The Australian Rangeland Society

RANGE MANAGEMENT NEWSLETTER
An official publication of The Australian Rangeland Society
ISSN 0812-4930

Citation
The material in Rangeland Management Newsletter has not been subject to peer review and may not be acceptable to some editors.

If cited it should be in the form:
Bastin, G. and Allan, G. (2012). After the smoke has cleared: 2011 fire in Central Australia. In: Range Management Newsletter (Ed. N Duckett). 12/2:3-6. (Australian Rangeland Society: Australia).

ISSN 0812-4930

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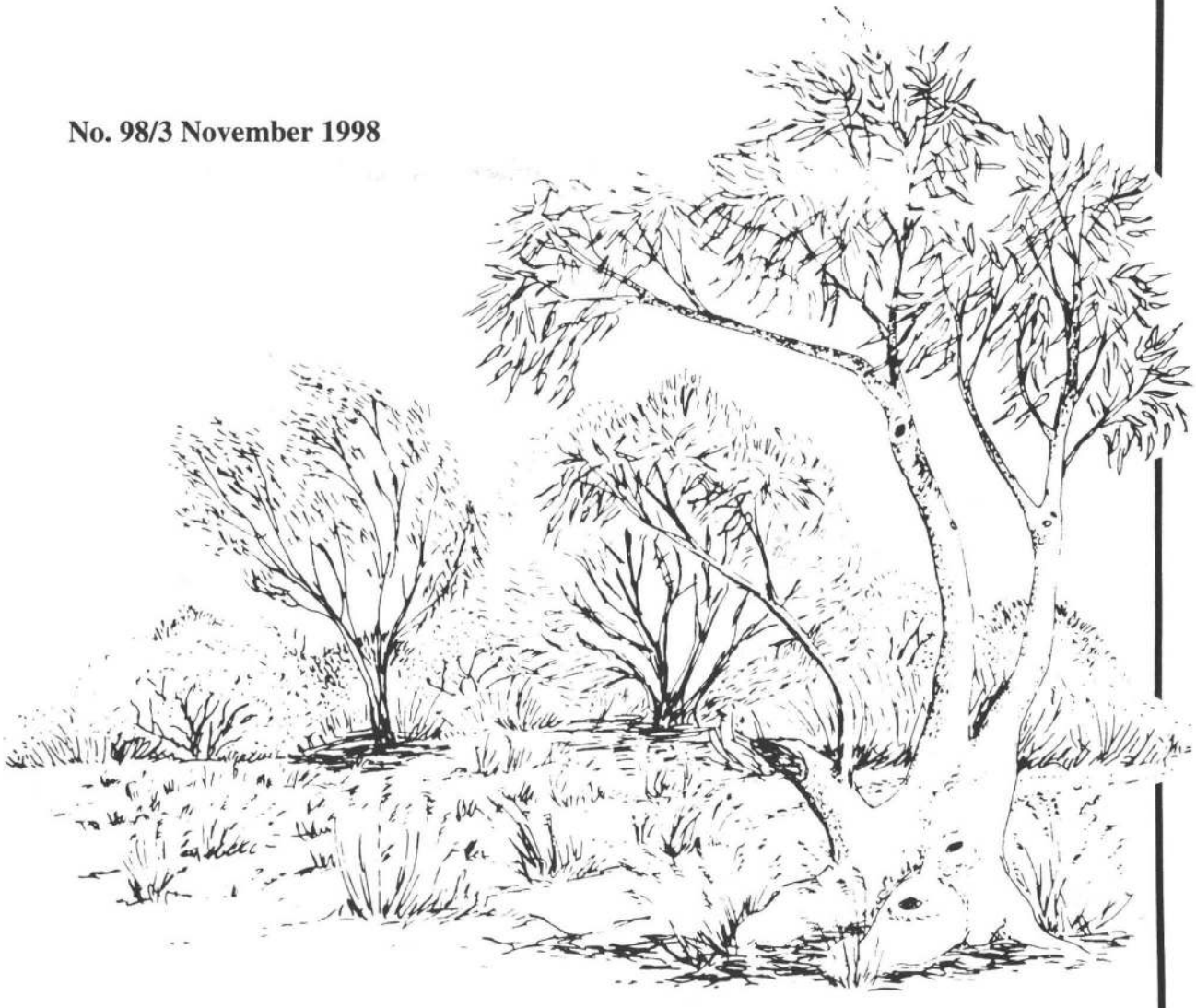
Range management Newsletter

