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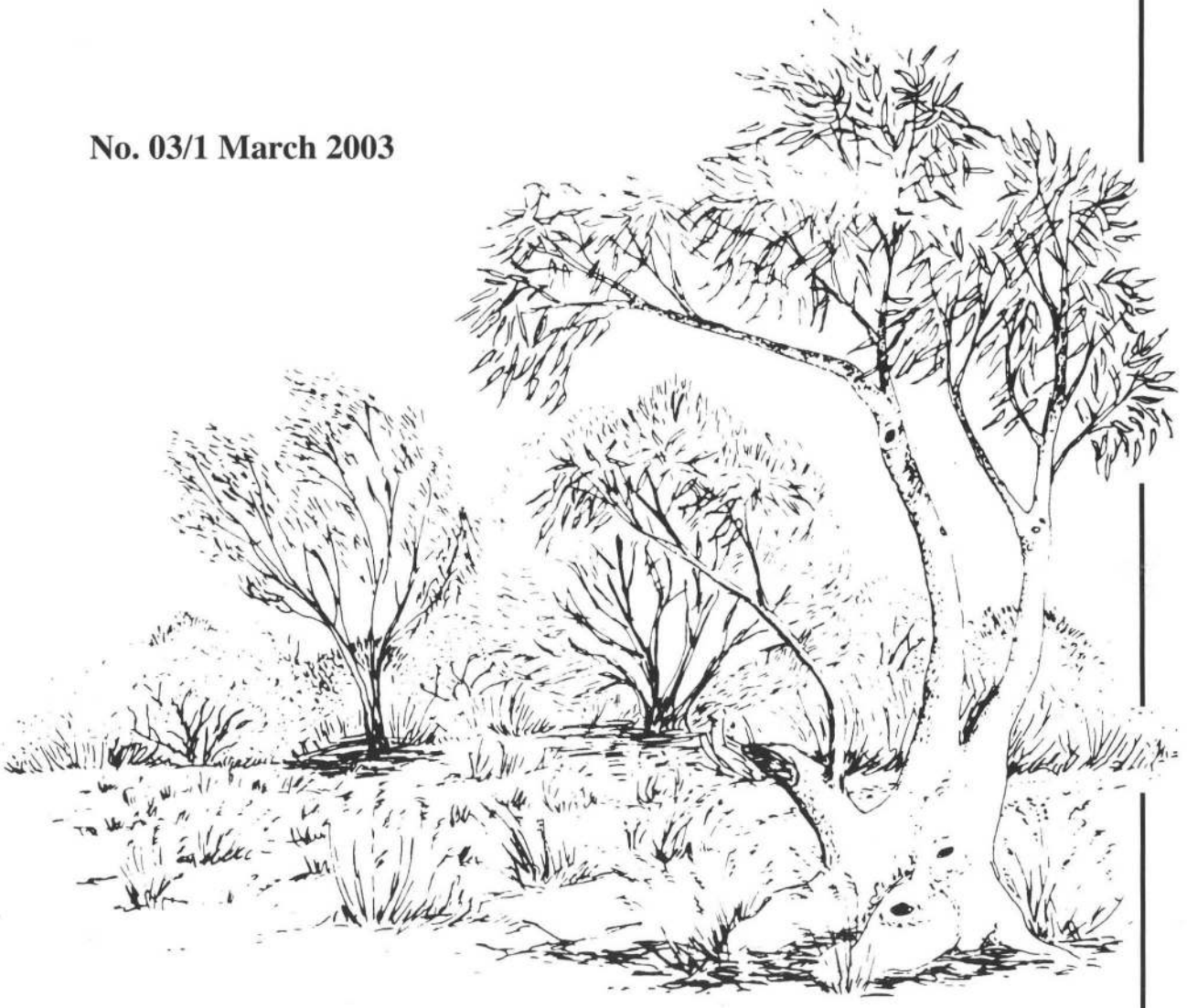

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No. 03/1 March 2003

EDITOR (*RMN*)
Noelene Duckett
7 Belcarra Place
The Woodlands Texas 77382 USA
Ph: 0011 1 281 681 1551
Email: nduckett@ozemail.com.au

EDITOR (*The Rangeland Journal*)
Assoc. Prof. Wal Whalley
School of Rural Science & Natural Resources
University of New England
Armidale NSW 2351
Ph: 02 6773 2477 Fax: 02 6773 3283
Email: rwhalley@metz.une.edu.au

PRESIDENT
Merri Tothill
Primary Industries and Resources
Port Augusta SA 5700
Ph: 08 8648 5170 Fax: 08 8648 5161
Email: Tothill.Meredith@saugov.sa.gov.au

VICE PRESIDENT
David Lord
Thackaringa Station
Broken Hill NSW 2880
Ph: 08 8091 1638 Fax: 08 8091 1540
Email: thackaringa@bigpond.com

FINANCE & AUDIT OFFICER
John Maconochie
Pastoral Program, Sustainable Resources
Department of Water, Land & Biodiversity Conservation
GPO Box 1671, Adelaide SA 5001
Ph: 08 8204 1837 Fax: 08 8207 2398
Email: maconochie.john@saugov.sa.gov.au

SECRETARY
Sarah Nicolson
Intercomm Event Coordination
22 Edmund Ave, Unley SA 5061
Ph: 08 8357 3378 Fax: 08 8357 3389
Email: nicolson@w130.aone.net.au

MEMBER SERVICES OFFICER
Robyn Cowley
Department of Primary Industries and Fisheries
PO Box 1346, Katherine NT 0851
Ph: 08 8973 9749 Fax: 08 8973 9777
Email: robyn.cowley@dpif.nt.gov.au

COMMUNICATION OFFICER
Lachlan Pegler
Natural Resources and Mines
PO Box 224, Charleville QLD 4470
Ph: 07 4654 4207 Fax: 07 4654 4225
Email: lachlan.pegler@dnr.qld.gov.au

SUBSCRIPTION MANAGER
Ian Watson
Centre for Management of Arid Environments
Department of Agriculture, Western Australia
PO Box 483, Northam WA 6401
Ph: 08 9690 2128 Fax: 08 9622 1902
Email: iwatson@agric.wa.gov.au

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ERRATUM Range Management Newsletter 03/1

Gremlins got into the last issue of the Newsletter. An incorrest contents list was printed on the inside front cover. Below is the correct contents list. It is printed on peel-off, self adhesive paper.
Simply trim to size, peel off backing and stick in place. Apologies for any inconvenience.

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FROM THE EDITOR

Noelene Duckett, 7 Belcarra Place, The Woodlands, Texas, USA, 77382. Email: nduckett@ozemail.com.au

Welcome to another Range Management Newsletter and the first for 2003.

In this issue I have been pleased to include three major articles examining changes in rangeland plant communities over time. It is always good to see the results of monitoring studies! The first two articles examine vegetation changes inside and outside vegetation exclosures in northern Australia, with one study based on cracking clay soil and the other on sandy soil. Results from the cracking clay study by Gary Bastin, John Ludwig and others suggested that the open grasslands do change with rainfall, fire and grazing. The study also demonstrated that the herbage layer remained fairly stable while there was a trend of woody thickening over time. Similarly, the study on sandy soils also suggested that grazing has influenced the vegetation composition. Greg Reilly suggests, however, that the resulting vegetation communities are equally as stable as the previous ones which is an important consideration in a region where drought conditions are characteristic. The third article, written by Ian Watson and Phil Thomas, examines vegetation changes in the shrubland communities of the Gascoyne-Murchison region of Western Australia. Their results revealed positive vegetation change between 1993 and 2001 across large area of the study area: a nice contrast compared with the degradation we often hear about. As an adjunct to these monitoring articles, Anita Smyth has submitted a report from the recent biodiversity monitoring workshop held in October 2002.

This issue also includes a number of short articles from Council. Lachlan Pegler fills us in on recent Council developments including the news that a great new ARS website is currently under development, thanks to David Wilcox. There is also news about the 2003 subscription rates, the success of last year's special issue of *The Rangeland Journal* and a request from the Subscription Secretary Ian Watson for back issues of *The Rangeland Journal* and the *Range Management Newsletter*.

The next issue of the newsletter is due out in July so I would appreciate receiving your articles by late May. In particular I would be keen to receive any longer articles – I am sure there are lots of you out there that are conducting both formal and informal studies and observations that would interest our members and readers.

A final reminder that time is running out to organise a trip to the VIIth International Rangelands Congress to be held in Durban, South Africa from 28 July – 1 August 2003. Get your registration in soon if you propose to attend.

VEGETATION CHANGES FROM 1973 TO 2002 ON A CRACKING CLAY IN NORTHERN AUSTRALIA

Gary Bastin, CSIRO Sustainable Ecosystems, PO Box 211, Alice Springs NT 0871. Email: Gary.Bastin@csiro.au
John Ludwig, Tropical Savannas Management CRC, c/o CSIRO Sustainable Ecosystems, PO Box 780, Atherton QLD 4883. Email: John.Ludwig@csiro.au
Robert Eager and Adam Liedloff, Tropical Savannas Management CRC, c/o CSIRO Sustainable Ecosystems, PMB 44, Winnellie NT 0822.
Email: Robert.Eager@csiro.au, Adam.Liedoff@csiro.au
Reg Andison, Qld. Beef Industry Institute, Department of Primary Industries, Bowen QLD 4805.
Email: Reg.Andison@dpi.qld.gov.au
Michael Cobiac, NT Dept. Business, Industry & Research Development, PO Box 8760, Alice Springs NT 0871
Email: Michael.Cobiac@nt.gov.au

Introduction

Long term exclosure studies contribute to our understanding of how vegetation responds to climatic variation and disturbances such as grazing and fire. Grazing effects should be better understood where fenced exclosures are used to remove or control grazing by various herbivores (Valamanesh 1999). As well as their research role, exclosures can also demonstrate to managers the potential benefits of spelling paddocks (Harrison and Shackleton 1999). Vegetation condition within exclosures provides managers with a reference area for them to compare the vegetation with areas outside these exclosures.

