1, 2).

This core woodland development site continues to provide data on regrowth rates following the initial clearing treatments in 1987 and subsequent treatments. All the permanent transects, recording the treatment effects, were re-recorded every two years. Because of the detailed monitoring undertaken at this site it has been used to collect data on woody plant biomass, soil carbon store and tree-grass relationships as they are affected by the various treatments imposed. The site has also been utilised in research projects involving staff of the Australian Bureau of Rural Sciences, CSIRO Division of Plant Industry and the DNRM Statewide Landcover And Trees Study (SLATS) group.

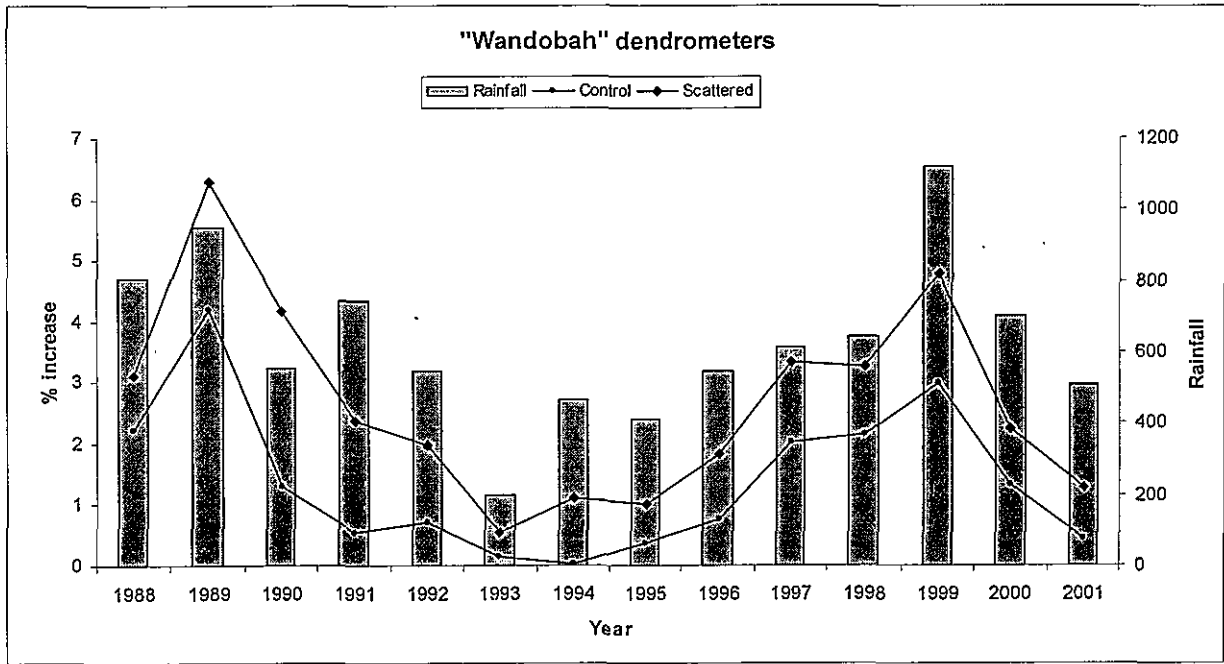


Figure 1. Changes in the circumferences of *Eucalyptus populnea* trees, as measured by dendrometers at ‘Wandobah’, Dingo. The measurements were made annually during August – September and the growth is shown as the mean increase in circumference (18 trees) for the preceding year. Mean annual rainfall for Dingo is 660mm.