Well known long term studies in the rangelands include the Jornada Experimental Range in southern New Mexico (Gibbens and Beck 1988) and the Koonamore Vegetation Reserve in South Australia (Noble 1977). In northern Australia, three exclosures were established on Victoria River Research Station, Northern Territory, in 1973; two on red loam soils and one on a grey self-mulching cracking clay (Foran *et al.* 1985). Vegetation changes inside and outside the red soil exclosures are reported in a paper currently with the *Rangeland Journal* (Bastin *et al.* submitted). On these red soils, the composition and cover of the herbaceous vegetation changed greatly following exclosure. The woody vegetation also changed, with tree and shrub densities increasing both inside and outside the exclosures, but more so inside.

In this article, we describe the changes in herbage composition and biomass, and in woody density, inside and outside the exclosure built in 1973 on the grey cracking clay site. Besides exclusion of livestock grazing inside the exclosure, the site was burnt twice by accidental fires. The first fire was in February 1997 and diary entries kept at the research station record that this "cool" wet-season fire had negligible impact on the vegetation. The second fire occurred in late May 2001 with most of the site being burnt. Based on more recent

plot data and photopoint records, we discuss the likely effects of this most recent fire on the vegetation.

Methods

Victoria River Research Station, Kidman Springs, is 40 km north of Victoria River Downs Homestead and 220 km south west of Katherine, Northern Territory. A 500 metre square exclosure was built in 1973 on grey self-mulching cracking clay in Bull Paddock to exclude cattle grazing. The area outside the exclosure continued to be grazed at moderate levels (5-7 head/km^2) by experimental cattle herds throughout (see Sullivan and O'Rourke 1997, for details). Wet-season rainfall was well above the 749 mm median in the mid 1970s and later 1990s – early 2000s (Figure 1), considerably below the median in the late 1980s and close to the median in most other years.

Herbage biomass was measured by clipping individual species in June of each year between 1974 and 1979, and again in June 2002. Species were harvested within five randomly placed 1-m^2 quadrats surrounding six permanently marked locations inside and outside each exclosure (see Foran *et al.* 1985 for more detail). Samples were oven dried to obtain dry weight. Additional biomass data were obtained in June 1989 and 1994 by estimating yield and composition using BOTANAL (Tothill *et al.* 1992) within 15 randomly placed 1-m^2 quadrats at each of the permanently marked sampling locations.

Woody species were categorized as "tree" or "shrub" and their density recorded by height class (immature shrubs <=0.5 m, mature shrubs >0.5 m, immature trees <=2 m, mature trees >2 m) within fixed 0.14 ha areas at each of the permanent sampling locations. A colour 35 mm landscape photograph was taken at these permanent locations at the time of each data collection.

The May 2001 fire burnt five of the six sampling locations inside the exclosure and four transect areas outside the exclosure.

Results

Prior to exclosure in 1973, the clay site was a very open grassland with almost no woody vegetation (Figure 2a). The buildings of Victoria River Research Station are visible on the hill in the background. By 1989, this clear view of the hill is beginning to be obscured by an increased density and height of woody plants (Figure 2b). Eleven years later in 2000, this view is even more obscured (Figure 2c). The dry-season fire in 2001 temporarily opened-up this view (Figure 2d), but by June 2002 the view was again obscured by rejuvenated woody plant canopies and by a dense ground cover of tall annual grasses (Figure 2e).

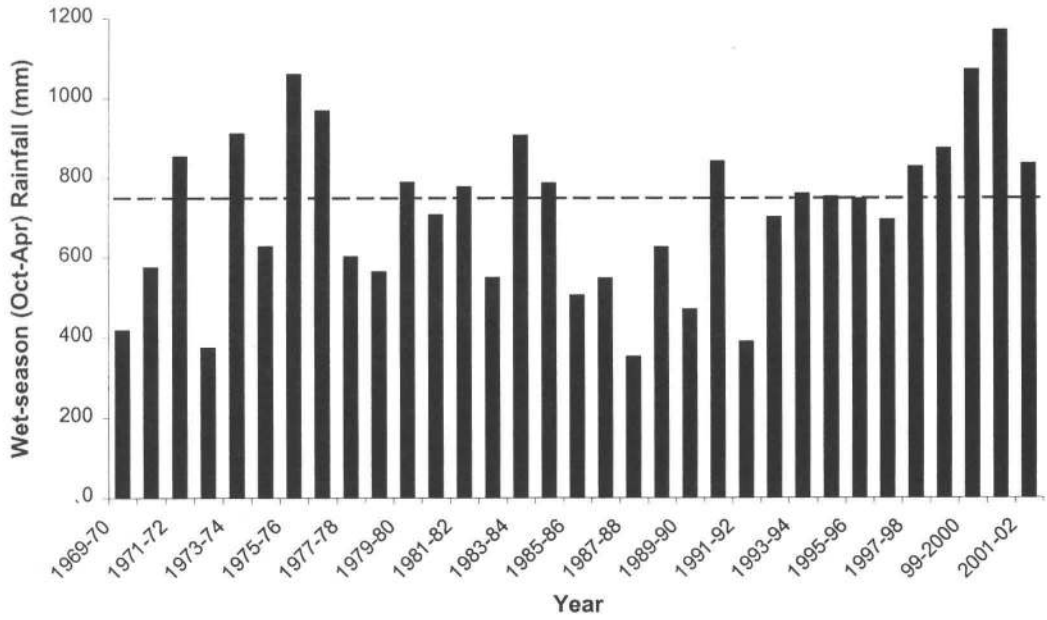
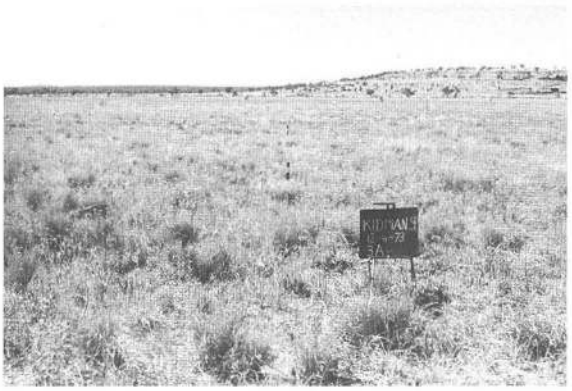


Figure 1. Total wet season (October-April) rainfall, Victoria River Research Station, NT, for the period 1969-2002. The horizontal line indicates the median wet season rainfall of 749 mm over this period.

(a)



(b)

(c)

(d)

(e)

Figure 2. Sequence of photographs from a fixed location, plot 3A, within an exclosure on cracking clay soil, Victoria River Research Station, Northern Territory: (a) April 1973, (b) June 1989, (c) June 2000, (d) November 2001 and (e) June 2002.

Woody density increase

The combined density of mature trees and shrubs was very low both inside and outside the clay exclosure in 1973 (Figure 3a). By 1989 the density of these taller (mature) woody species had increased, and they continued that trend through until 2002, with the most profound increase occurring outside the exclosure, especially between 1994 and 2002. Most of this increase was due to rosewood (*Terminalia volucris*) with bauhinia (*Lysiphyllum cunninghamii*) also being a significant contributor. The combined density of immature shrubs (<=0.5 m high) and trees (<=2 m) also markedly increased from 1989 onwards (Figure 3b), and this trend continues inside the exclosure.

The 2001 wildfire appeared to have very little effect on the density of the dominant tree species recorded in 2002 (Table 1). The density of mature rosewood in 2002 on burnt areas both inside and outside the exclosure was higher than that recorded in 1994. The density of immature rosewood inside the burnt part of the exclosure was also much higher in 2002 compared with 1994 and earlier recordings. Bauhinia had a more patchy distribution than rosewood but again, the 2001 wildfire appeared to have little effect on its density. The density of both mature and immature forms increased slightly between 1994 and 2002 on burnt areas within the exclosure (Table 1). The 14 immature individuals recorded within the unburnt part of the exclosure in 1994 had grown into the taller height class by 2002. Unburnt transects outside the exclosure showed a three-fold increase in the density of mature bauhinia and considerable decline in the density of immature bauhinia over this same period.

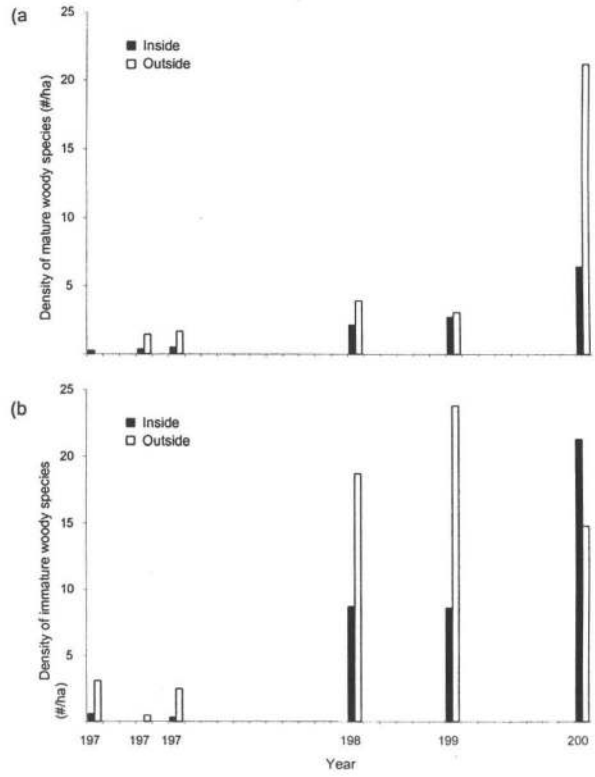


Figure 3. Mean density (#/ha) of trees and shrubs in two height classes: (a) "mature" trees >2 m and shrubs >0.5 m, and (b) "immature" trees <=2 m and shrubs <=0.5 m.