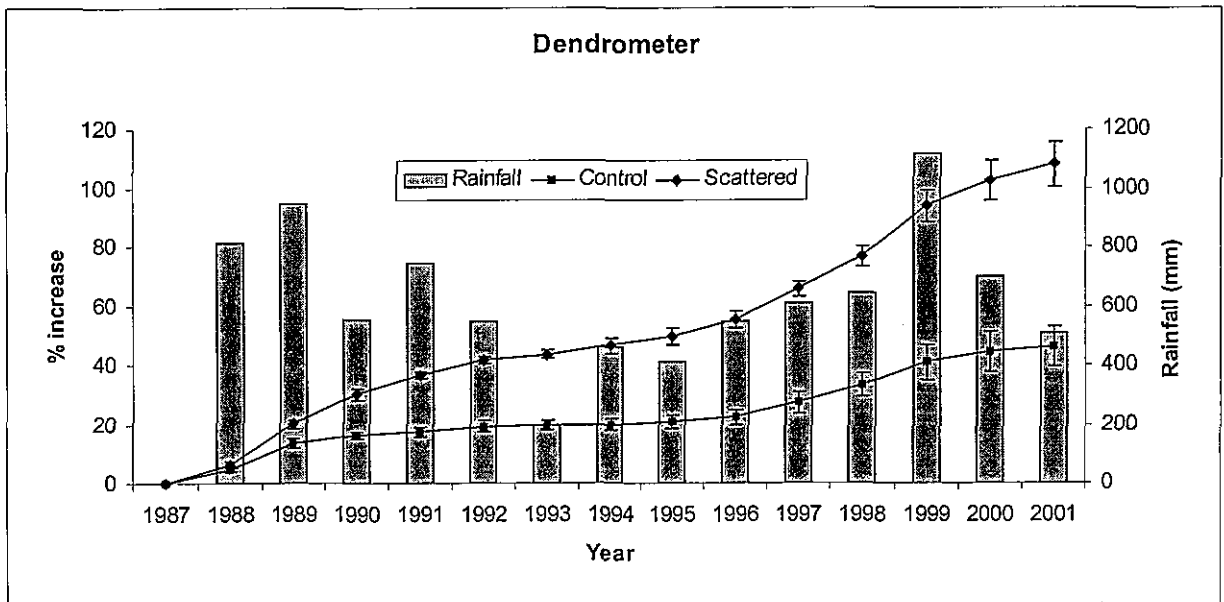


Figure 2. Cumulative increase in the basal area of *Eucalyptus populnea* trees as a proportion of the original basal area as measured using dendrometers at ‘Wandobah’.

The “Wandobah” site, and the insights gained from the work at the site, have been used for major woodland management field days and numerous field visits. These field visits have included Landcare groups, MLA Peer Review Group, an Expert Panel of the Inter-governmental Panel on Climate Change (IPCC), Vegetation management professionals, Beef 2000 tour and Agribusiness representatives. The site has also been the focus for a number of media presentations including Television, Radio and written publications (newspaper and farm journals).

(b). Woodland species dynamics

This project and its predecessors has supported the only comprehensive ground based monitoring of woody species populations in Queensland's grazed woodlands (60 M ha). Plant populations are recorded and data synthesised using the TRAPS (transect recording and processing system) network and software. The methodology is documented in Back (1999, 2001) and Back *et al.* (1997, 1999). It has also been widely used in synthesis studies (Back 1998, Burrows *et al.* 1998 a,b,c, 1999, Carter *et al.* 1998, Burrows *et al.* 2000 and Burrows *et al.* 2001a,b - submitted).

In summary the woodland studies have confirmed a general unidirectional increase in woody plant basal area and/or cover/density on most grazed woodland communities not subject to clearing. A photo sequence and TRAPS graphics illustrate this point for a narrow leaved ironbark site in Central Queensland (Fig. 3).

Regulatory controls have been introduced which limit tree clearing on significant areas of leasehold and freehold grazing land in Queensland. The TRAPS data suggest that this will inevitably lead to restricted livestock carrying capacity on those wooded areas subject to such controls. The associated impact on the sustainability of livestock production on affected lands does not appear to have been addressed by land administrators. Land owners and managers also need to weigh up the subtle but important implications for sustainable grazing that will be crystallised by these woody population changes.

An unanticipated outcome of the woodland monitoring program is that it has provided quantitative data on net greenhouse gas emissions from the tree/shrub component in these communities. It also provides a sound basis for evaluating the potential for carbon trading activity on the woodlands at some future date. Information gathered and synthesised in Burrows *et al.* (2001b - submitted) indicate that Australia will not be able to avail itself of Article 3.7 of the Kyoto Protocol of the UN Framework Convention on Climate Change. This is because the TRAPS data show this country's Land Use Change & Forestry Sector would be a net sink and not a net source of emissions in 1990 as required by Article 3.7. In this event it is unlikely that Australia could sensibly ratify the Protocol.¹