Table 1. Density (#/ha) of rosewood and bauhinia in two height classes at different times on cracking clay soil. Density data are grouped by exclosure treatment and whether permanent sampling areas were burnt or unburnt in 2001.

Height class	Exclosure	Burnt in 2001	Rosewood (*Terminalia volucris*)						Bauhinia (*Lysiphyllum cunninghamii*)					
			1973	1976	1978	1989	1994	2002	1973	1976	1978	1989	1994	2002
mature (>2 m)	inside	yes	3	0	3	6	26	56	0	1	1	1	1	3
		no	0	0	0	0	0	0	0	0	0	0	0	14
	outside	yes	0	0	7	11	11	43	0	0	0	0	0	0
		no	0	21	14	29	21	261	0	18	25	39	29	93
immature (<=2 m)	inside	yes	3	0	1	91	90	218	4	0	0	0	1	4
		no	0	0	0	21	21	86	0	0	0	7	14	0
	outside	yes	25	0	4	39	43	21	0	0	0	0	0	0
		no	29	0	21	318	439	104	21	0	14	179	203	146

Herbage biomass

Grass biomass (Figure 4a) far exceeded that of broad-leaved forbs (Figure 4b) although these forbs were a notable component of total herbage in 2002 (Figure 4b and Table 2). Grass biomass was generally slightly greater inside the exclosure, except for 2002 when the difference was more substantial. Apart from 1978 and 1994, the biomass of broad-leaved forbs outside the exclosure was less than that for ungrazed areas inside the exclosure. There was no consistent relationship between total wet season rainfall (Figure 1) and ensuing recorded biomass for grasses and forbs (Figure 4).

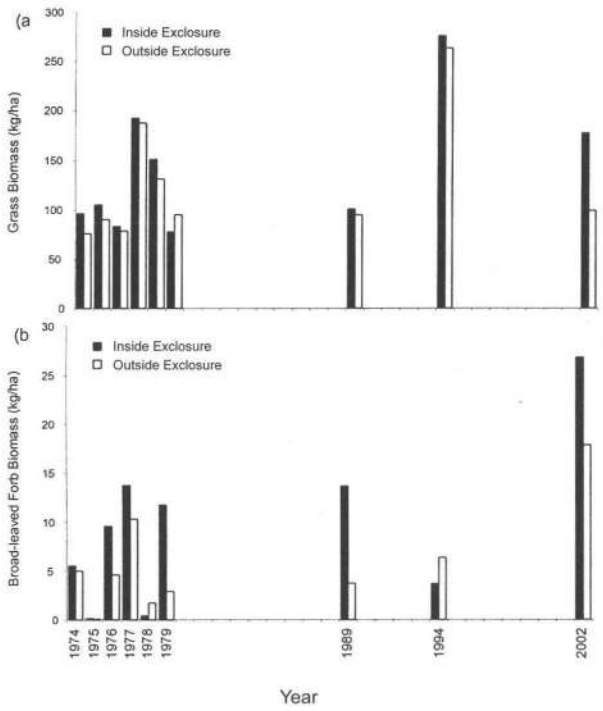


Figure 4. (a) Above-ground biomass of grasses measured inside and outside an exclosure on cracking clay soil, and (b) biomass of broad-leaved forbs at the same sample locations (note difference in scaling of Y axis).

The perennial golden-beard grass (*Chrysopogon fallax*) and annual Flinders grass (*Iseilema spp.*) were dominant pasture species throughout (Table 2). In most years, there was little difference in the biomass of these two species with exclosure (data not shown). However, in 1994 and 2002 there was appreciably less Flinders grass on grazed areas, as much as 67% less in 2002. When the 2002 biomass was partitioned amongst transects either burnt or not burnt in the May 2001 fire, there was twice the biomass of Flinders grass on the burnt and grazed area compared with unburnt grazed transects. This difference was reversed within the exclosure with the unburnt area having 5.6 times the biomass of burnt transects (again, data not shown).

Table 2. Percentage composition of dominant grasses and the "broad-leaved forb" category as components of total herbage biomass. (Data averaged for exclosed and grazed treatments.)

Year	Species		
	golden-beard grass (*Chrysopogon fallax*)	Flinders grass (*Iseilema spp.*)	broad-leaved forbs
1974	59	35	6
1975	66	27	0
1976	48	27	8
1977	47	35	6
1978	72	20	1
1979	57	26	8
1989	71	16	8
1994	37	45	2
2002	53	10	14

Other minor grasses present at times included Queensland bluegrass (*Dichanthium sericeum*) in the early years, native millet (*Panicum decompositum*) in latter years and downs sorghum (*Sorghum australiense*) in 2002.

Discussion

Herbage biomass, woody density and photopoint data collected on a grey cracking clay site at Victoria River Research Station over a 29-year period from 1973 to 2002 demonstrated that this open grassland savanna vegetation will change with rainfall, fire and grazing. Woody thickening appears to be an ongoing process and should be of concern for grazing management. However, the herbage layer appears to be much more stable. Changes in the herbage layer were considerably less than those measured inside and outside exclosures on red loams in an adjacent paddock (Bastin *et al.* submitted).

Grazing pressure in Bull Paddock was moderate throughout this study (e.g. Sullivan and O'Rourke 1997), hence we did not expect any great differences in the pasture layer inside and outside the exclosure at this site. There were seasonal shifts in recorded species composition with, for example, either Flinders grass or broad-leaved forbs being more abundant in some years (Table 2). It is difficult to say if these shifts represent real differences or are due to selective removal of more palatable forage species by the time of vegetation sampling following wet season rainfall. Overall we conclude that this pasture appears to be remarkably resilient under moderate grazing pressure.

Although we consider the herbage layer to be fairly stable under current grazing practice, there appears to be an incipient trend of woody thickening. The dynamics of tree and shrub establishment are not well understood

in this environment but observations across the Victoria River District indicate that recruitment is spasmodic and that the age structure of rosewood and bauhinia varies considerably on grey cracking-clay soil. Climatic conditions that favour recruitment may be less about wet season rainfall and more about the length of the dry season. It is likely that many woody seedlings emerge during a wet season but fail to survive an ensuing long hot dry season. When the dry season is shorter (i.e. the preceding wet season finishes late and the next starts early) or significant dry-season rainfall occurs may well favour successful episodic recruitment.

The accidental fire in May 2001 was only of moderate intensity (Don Cherry, pers. comm.) and appeared to have little impact on the woody vegetation. We observed that this fire killed a few larger trees, and scorched the lower leaves on trees less than 8 m, but most trees had resprouted at the base or on trunks and lower limbs by June 2002. Will thickening of woody species continue in this area regardless of rainfall patterns and possible future spasmodic occurrence of fire? If so, then it is likely that woody density will reach the point where it actively suppresses grass growth (Scanlan and Burrows 1990, Cafe *et al.* 1999) and considerably hampers stock management by increasing mustering difficulty. Fire experiments elsewhere on Kidman Springs and modelling studies indicate that woody thickening can be controlled by the strategic use of fire and grazing (Dyer *et al.* 1997, Dyer and Mott 1999, Liedloff *et al.* 2001). Other savanna studies suggest that periodic severe droughts reduce tree densities (Fensham and Holman 1999).

Despite inconclusive evidence from this study, we advocate fire in controlling woody thickening on grey cracking clays in the Victoria River District. Burning experiments and observation in other rangeland environments show that fire is most effective in killing immature trees and shrubs. A regular burning regime should gradually thin woody vegetation over time as older trees die from natural causes and fire restricts the recruitment of new individuals.

Although fire is not part of the experimental design, the continued observation of this exclosure study, plus that in the adjacent Conkerberry Paddock (Bastin *et al.* submitted), should contribute to an improved understanding of long-term change in savanna vegetation in this part of northern Australia.

Acknowledgements

We thank those who have helped collect vegetation data over the 29-year period of this study. We also thank the various managers of Victoria River Research Station (Kidman Springs) for their assistance and hospitality during the same period, particularly Brian Hill who helped initiate the study and Rohan Sullivan and Don Cherry for their support in later years. Linda Cafe and Rik Dance assisted with data collation, and Jeff Corfield processed the 1994 BOTANAL data for us.

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THE IMPACTS OF GRAZING ON PASTURE COMPOSITION IN A SANDY OPEN WOODLAND, CENTRAL AUSTRALIA

Greg O'Reilly, N.T. Department of Business, Industry, and Resource Development, PO Box 8760, Alice Springs NT 0871. Email: greg.oreilly@nt.gov.au

Background

A recently published Northern Territory Government Technical Bulletin (O'Reilly 2002) reveals some interesting pasture composition changes resulting from the relatively short grazing history of sandy open woodlands in central Australia.

It wasn't until after World War II that many sub-artesian bores were first equipped in the Centre, opening up previously water-less areas (Connellen 1965). There is precious little known about what impact 50 years or so of grazing has had on vegetation composition in these areas; knowledge that is fundamental to the understanding of the sustainability of the grazing system.

Several long-term cattle exclosures were constructed in central Australia after the dust bowl conditions from 1958-1966 (Condon, Newman and Cunningham 1969), to monitor range condition and trend over time in relation to distance from watering points (Foran 1973). One of these exclosures remains intact, at Spinifex bore, Mt. Riddock, 140 km north-east of Alice Springs. It is now 128 hectares in area, half of its original size.

The bore was first equipped in 1954 indicating 14 years of grazing before the exclosure was constructed in 1968. The grazed and exclosed treatments have been in place now for nearly 50 years and just over 30 years respectively.

Considerable seasonally driven change in pasture composition occurred during the initial study period 1973-1978 (Figure 1). However the exclosure revealed no consistent impact on pasture composition attributable to cattle grazing, even after 10 years of the imposed treatments (Foran *et al.* 1982).

By the late 1990s, obvious pasture composition differences 'across the fence' had developed, while pastures overall had a markedly different composition to that described in the 1970s study.

It was decided to quantify the differences in vegetation composition between treatments at the site over the period 1998-2001, with 2000 and 2001 turning out to be longest fluvial period since the 1970s. While the limitations of these types of exclosure studies are acknowledged (Valamanesh 1999), the size, age, and known history of the exclosure provide a useful demonstration of long-term change in the arid rangelands.

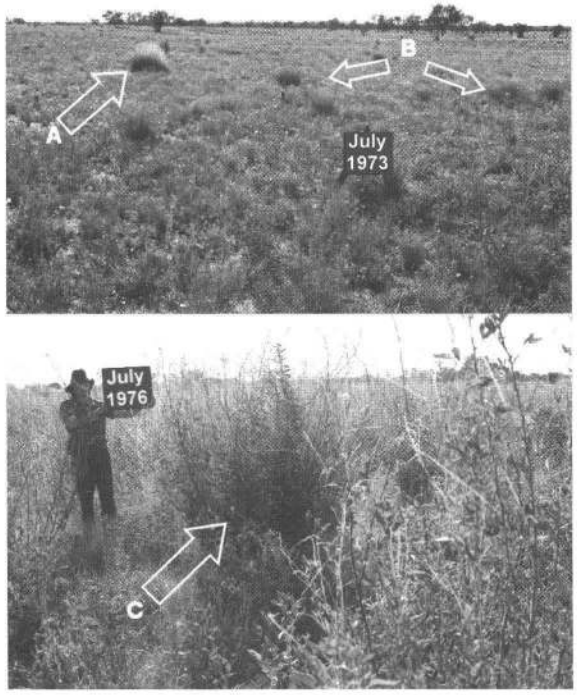

*Figure 1. Vegetation flux masked grazing impacts in the 'wet' 1970s at Spinifex Bore exclosure. This photograph from the same site inside the exclosure shows the effects of record rainfalls from 1974 to 1976. The 1973 photo shows a single spinifex (*Triodia schinzii (spinifex) *tussock (A), and scattered clumps of woollybutt grass (*Eragrostis eriopodaa (woollybutt) *grass (B). By 1976, a more vertical pasture had developed with a thick ground cover under the tall forbs, birdflower* (Crotalaria cunninghamii) (birdflower), *and verbine* (Cullen patens*) (verbine) (C).*

Methods

Study site

The exclosure is located on an alluvial coarse sandy plain derived from the nearby Harts Range. Soils are massive coarse sand (0-30cm) overlying massive loamy sand (>30cm) (Ballenger 2001). The open woodland pasture type (15,000 km^2) occupies areas adjacent to several mountain ranges in central Australia, and is moderately to highly productive (Bastin and Shaw 1996).

Open woodlands are characterised by very scattered edible topfeeds like whitewood (*Atalaya hemiglauca*), supplejack (*Ventilago viminalis*), ironwood (*Acacia estrophiolata*), mulga (*Acacia aneura*) and witchetty bush (*Acacia kempeana*). Dominant annual grasses include mulga grass (*Aristida contorta*) and oat grasses (*Enneapogon* spp.). Sandier plains are dominated by the less palatable woollybutt grass (*Eragrostis eriopoda*) and kerosene grass (*Aristida holathera*).

Data collection

Dry matter weights of substantive species was were visually estimated in 800 x 1m^2 permanently marked sampling plots distributed randomly at 40 sites across both the grazed and exclosed treatments.

Visual estimates were assisted by site-specific photostandards of known dry weight and pasture composition (Wilkie 1997) while regular estimation and harvesting of 1m^2 plots adjacent to sampling sites provided comparison of operator consistency between years. All species present in each sampling plot were recorded, while woody plant canopy cover was estimated in 1998 at each sampling site using the Bitterlich variable plot method (Friedel and Chewings 1988).

Results

Average dry-matter estimates for the four dominant pasture grasses are shown in Figure 2. Woollybutt (*Eragrostis eriopoda)* had consistently higher estimated production in the grazed treatment while oatgrass (*Enneapogon polyphyllus)* and mulga grass (*A.Aristida contorta)* only produced significant estimated dry matter in the exclosed treatment. Kerosene grass *(A.ristida holathera)* was unaffected by grazing treatment.

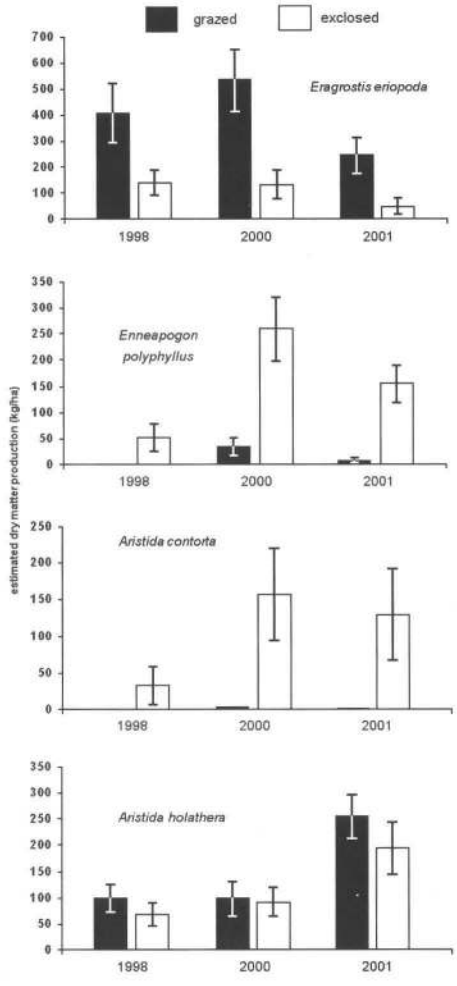

Figure 2. Average estimated dry matter production (kg/ha^{-1}) and standard errors of the means for four dominant pasture grasses at Spinifex bore cattle exclosure. Differences between treatment and sampling year shown.

Other substantive species to show significant differences at one or more sampling events include the spinifex grass, *Triodia schinzii*, which was not recorded in the grazed treatment at all, but occurred in 15 percent of samples taken inside the exclosure, yielding an average 100 kg/ ha^{-1} estimated dry matter. The forb, *Salsola kali,* was only a significant contributor to production in 2000, when an average of 333 kg/ ha^{-1} was recorded inside the exclosure, with only 2 kg/ ha^{-1} estimated dry matter recorded from the grazed treatment. This was the only time total pasture yield was significantly different between treatments. Various minor forbs and grasses showed significant differences in estimated dry matter and/or frequency of occurrence when seasonal conditions were favourable to their growth.

There were no treatment differences for the number of pasture species recorded. The number of species overall declined with wetter seasonal conditions in 2000 and 2001. Table 1 shows the number of pasture species described as generally decreasing or increasing under grazing based on one or more significantly different ($p<0.05$) results, either in dry matter production and/or frequency of occurrence.

Table 1. Number of decreaser and increaser species in the Spinifex bore exclosure.

	Decreasers	Increasers	Unaffected
annual grasses	2	4	2
perennial grasses	2	1	5
forbs	5	6	8
total	9	11	15

Overall woody plant canopy cover was less than one percent in both treatments. The only consistent difference was that the chenopod shrub, *Rhagodia eremaea*, had significantly higher canopy cover inside the exclosure. However *R. eremaea* was also the dominant woody plant cover in the grazed treatment also. Figure 3 compares changes to woody plants at one site looking over the exclosure between 1970 and 1997.

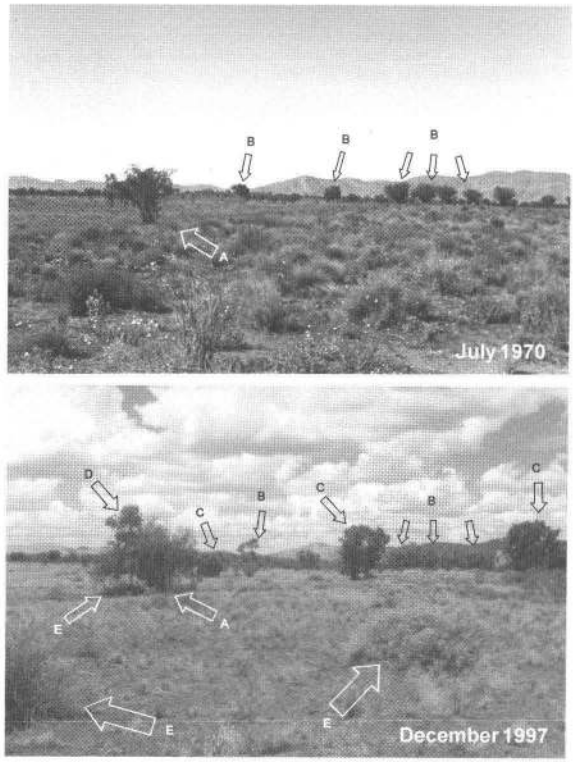

*Figure (3) Change in woody plants, Spinifex bore exclosure, from 1970-1997. A supplejack (*Ventilago viminalis*) is only slightly bigger after 27 years in the mid-ground (A). Other* V. viminalis *trees in the background also appear to have changed little (B). Several whitewoods (*Atalaya hemiglauca*) have emerged and grown to maturity since 1970 (C). A bloodwood tree (*Eucalyptus opaca*) has emerged at (D), while several saltbushes (*Rhagodia eremaea*) have also appeared, both in open areas, and under other shrubs. (E)*

Discussion

It wasn't possible, or desirable, to repeat the 1970s study as the exclosure was subdivided in 1982 and the sampling plots were removed. However, some very loose comparisons can be made between the 800 x $1m^2$ visually estimated sampling plots from the current study, and the 180 x $1m^2$ harvested sampling plots, used in the 1970s study to determine pasture composition by yield.