Given the overall trend for increasing woody plant cover in areas not being cleared it is timely to consider the causes of such changes. Burrows *et al.* (2001b - submitted) concluded that the grazed woodlands were a fire mitigated sub-climax community prior to the introduction of domestic livestock. There are many parallel situations which have developed elsewhere in the world's savanna regions, once livestock grazing commenced. Such observations suggest that the tree/shrub - pasture - fire x grazing interaction needs to be far better understood. This is especially so in the light of increased regulation of tree clearing practices. In such regulated areas (as well as in other 'intact' woody vegetation) graziers will need more detailed knowledge of tree/shrub interactions if they are to maintain the grazing capacity of retained woodland communities.

¹ Although much of the 76 M ha with woody vegetation cover in Queensland can be assessed as managed either for timber production or for grazing only about 6% is currently included in greenhouse accounting. Likewise of the 157 M ha national forest estate the national inventory reports human induced change in carbon stocks on only approximately 10%. By way of contrast the national inventory in the USA includes all of its' 302 M ha forested land in its accounting.



Feb 1983



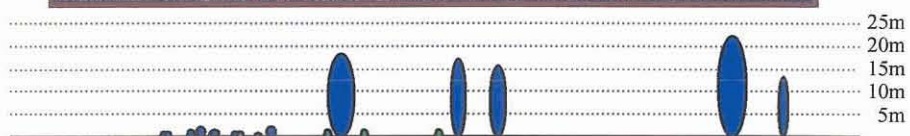
Figure 3. 'Kaiuroo' TRAPS site. Photo sequence from 1983 - 2001. Graphic represents each woody plants position and height along the transect in the photos.



June 1986

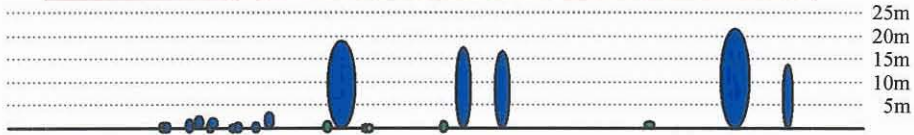


June 1992

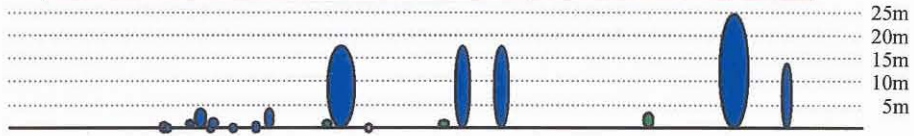




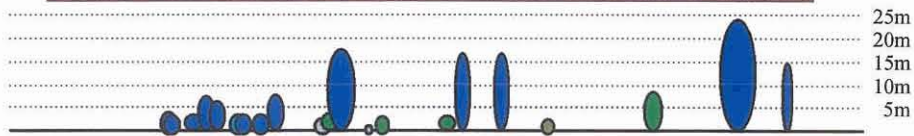
May 1995



July 1997



May 2001



2. Woody Weed Control Studies:

(a). Fire

The control of wattle regrowth (*Acacia leiocalyx*, *A. grandifolia*) with fire study at "Wigton" near Gayndah in the Burnett has highlighted the difference in the response to fire between and within the two wattle species in this trial and other woody plants. The drought meant that fuel loads for the 1995 and 1996 burns were not high but successful burns were obtained. However the 1997 and 1998 burning was not possible due to low fuel levels and frequent small falls of rain that kept what fuel there was green, and unsuitable for burning. All the plots were successfully burnt in August 1999. The plots were re-recorded during August - September 2000 and showed root suckering of *Acacia leiocalyx* and a mass germination of *Acacia grandifolia* seedlings following this fire. (Figures 4 and 5). The plots were re-recorded in July 2001 to follow the fate of these suckers and seedlings. There was a general reduction in the number of root suckers of *Acacia leiocalyx* and many of the *Acacia grandifolia* seedlings had died.