Between 1974 and 1978, *Aristida holathera* made up 86 percent of total pasture production, whereas between 1998 and 2001, *A. holathera* contributed just 21 percent of total pasture. . Figure 4 shows that, given the limitations of comparing the two studies, it would appear that *Enneapogon polyphyllus* and *Aristida contorta* are at roughly equivalent levels in the grazed area today as they were in the 1970s. However, they have greatly increased their dominance of the exclosed area since that time. *Eragrostis eriopoda* has increased significantly across both treatments since the 1970s, but particularly so in the grazed area.

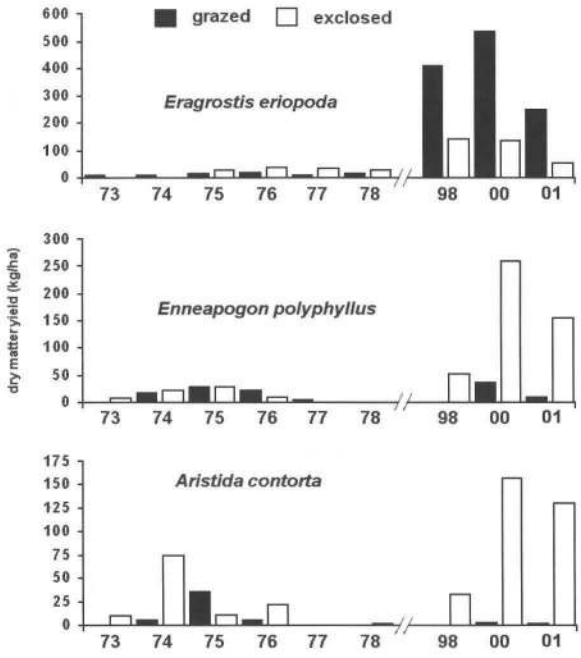

Figure 4. Comparison of dry matter production for three pasture grasses between 1973-1978, and between 1998-2001, at Spinifex bore cattle exclosure. Mean dry matter production based on 180 x 1m² harvested sampling plots for each year of the 1970s (Foran 1973), and 800 x 1m² visually estimated sampling plots between 1998-2001.

There is no doubt that the pasture inside the exclosure has a better balance of coarse perennial grasses (*Eragrostis eriopoda* and *Triodia schinzii*), with nutritious annual grasses (*Enneapogon polyphyllus* and *Aristida contorta*) contributing up to 40 percent of total pasture inside the exclosure in good seasons. It can generally be concluded that the relatively short 50-year history of livestock grazing at this site has resulted in some deterioration to the balance of useful pasture plants, assuming that pasture composition pre-1954 was similar to that found inside the exclosure today. Regardless of this, the study also shows that an equally stable, if not more stable, vegetation has developed under grazing, which is an important consideration in a region where drought conditions are characteristic.

Acknowledgements

The Cadzow family, Mt. Riddock station, have kept the exclosure intact for the past twenty years.

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MONITORING SHOWS IMPROVEMENT IN GASCOYNE – MURCHISON RANGELANDS

Ian Watson, Department of Agriculture Western Australia, PO Box 483 Northam WA 6401.
Email: iwatson@agric.wa.gov.au
Philip Thomas, Department of Agriculture Western Australia, Locked Bag No. 4, Bentley Delivery Centre, WA 6983. Email: pthomas@agric.wa.gov.au

Resilience in the Gascoyne – Murchison rangelands

We hear a lot about degradation in the Australian rangelands, but the latest results to come from the Western Australian Rangeland Monitoring System (WARMS) suggest that change for the better can also occur.

The good news from WARMS is that the rangelands of the Gascoyne – Murchison region are not moribund and substantial resilience remains. The rangelands have demonstrated the capacity to show marked improvement given the right conditions.

The results from 223 WARMS sites reassessed in the Gascoyne - Murchison Strategy area (Lewis 2001) show improvements in a range of attributes related to perennial vegetation between 1993 and 2001. Improvements were seen in species known to decrease under grazing (Decreasers) as well as species known to increase (Increasers).

Given that range stability in the shrublands of the region is dependent on healthy and vigorous shrub populations, the results demonstrate that positive change has occurred across large areas of the pastoral rangelands in the Gascoyne - Murchison area.

The analysis reported here was done as part of the development of a monitoring and evaluation framework for the Strategy within the "EMU' project outlined by Hugh Pringle and Ken Tinley in an earlier Newsletter (Pringle and Tinley 2001).

What is WARMS?

WARMS is a system of about 1,600 ground based sites throughout the pastoral areas of Western Australia used to provide an indication of change in the rangelands. Grassland sites are used in the Kimberley and Pilbara. Shrubland sites are used in the southern Pilbara through to the Nullarbor. The data for this article come from Shrubland sites only.

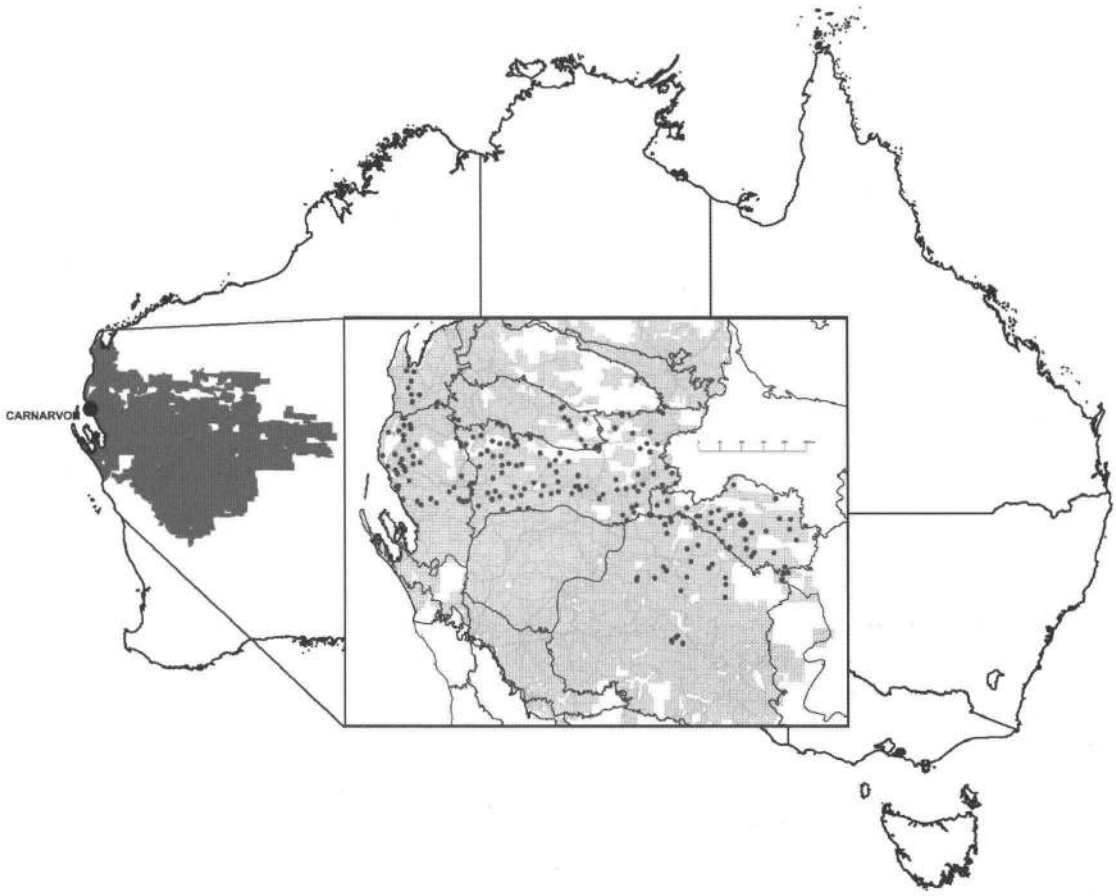

Figure 1: The pastoral rangelands of the Gascoyne – Murchison Strategy area in Western Australia and locations of the 223 reassessed monitoring sites. The scale shown on the inset map indicates 50 km increments from 0-250 km

Since there are only several sites per station, the principal aim of WARMS is not to provide a management tool at the station scale. Rather it is to provide information at the regional, district or vegetation type scale, reporting *"... to parliament, its agencies and the community ..."* (Holm 1993).

The areas sampled by WARMS sites are representative of the rangelands in the region, although there were some well defined biases to site selection. At the regional level, site locations were based on vegetation type, biased towards areal extent, pastoral productivity and fragility. At the local scale, the sites were located to represent the range of vegetation states within an area (although the majority of sites were on the most common state), to proportionally represent the major land units and to represent the largest grazed areas of a particular type within each paddock. Isolated or small areas that might be preferentially grazed were avoided, as were holding paddocks, river banks and isolated examples of actively eroding country. The majority of sites were located within grazing distance of water.