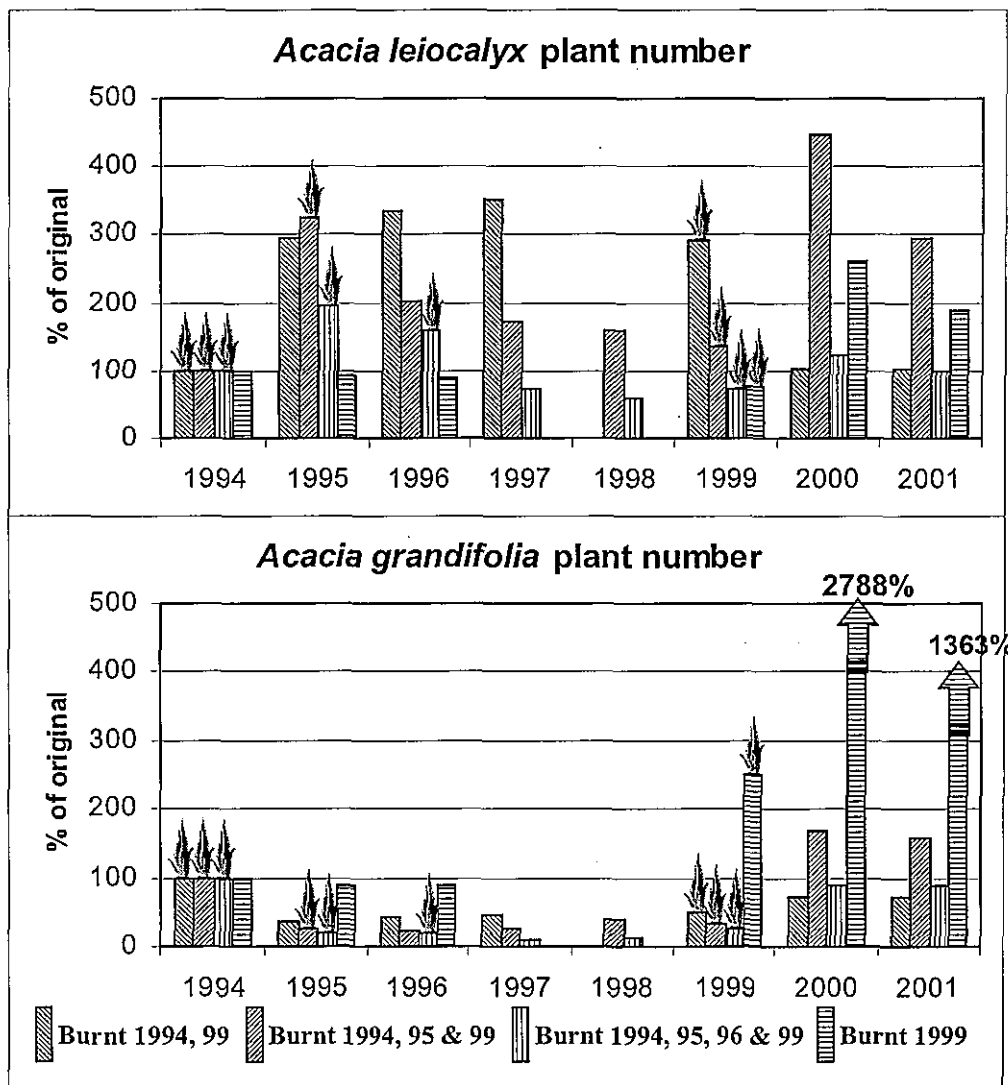


Figure 4. Changes in wattle populations following burning at the 'Wigton' wattle burning trial as a percentage of the original population.

By using the 'TRAPS' methodology it was possible to track the fire effects on individual woody plants in this trial. It has been found that complete replacement of the *Acacia grandifolia* population occurs following burning except for those few plants that were big enough (>5m tall) not to be completely

'browned out' by the fire. However, the response from *Acacia leiocalyx* was less definite as it root suckers profusely so that even though the original stems were killed by the fire, the root system survived. This made ascribing a fire effect to individuals more difficult. The fire had little effect on survival or population size of *Eucalyptus crebra* or *Alphitonia excelsa* regrowth.

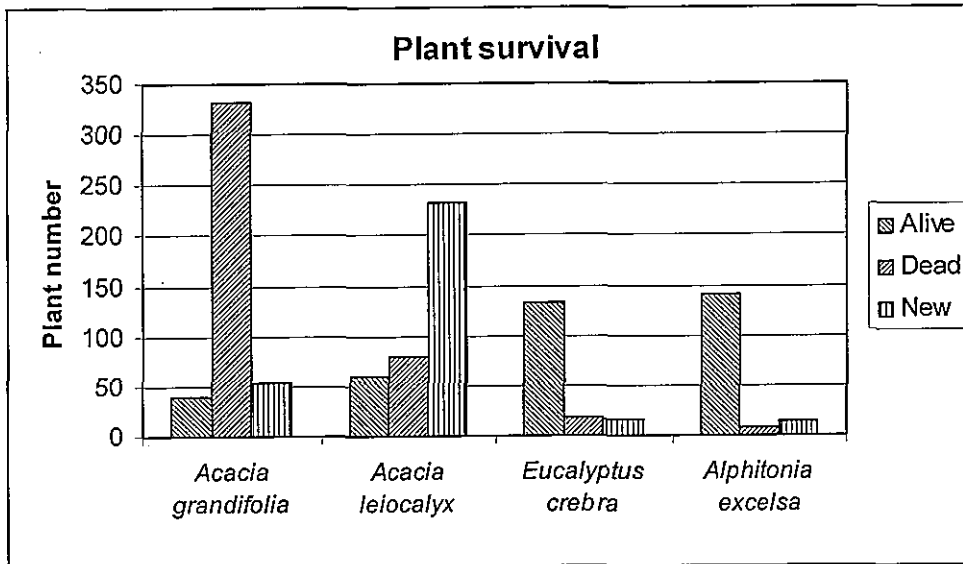


Figure 5. Woody plant survival following one fire (1994) in woody regrowth near Gayndah. Included are any new plants that appeared within the transects following the fire.

A study on controlling currant bush (*Carissa ovata*) with fire at "Pasha" in the Mt. Coolon area was established in 1993. Drought in the area delayed the first burn until February 1996. Subsequent burning treatments were imposed in October 1997, October 1998 and September 1999. The final burning treatment due in 2000 was postponed until October 2001 (Table 3).

The burn rating in Table 3 (B.R.) is the mean for all plants in all treatments burnt at that time and was based on 0= no visible effect, 1= all leaves browned out, none consumed, 2= all leaves consumed, stems intact, 3= all plant consumed. Burns 1,3,4 and 5 were effective burns with adequate fuel loads. At the time of the second burn there hadn't been enough fuel build up to give a very effective burn as can be seen in the burn rating for this fire. The effectiveness of these burns on the canopy cover of *Carissa ovata* can be seen in Fig. 6 (A and B).

Table 3. Burning treatments in the *Carissa ovata* burning trial at "Pasha".

<u>Treatment</u> (Burn Rating)	<u>Burn 1</u> (B.R. 2.1)	<u>Burn 2</u> (B.R. 1.0)	<u>Burn 3</u> (B.R. 1.8)	<u>Burn 4</u> (B.R. 2.3)	<u>Burn 5</u> (B.R. ?)
1 (Control)					
2	13/02/1996				
3		16/10/1997		5/10/1999	
4			6/10/1998	5/10/1999	
5	13/02/1996	16/10/1997			
6	13/02/1996	16/10/1997	6/10/1998		
7	13/02/1996		6/10/1998		
8	13/02/1996		6/10/1998		29/10/2001