These site location criteria impose some caveats to the interpretation of WARMS results. Caution should be exercised in assuming that all Gascoyne – Murchison rangelands have improved. For example, the sites do not necessarily represent rangelands within the Gascoyne - Murchison area that have acute degradation problems. Identification and management issues arising from these degradation "hotspots" are addressed by range condition surveys, individual pastoral lease inspections and the activities of the "EMU" project of the Gascoyne - Murchison Strategy.

The rangelands of the Gascoyne – Murchison are mostly arid or semi-arid shrublands and it is the shrub component of the vegetation that is primarily monitored by WARMS. Sampling also includes standard CSIRO Landscape Function Analysis techniques (Tongway 1994) although results from these data are not presented here.

At each sampling, a complete census of shrubs was taken. That is, the locations of all individuals were recorded on permanent transects. The maximum canopy height (to a limit of 205 cm) and width was also assessed. All shrub species were included except those typically living for only five to ten years. This means that the WARMS sampling is concerned with the long lived components of rangeland vegetation. These components are well related to range stability and condition. Furthermore, they are not affected by short term seasonal fluctuations in the same way as annual and ephemeral vegetation.

Densities were calculated from the census data, as was recruitment. Canopy area was calculated from canopy width, after making the assumption that canopies were circular in plan view. Canopy size was a simple addition of width plus height.

Results for species are presented here for populations of "reasonable number", i.e. where there were at least 20 individuals. This was simply to filter extraneous results coming from small populations. For example, if a population of a single plant is joined by one recruit, the density has increased by 100%.

Data used in this study

There are 650 Shrubland sites in the Gascoyne – Murchison area. Of these, 223 had been reassessed up until the middle of 2001. These sites were installed between November 1993 and February 1997 (Date 1) and reassessed between August 1999 and June 2001 (Date 2). The average time between installation and reassessment was 5 years and 3 months. Three-quarters of the sites were located between 1.5 and 3.5 km from permananent stock water.

The data set consisted of a total of 36,167 individual shrubs and 2,231 "species by site" combinations, containing 143 different species.

Results

Substantial increases in density were observed for both the majority of sites and the majority of species (Figure 2). The average increase in density for all sites was 47%, when all individuals of all species were considered on each site. The average increase in density for each species was 59%. The average population growth rate of Decreasers was similar to that of Increasers and Intermediates.

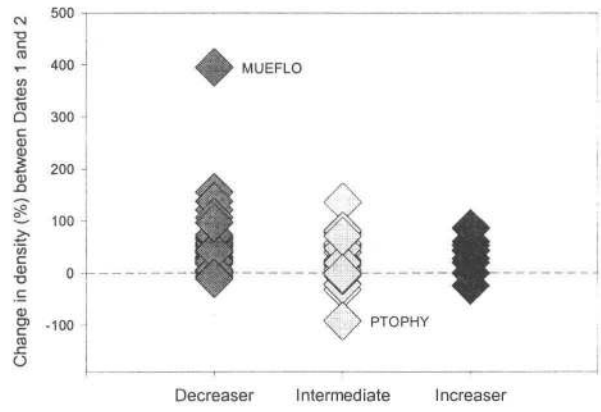

*Figure 2. Change in density (%) for species aggregated across sites, and grouped by response category. Each diamond symbol represents an individual species. There was an increase in density between the two dates for all those species above the dashed line. Outliers noted are MUEFLO (*Muehlenbeckia florulenta*, lignum) and PTOPHY (*Pittosporum phylliraeoides*, snotty gobbles).*

Canopy area, used here as a surrogate of cover, increased on 214 of 223 sites (96%), by an average of 81% (Figure 3).

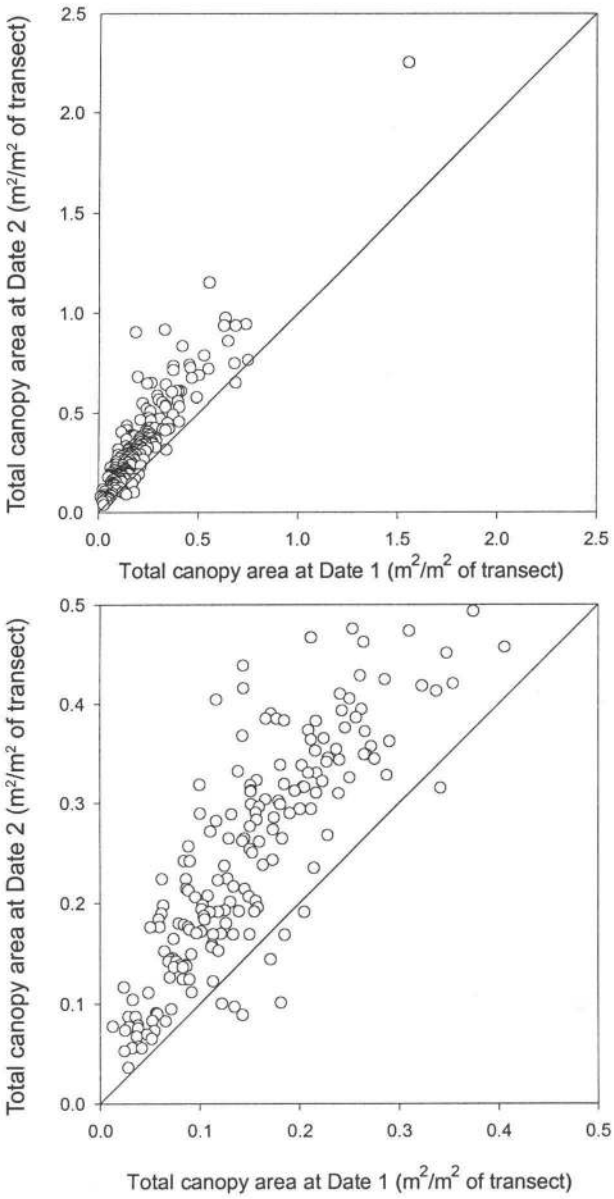

Figure 3: Change in total canopy area for all sites between Date 1 and Date 2. Each symbol represents a single site. Total canopy area increased between Date 1 and Date 2 for all sites above and to the left of the diagonal line. The top pane shows all data, the bottom pane is an expanded view to better show changes where the total canopy area at Date 1 was less than 0.5 m^2/m^2.

Individuals that were alive at both dates were used to determine changes in canopy size for each species. The average increase in canopy size per species was 73%. The average increase for species known to decrease under pastoral grazing was less, at 53%. The canopy size increased for all species (of "reasonable number"). These results suggest vigorous growth over the assessment period and indicate healthy populations.

At the local scale, 86% of species increased their distribution, i.e. they were found on more sites at Date 2 than Date 1. There was no difference between response categories. Decreaser species were just as likely to be found on more sites as Increaser species.

Species richness by site increased an average of 15% and on 91% of sites there were at least as many species at reassessment as at installation (Figure 4).

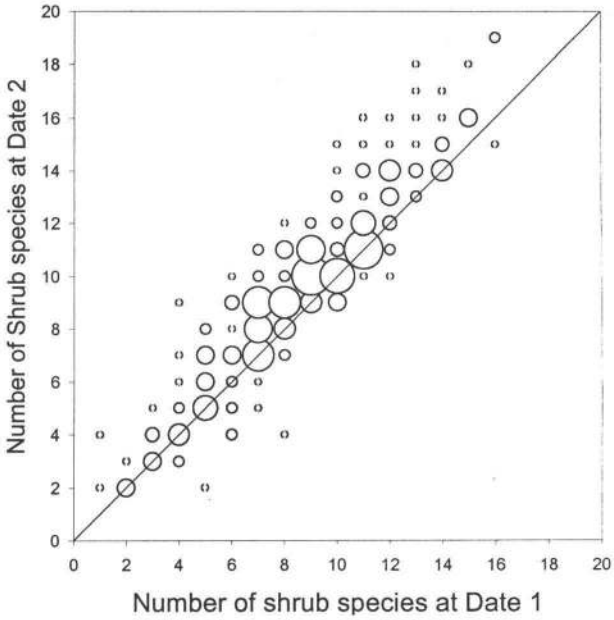

Figure 4: Species richness: number of shrub species on each site at Date 1 and Date 2. Each symbol represents a site and where multiple sites have identical values at Date 1 and Date 2 the bubble size represents the number of sites having these values. The number of species increased between Date 1 and Date 2 for all sites above and to the left of the diagonal line.

Recruitment was widespread spatially and widespread across species, including Decreaser species. There was recruitment on all 223 sites and for almost all species (96%) when considering populations of "reasonable" initial number.

Species known to be "woody weeds" increased in density, canopy size and distribution. However, the increases were similar to those found for Decreaser species.

Taken together, these results are impressive because of the consistency between sites, the consistency between species, and the scale of the improvement. They show that the shrublands of the Gascoyne - Murchison are not moribund and are capable of responding when circumstances allow.

Season or grazing?

The Gascoyne - Murchison area received unusually high rainfall, particularly during summer, over the assessment period. There is no doubt that the high rainfall was a major factor in producing these good results.

Assessing the contribution of pastoral management to these results is more difficult. Pastoral management has generally become more benign over the last few decades

and some improvement in perennial vegetation would be expected. It may be that this relatively wet period allowed those management gains to be expressed. That is, that improved management over time conditioned the rangelands to respond. Good rainfall in the 1990s triggered this response. In the absence of either good rainfall or good management, the observed changes were unlikely to occur.

Whatever the cause, whether season or grazing, the main issue is that there have been substantial positive changes observed on all areas of the Gascoyne - Murchison where data are available.

Will the trend continue?

The results show marked, rather than marginal, improvement. The scale of the change suggests that it is not part of a trend, since it is unlikely to continue at the same rate over the next reassessment interval. More likely, the change captured by WARMS was a "once-off" or transitional event (Westoby *et al.* 1989). Time will tell whether the increased populations remain and whether new stable states have been reached or whether the transition was temporary only. The immediate management challenge is to maintain these improvements and avoid making transitions back to less desirable states.

Further detail

This article has been abstracted from a recently completed, but unpublished, report *"The Western Australian Rangeland Monitoring System (WARMS) in the Gascoyne – Murchison Strategy area, including an assessment of recent changes to shrub populations"* by Ian Watson and Philip Thomas (November 2002). Please contact us if you would like a copy or more detail on WARMS.

Acknowledgements

The Gascoyne – Murchison Strategy is a partnership of the Natural Heritage Trust, Rural Business Development Corporation, Department of Agriculture Fisheries and Forestry Australia, the Western Australian and Federal Governments, and the pastoral community of the Gascoyne - Murchison region. The Western Australian Rangeland Monitoring System (WARMS) is a core funded activity of the Department of Agriculture, Western Australia.

The report from which this article was prepared, or the article itself, was improved by comments from David Blood, Andrew Craig, Wayne Fletcher, Alec Holm, Angas Hopkins, Hugh Pringle and David Wilcox, although the conclusions presented are those of the authors. Josh Smith produced the maps. Wayne Fletcher and Kerry Skinner collected most of the data.

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NEW CONTACT DETAILS FOR ARS PUBLICATIONS COMMITTEE

If you need to contact the Australian Rangeland Society Publications Committee, please note that the contact details for the Chairperson, Leigh Hunt, have changed. Leigh's new details are as follows:

Leigh Hunt
CSIRO Sustainable Ecosystems
Tropical Ecosystems Research Centre
PMB 44
Winnellie, NT 0822
Tel: (08) 8944 8485 Fax: (08)8944 8444
Email: leigh.hunt@csiro.au

BIODIVERSITY MONITORING IN THE RANGELANDS – HIGHLIGHTS FROM A NATIONAL EXPERT TECHNICAL WORKSHOP

Anita Smyth, Centre for Arid Zone Research, CSIRO Sustainable Ecosystems, PO Box 2111, Alice Springs, NT, 0871. Email: anita.smyth@csiro.au

Background

An expert technical workshop on rangeland biodiversity monitoring was held in Alice Springs during late October 2002. It grew out of the National Land and Water Resources Audit proposal to implement an Australian Collaborative Rangelands Information System (ACRIS).

At its final meeting in May 2002, members of the National Rangeland Monitoring Coordinating Committee were made aware of the knowledge gaps in rangeland biodiversity monitoring by an author of the Tropical Savannas CRC (TS CRC) report on *Developing an Analytical Framework for Monitoring Biodiversity in Australia's Rangelands* and others with expertise in biodiversity research and planning. Most agreed that biodiversity monitoring still needed work before it could be implemented as a component in ACRIS at a national scale. In recognition of this, Environment Australia contracted the Centre for Arid Zone Research at CSIRO Sustainable Ecosystems in Alice Springs to organise the workshop through a Steering Committee of Commonwealth, State and Territory experts.

Workshop Objectives

The intent was to bring together experts on biodiversity monitoring in the rangelands to build on the TS CRC report and to produce:

- a brief review of new (often unpublished) research on biodiversity monitoring in the rangelands identifying what we know, what we don't know and how to move forward;
- an assessment of the adequacy of monitoring attributes and techniques, with an emphasis on value-adding existing information and learning from past experience;
- a "manual" of the most appropriate monitoring attributes and techniques for the different monitoring purposes of rangeland clients for use now and for input into the national *NRM Matters for Targets* being developed by Environment Australia; and
- guiding principles for an operational framework for rangeland biodiversity monitoring to support adaptive management and improved decision-making in biodiversity maintenance.

Thirty-four participants with research backgrounds in landscape surface processes, fire, grazing, native plants, weeds, invertebrate aquatic and terrestrial animals, vertebrate terrestrial animals including feral predators and grazers, and statistical analytical techniques attended the workshop. Most participants were from biodiversity conservation or NRM planning agencies in State and Territory governments. Others came from CSIRO, various universities and a mining enterprise with pastoral interests. The outputs of the workshop reflect their collective wisdom on present day knowledge of biodiversity monitoring in the rangelands.

Highlights

- The purposes for rangeland biodiversity monitoring identified by 28 government and some non-government rangeland stakeholders from a pre-workshop survey and during the workshop itself.
- Seventeen state-of-the-art papers developed by experts on the key issues of biodiversity monitoring in the rangelands.
- Fifty-six specific attributes of land use pressures and biotic responses identified as being the most appropriate ones to monitor.
- Eighty-nine techniques identified as the most appropriate ones for monitoring the different attributes.
- An appraisal of the data quality of measures captured by each monitoring technique produced for specific land use pressure and biotic attributes.
- Appropriate indicators for regional and local-scale biodiversity reporting identified.
- Preliminary guiding principles for developing an operational framework to support biodiversity monitoring programs established.
- New knowledge and research needed to improve rangeland biodiversity monitoring in the future identified.

More information on the highlights can be obtained as from the following sources. follows:
The proceedings will be produced as a report titled *Biodiversity Monitoring in the Rangelands: a Way Forward* to be released on the Environment Australia website (www.ea.gov.au) soon after 7 February 2003. Alternatively, contact the Communications Officer at CSIRO in Alice Springs (karen.eva-stirk@csiro.au or phone 08 8950 7123). Additionally Commissioned papers will appear in a thematic issue of *Austral Ecology* in late 2003 subject to the journal's peer review process.

REPORT FROM COUNCIL

Lachlan Pegler, ARS Communications Officer, PO Box 224, Charleville QLD 4470.
Email: lachlan.pegler@dnr.qld.gov.au

Some of the most exciting news from the council is that David Wilcox has really started the web site project in earnest. It is shaping up as a key resource for all members of the society, as well as providing an attractive and informative face for the society to the world.

Other important council issues included:

- The Society membership rates will be increased in 2003, as the current fees are not covering production costs. For example, the new rate for individuals/families will be $80 (see the article from ARS President Merri Tothill later in this newsletter).
- The conference organisers have reported a preliminary estimate of the profit from the Kalgoorlie conference to be over $10 000.
- A quote was accepted from a web site developer to establish and produce a site, as soon as possible. The site development is progressing well with an advanced draft site already developed. Members have been supplying David Wilcox with photographs from across Australia to illustrate the site.
- The publications committee are investigating the options for electronic publication of the journal in the future.
- Council members will be attending Federation of Australian Scientific and Technological Societies (FASTS) workshops on planning and communication in societies (Lachlan Pegler & Robyn Cowley) and managing societies for membership benefit (Robyn Cowley).

JOURNAL SPECIAL ISSUE PROVES POPULAR

Leigh Hunt, Chair, Publications Committee, CSIRO Sustainable Ecosystems, Tropical Ecosystems Research Centre, PMB 44, Winnellie NT 0822.
Email: leigh.hunt@csiro.au

Members might be pleased to learn of the success of the last special issue of *The Rangeland Journal* (Vol. 24(1)) which was published in June last year. You will recall that the issue focused on vegetation management in Queensland, and in particular the issue of clearing of vegetation. Papers addressed a range of topics such as the consequences of clearing for various resource values, including biodiversity and grazing, the effects on landscape processes, and policy and other management issues. The issue was edited by Clive McAlpine, Rod Fensham and Sue McIntyre.

Over 100 copies of the special issue have been sold to non-members. Copies were ordered by people from all over Australia, including Tasmania, although as one might expect the majority went to Queensland. State land management authorities and conservation groups purchased numerous copies.

One of the aims in producing special issues of the Journal is to attract interest in the Australian Rangeland Society and its activities from outside. This is partly intended to broaden the readership and the author base for the Journal, and also attract new members. Clearly this special issue has been a great success in raising the profile of the Journal and we can only hope that this encourages more people to join the Society and participate in its activities.

Because of the unprecedented demand for the special issue we have now run out of stock, and are currently unable to satisfy about seven international orders for it. So if you no longer have a need for your copy and would like to help the Society promote itself internationally, our subscription manager (Ian Watson) would happily accept your copy for 'recycling'. If you can help out please send your copy to him at the following address. Thank you!

Dr Ian Watson
Subscriptions Manager
Australian Rangeland Society
c/o Department of Agriculture Western Australia
PO Box 483
NORTHAM, WA, 6401
Tel: 08 9690 2128 Fax: 08 9622 1902
Email: iwatson@agric.wa.gov.au

OLD COPIES OF THE JOURNAL AND NEWSLETTER WANTED

Ian Watson, ARS Subscriptions Manager, c/- Department of Agriculture, Western Australia, PO Box 483, Northam WA 6401. Email: iwatson@agric.wa.gov.au

Do you have some old copies of the Journal and Newsletter, in good condition, that you would be prepared to return to the Society? As mentioned above, from time to time the ARS gets orders for back issues, either because we get retrospective orders for membership (often from libraries or institutions) or because for some reason the issue gets lost in the post. Sometimes we don't have enough copies of old issues to cover the backorders.

In addition to the back issues required for last years special issue, we also have an immediate requirement for the following:

Range Management Newsletter 01/1 and 01/2 – the first 2 Newsletters of 2001 (1 copy of each required)

I would very much appreciate anyone who has copies of these that they have finished with to contact me (details above) so that we can arrange their redistribution.

ARS SUBSCRIPTION RATES INCREASE FOR 2003

Merri Tothill, ARS President, PO Box 357, Port Augusta SA 5700. Email: Tothill.Meredith@saugov.sa.gov.au

By now, you should have all received your renewal notices for 2003. You will no doubt have noticed that Subscription Rates have increased this year. Subscription rates last increased in 2001, most of that increase being due to the addition of GST for the first time. The need to raise rates is unfortunate, but necessary to keep pace with rising costs. Please be assured that Council continues to look for ways to reduce costs and increase efficiencies so that Subscription Rate rises are kept to a minimum.