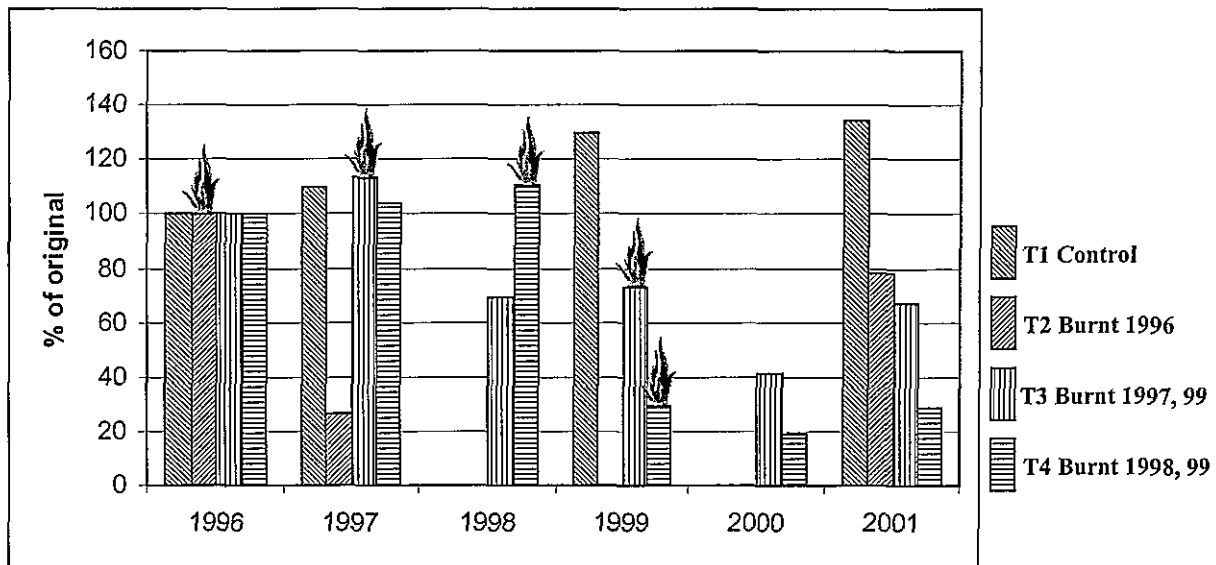


Figure 6 (A). Canopy cover of *Carissa ovata* as a percentage of the original. Treatments 1- 4.

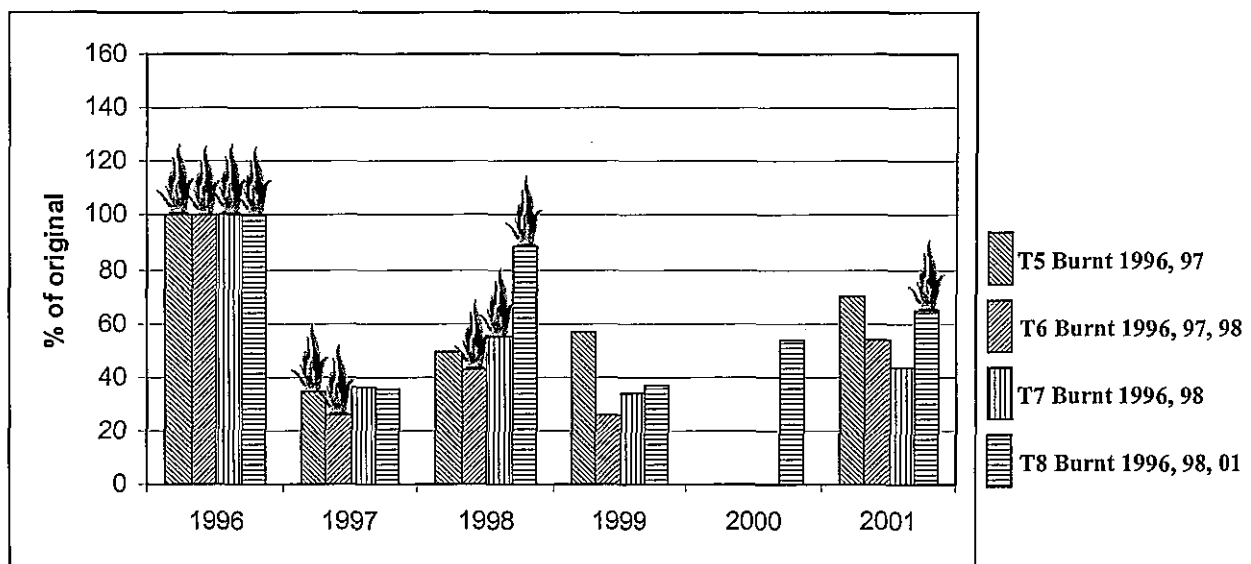


Figure 6 (B). Canopy cover of *Carissa ovata* as a percentage of the original canopy cover (1996). Treatments 5 - 8.

Burning *Carissa ovata* is an effective way to reduce the canopy cover of this plant and thus lower its competitive effect on pasture production. However, the plant is not killed by fire and can regrow to its previous size in 5 to 7 years. Also, as *Carissa ovata* spreads into large clumps by layering, burning tends to help create new plants separate from the original plant. Identification of these 'layered' plants has been simplified by using the 'TRAPS' methodology.

(b). Herbicide Screening

Herbicide screening trials have been an ongoing part of the woodland project. During the life of NAP3 trials looking at effective chemical control using various application techniques have been carried out on the native woody weeds *Acacia salicina* (4 trials), *Acacia farnesiana*, *Alstonia constricta* (2 trials), *Carissa ovata* and *Atalaya hemiglauca*. This work has been carried out in conjunction with the agrochemical industry and the results disseminated through "Woody Weed Adviser", personal consultations and used in the revision of registered herbicide labels.

3. Woody Weed Adviser

The Woody Weed Adviser upgrade was distributed to all registered users in November 2000. A steady trickle of sales continues and it is well supported by end users. The future of this decision support tool is dependent on acquiring continued financial support, as some re-programming is needed before the next upgrade can be distributed.

4. 'TRAPS' Methodology (Including software development and manual)

A paper and poster outlining the methodology was presented at the XIX International Grasslands Congress which was held in Brazil in February 2001 (Back P.V. Using 'TRAPS' (Transect Recording And Processing System) in Woody Weed Control Studies in Australia).

5. Project Communications (1997-2001)

- **Beef 97:** This was held in Rockhampton in April 1997 and woodland management and woody weed control was a major theme at the comprehensive DPI and TBC displays. Beef 97 is the premier beef industry exhibition in Australia and attracts many thousands of producers. This project highlighted woodland management for sustainability.
- A DPI NOTE on 'Control of currant bush in developed brigalow country' was prepared from the results of the "Tullach Ard" trial and was distributed through the DPI NOTE system.
- A program segment on managing eucalypt woodlands was filmed at "Wandobah" in June 1997 for the "CROSS COUNTRY" national television program. Emphasis was placed on the part that this study has played in developing the State Tree Clearing Guidelines. This was shown nation wide in August.
- Statewide newspaper coverage and regional radio coverage was given to the black wattle control work in progress during August 1997.
- An Expert Panel of the Inter-governmental Panel on Climate Change (IPCC) met in Rockhampton in September 1997 to assess, *inter alia*, the effect of Queensland's vegetation thickening on greenhouse gas emissions.
- A paper on 'Regrowth and woody plant thickening' was presented to this IPCC workshop and is to be published in the workshop report.
- A paper on 'Land clearing practices' was also presented to this IPCC workshop.
- The NAP3.210 communication strategy was prepared and approved by the MRC.
- A comprehensive display, including woodland management software, was prepared for the Emerald Meat Profit Day. This was supported by a verbal presentation given by Dr. Burrows to all attendees in rotating groups.
- A field day to demonstrate progress to date and to discuss the direction of the 'Wigton' wattle burning trial was held in early April 1998. Twenty-five producers and others attended the day that ended with an involved discussion of what had been seen. The general consensus was that very little was understood about the way fire should be used in this class of country and that more work was needed to gain a better understanding.
- Dr. Burrows presented results of the 'Wandobah' Clearing Strategies study to over 100 people who attended the 'Keilambete' Field Day in June 1998.
- The Windows version of 'Woody Weed Adviser' was launched in November 1997 and is being promoted through field days, the Cattlemen's Union Journal and through the DPI's Information Services.