The full rate list is included below. Note that all rates include GST and postage and handling.

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Student	A$30
Student Overseas	A$35

INSTITUTION OR COMPANY

FULL (Journal & Newsletter)	
Australia	A$110
Overseas (Air Mail)	A$135
PART (Newsletter only)	
Australia	A$60
Overseas (Air Mail)	A$70

ADDENDUM TO LIST OF ARS MEMBERS AS AT 15 OCTOBER 2003

The following people were inadvertently left off, or were incorrectly listed, in the member list published in the November 2002 Range Management Newsletter.

Bruce Alchin, Agriculture and Horticulture, University of Queensland (Gatton) Gatton QLD 4343

Ockie Bosch, Natural and Rural Systems Management, University of Queensland (Gatton) Gatton QLD 4343

Kamaljit Kaur Sangha, Central Queensland University, Emerald QLD 4720

FURTHER FEEDBACK FROM THE 12th BIENNIAL ARS CONFERENCE

David Lord, 'Thackaringa' Station, via Broken Hill, NSW, 2880. Email: thackaringa@bigpond.com

The theme of the conference "Shifting Camp" was more of recognition the constantly changing world we live in, rather than promoting new concepts for the rangelands. Rather than giving a précis of each paper I would like to reflect upon what I considered to be the tone of the conference.

ARS conferences are always well attended by bureaucrats, academics and scientists and not so well by land managers. This imbalance is largely our fault. I believe, however, that often there are few take home messages from conferences of this type that will justify, in the short term, the time taken from core business on the property. Future conference organisers need to include some more pragmatic sessions that land managers would value in order to get a greater attendance from this group.

Day 1 did see some blaming and looking back at past mistakes, which in my view is pointless. For example, the "extinction rate" in Australia came up again. I believe this is too complex an issue to lay blame at any one cause. This issue was raised again later in the conference, and one scientist did acknowledge - "*we are no doubt in a major extinction phase in the World's History.*" That comment is a positive "shift", as too often some people take a very narrow view and blame the extinction rate on pastoralism.

There were some interesting points by the economists - one being that it has taken 30 years for good commodity prices to coincide with good seasonal conditions in Northern Australia. A long-term view like that is very important, as too often judgement is made on a much shorter period.

A subsequent paper looked at the wool industry, its return on investment, declining terms of trade, employment figures etc. The data used was from the period 1992-1997 – this is hardly fair period to judge the industry on, or to pass the comment "*we need to be hard nosed about the value from grazing.*"

One change which was not recognised, and it is probably the most significant for much of the rangelands for 50+ years, is the impact of Rabbit Calicivirus Disease (RCD) on total grazing pressure, and the quick effect it had on biodiversity (also hopefully we will see a positive trend in economic values for land managers down the track). This to me is a glaring omission, and suggests that there is a serious disconnection between some sections of the rangeland community and what is happening in the paddock. It is important that we remind those people to take some time out of the office and come out for a look. It is also clear to me that some of the older people with perhaps 30 plus years experience, but not actually hands on, value the land managers much more than some who have perhaps only 10 or so years experience – remember the 30 year cycle.

Another interesting paper was presented by a member of the mining industry, who offered a range of views of the value of their inputs to production and conservation in the rangelands. I believe that the contrast between the resources available to these managers of rangelands, and the grazing fraternity were demonstrated by a range of biodiversity initiatives far out of the reach of any normal grazing operation.

An additional discussion point at the conference was related to communications changes. Computers were hailed a decade or so ago as being the magical tools which were going to enable huge management changes. Well that clearly didn't happen, and there are some wise people in the community who can say "*I told you so*". I believe, however, that the ability for people to access the web and use emails has brought about a major change in communications and life in remote Australia.

Towards the end of Day 2 of the conference the following comment was passed - "*These conferences are critical to prevent the discontent between land managers in the paddock and the administration of the state. It is debilitating at both ends*". I support that view. You get the opportunity to socialise with people who work in different areas of the rangelands, thus gaining some idea of the constraints they are working under.

I also believe it very worthwhile to get out of your comfort zone and attend such conferences because you benefit from talking to others and they gain from hearing your opinion. You come away with a broader view, although I doubt likely to make any significant management changes at home.

Another thing which made the conference enjoyable was the fact that I didn't necessarily agree with all that was said. This makes me pause and review my own thoughts and operation – which should improve my performance.

I thoroughly enjoyed the four days in Kalgoorlie, because I gained a better understanding of where other people associated with rangelands are coming from. This gives me the opportunity to view critically my own operation and thus argue my position more wisely.

NEW MEMBERS

Yohannes Alemseged
Trangie Agricultural Research Centre
PMB 19
Trangie NSW 2823

Deborah Bate
C/- Dept Land and Water Conservation
126 Lachlan Street
Hay NSW 2711

Wayne Fletcher
11 Drummond St
Toodyay WA 6566

Dr Ed Barrett-Lennard
Department of Agriculture, WA
Private Mail Bag
Bentley Delivery Centre WA 6983

Ray Tauss
PO Box 847
Nedlands WA 6909

Pastoral Program
Dept of Water, Land and Biodiversity Conservation
GPO Box 2834
Adelaide SA 5001

Serial Section - 2nd Copy Subs.
Central Library
University of Queensland
St Lucia QLD 4072

Swets Blackwell Ltd
GPO Box 4990
Melbourne VIC 3001

INFORMATION SNIPPETS

VIIth International Rangelands Congress

Don't forget that the next International Rangeland Congress to be held in Durban, South Africa from 28 July – 1 August 2003 is fast approaching. While early-bird registrations closed on 31 January, it is not too late to think about attending.

The IRC website (www.ru.ac.za/rgi/irc2003/IRC2003.htm) contains a wealth of information about the scientific program, registration, accommodation and field trips that are available.

All submitted abstracts are also available for viewing online in the relevant program session. By mid-January 670 abstracts had been received and processed (this number will increase as late submissions are processed). All abstracts will be published in the *African Journal of Range & Forage Science* 20(2). In addition, over 300 full manuscripts having been received and are being processed by the editorial panel. The panel report that the standard is extremely high with a majority of authors having had their manuscripts peer-reviewed.

Further information about the conference is available from the website or from:

Sue Bumpsteed Conferences
Private Bag X37, Greyville
4023 Durban South Africa
Tel: +27 31 303 2480
Fax: +27 31 312 9441
Email: delegates@sbconferences.co.za

International Association for Landscape Ecology 2003 Congress

The 6th International Association for Landscape Ecology (IALE) World Congress will be held from 13–17 July in Darwin, Northern Territory at the Carlton Hotel/Darwin Entertainment Centre complex. The theme for the conference is Crossing Frontiers: Landscape Ecology Down Under: Building bridges between cultures, disciplines and approaches.

This is the first time the world congress has been held in the southern hemisphere, and the first time it has been in the tropics. The theme of the conference reflects the dual goals of the congress, which are to highlight the frontiers of the science of landscape ecology and to develop the integrative nature of the science. Symposia are either half-day or full day and all relate in some way to the dual themes of frontiers in landscape ecology and of building bridges.

Further details of the conference including the symposia, registration and accommodation details are available from the conference website at www.iale.ntu.edu.au.

The local organizer for the conference is:

Dr Diane Pearson
Biological, Environmental and Chemical Sciences
Northern Territory University
Darwin NT 0909
Email: diane.pearson@ntu.edu.au
Tel: 08 8946 6046 Fax: 08 8946 7088

The Conference Secretariat is

Convention Catalysts Int.
GPO BOX 2541 Darwin NT 0801
Email: convention.catalysts@norgate.com.au
Tel: 08 8981 1875 Fax: 08 8941 1639

2003 National Landcare Conference

This conference will be held at the Carlton Hotel, Darwin, Northern Territory from 28 April - 1 May. The Conference has the theme of 'Respecting Values - Working and Learning Together'

The National Landcare Conference 2003 will provide an opportunity to showcase the successes of the Landcare movement around Australia. It will highlight the diverse land management cultures from indigenous communities to pastoralists to the tourist industry. The conference will emphasise the need to respect the different values involved in this diversity and the need for different groups to work and learn together.

Further details about the conference are available at www.landcareconference.nt.gov.au or from the conference organizers:

Desliens Conference and Event Management
Tel: 08 8941 0388 Fax: 08 8981 8382
Email: dcem@desliens.com.au

New Bureau of Rural Sciences Report Released - Understanding Landholders Capacity to Change to Sustainable Practices

It is well known that the human capacity to change to sustainable management practices varies across Australia's agricultural and pastoral landscapes. The Bureau of Rural Sciences has recently released a document examining this why these differences arise. As the report points out "*From both a policy-development and a scientific perspective it is important to understand how people conceive of and respond to the need for sustainable land use. If we want to arrest and reverse land and water degradation in rural landscapes we need first to understand what motivates those whose everyday decisions and actions influences land management.*"

This publication synthesises recent research by the Bureau of Rural Sciences, supported by the Social and Institutional Research Program of Land and Water Australia, and the National Land and Water Resources Audit, on the capacity of landholders to adopt sustainable practices. Policy makers, catchment management professionals, extension workers, community groups and those concerned with designing effective land management programs will all find this document of interest.

Although the publication is not for sale, limited copies are available from the Bureau of Rural Sciences Social Sciences Program at socialsciences@brs.gov.au. The report is also available in pdf format from the AFFA website (www.affa.gov.au) – look under Publications/ Bureau of Rural Sciences/Social Sciences.

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