- The 'TRAPS' package (software and manual) was completed in November and workshops to train potential operators were held in Rockhampton (12 trainees) and Charters Towers (14 trainees). Posters and a brochure have been produced to promote the package.
- The woodland management page on the Tropical Beef Centre's WWW site has been updated with a page on 'TRAPS' which is also referenced at www.dnr.qld.au/slats.
- The final draft of a paper on the mechanical and chemical control of *Carissa ovata* has been submitted to 'Tropical Grasslands' for publication
- The field visit to the core woodland site 'Wandobah' is being held on the 7th July 1998 with forty seven technical, extension, landcare and future profit people invited to attend. This group will be utilised, *inter alia*, to determine an advisory committee structure for woodland management in the States grazing lands previously covered by the CQBRC as an interim measure.
- Five comprehensive papers detailing TRAPS and/or 'Wandobah' results have been contributed to regional, national and international symposia/workshops during the 1997/98 year (see publications).
- A field day to demonstrate progress to date and to discuss the direction of the 'Wigton' wattle burning trial was held in early April 1998. Twenty-five producers and others attended the day that ended with an involved discussion of what had been seen. The general consensus was that very little was understood about the way fire should be used in this class of country and that more work was needed to gain a better understanding.
- Dr. Burrows presented results of the 'Wandobah' Clearing Strategies study to > 250 producers in total at workshops/field days organised by the South West Strategy (Charleville) and Land Care groups at Bajool, Dingo, Nebo, Marlborough and Baralaba.
- The Windows version of 'Woody Weed Adviser' is being promoted through field days, Land Care groups, the *AgForce Journal* and through the DPI's Information Services.
- Researchers in the DPI, DNR and EPA throughout Queensland and DPIF in the Northern Territory have taken up the 'TRAPS' package (software and manual).
- A paper on the mechanical and chemical control of *Carissa ovata* has been published in 'Tropical Grasslands'.
- A field visit to the core woodland site 'Wandobah' was held on the 7th July 1998 with forty seven technical, extension, landcare and future profit people attending. This group performs, *inter alia*, an advisory role for woodland management in the States grazing lands, previously covered by the CQBRC as an interim measure.
- A literature review has been prepared for the TRAPS scientific paper. Additional support of SLATS funding has enabled a rapid increase in site coverage throughout the State. Concentration on this aspect has overtaken earlier analyses based on 24 or 47 data sets (cf. the current 131 established sites). However, 6 comprehensive papers detailing TRAPS and/or 'Wandobah' results have been published in the VIth International Rangelands Congress proceedings and in a Professional Workshop on Practical Rangeland Ecology held in conjunction with it.
- A video detailing the correct techniques for applying herbicides to woody plants was prepared in conjunction with and funded by Dow AgroSciences. This has been widely distributed to chemical resellers and others.
- A brochure on the results from the 'Wandobah' project was produced in conjunction with DuPont and a Field Day poster and fact sheets on basal bark spraying were produced in conjunction with Dow AgroSciences.
- The economic analyses of the 'Wandobah' Clearing Strategies trial scenario are updated in line with ongoing results (regrowth rates) and changes in commercial treatment costs (e.g. the applied price of the herbicide Graslan[®] was reduced by 1/3 in 1999). These analyses – carried out in conjunction with Bill Holmes, Agricultural Economist – examine the outcome of tree clearing over 15 year time frames. The output sheets are in steady demand from producers and agro-business alike.
- The "Wandobah" eucalypt clearing strategies trial was a major focus of a bus tour organised as part of 'Beef 2000'. Visitors from all over Queensland and the Northern Territory saw a

range of cattle country at various stages of development including tree clearing options, native woody regrowth management and noxious weed control. Local producers, DPI, EPA and DNR staff discussed aspects of woodland development and management, noxious weed control, biodiversity implications and legislative requirements.

- During 2000 the clearing trial data has been presented to a meeting of Westpac Bank managers from all over Queensland and to well attended producer forums at Emerald and Taroom.
- The Windows version of 'Woody Weed Adviser' was upgraded in November 1999 and is being promoted through field days, Land Care groups, the AgForce Journal and through the DPI's Information Services.
- A poster detailing the correct techniques for applying herbicides to woody plants using the cut stump technique was prepared in conjunction with Shindaiwa. This was presented at the Tropical Grasslands Conference at Emerald in May 2000. An A4 version funded by Shindaiwa has been widely distributed to chemical resellers and small machinery retailers.
- An invited paper, "Deforestation for pasture development – has it been worth it? Was presented to the XIX International Grassland Congress held in Brazil in February 2001.
- A poster and poster paper on the use of 'TRAPS' in woody weed control research was presented at the XIX International Grassland Congress held in Brazil in February 2001.

6. Publications (1997 – 01)

- Anderson, E.R., Burrows, W.H., Back, P.V. and Hoffmann, M.B. (1998). Land clearing practices and associated impacts on the land use change and forestry inventory. Working paper – IPCC Workshop on Biomass Burning, Land-use Change and Forestry, Rockhampton, Australia (IEA/OECD: Paris)
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