No. 98/3 November 1998



Registered by: Australia Post - Print Post No. 545270/00001

No. 98/3 November 1998

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CONTENTS **Range Management Newsletter 98/3**

FROM THE EDITOR

Gary Bastin, CSIRO, PO Box 2111, Alice Springs NT 0871

Welcome to the final newsletter for 1998. This issue has two high-quality articles on different aspects of rangeland use. In the first article, John Ludwig and David Tongway report on the longer-term ecological success of using cut tree branches strategically placed across a site to achieve low-cost rehabilitation of degraded mulga rangeland. Although their results are at the scale of small experimental paddocks, they nevertheless provide valuable information about ecological processes involved in the successful restoration of this landscape type. The challenge now is to apply the technique at the scale of management while both maintaining its effectiveness and minimising costs. In the final section of their article, John and David provide some suggestions on how this might be achieved by adapting current practices of tree-pushing to provide fodder during drought and chaining to thin areas of dense scrub.

In the second article, Melinda Hillery and other CSIRO scientists describe the results of a survey to investigate the impact of tourism on natural attractions in the rangelands, and the extent to which visitors perceive the extent and importance of any such impact. Their results indicate that visitors to the survey area had a general awareness of negative environmental impacts of tourism and were able to rate the severity of such impact amongst sites locally and across regions within Australia. As the authors say, "these visitors present a potential paradox". They want to be able to visit natural areas with high scenic or cultural value yet recognise that such visitation poses a long-term threat to maintaining the intrinsic attractiveness of such areas.

The remainder of the newsletter has "letters to the editor" in response to recent articles, news from Council and reports on other activities relevant to the rangelands. I am sure that you will find something of interest in this issue. As this is the final newsletter for 1998, I take this opportunity to wish you a merry Christmas and all the best for 1999. And one final request. Included in this issue you will find your subscription renewal form for 1999. Please pay promptly so that you continue to receive the Society's publications.

I welcome your contributions to future issues. My deadline for the first *Range Management Newsletter* next year is the end of February.

TEN YEARS ON, CREATED LANDSCAPE PATCHES ARE STILL FUNCTIONING

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Summary

In August 1988, piles of mulga (*Acacia aneura*) branches were used to test experimentally whether vegetation patches could be recreated on slopes made barren by a grazing trial. The experiment was designed to verify the proposition that by consistently concentrating scarce resources onto a patch, soil properties would be markedly improved, favouring the establishment of perennial grasses. This experiment, conducted on Lake Mere Station, NSW, was monitored each spring, summer, autumn and winter season until 1991. After this three-year period, the branch-treated plots had greatly improved physical, chemical and biological soil properties and supported healthy populations of perennial grasses, especially compared to the experimental plots without mulga branches. These experimental results were reported in two companion papers (Ludwig and Tongway, 1996; Tongway and Ludwig, 1996). After 1991, the experimental plots were monitored each spring until 1995 and then again in August 1998. In this article, we report that after ten years, the mulga branch plots were still functioning as fertile patches. This is evident from their ability to produce a burst of plant growth following removal of grazing in 1997 and good rains in the summer and autumn of 1998. This 'good seasons' burst was not evident in non-patch plots, which (except for ephemerals) remained about as bare as after the 1991-1995 drought.

Introduction

Restoring the productivity of over-utilised rangelands is difficult from a number of different perspectives, particularly economics. This fact was documented in a series of papers in the *Australian Rangeland Journal* in 1989 (Vol. 11, No. 2) and 1990 (Vol. 12, No. 1). These papers, from a Rangelands Restoration Workshop (see Ludwig *et al.*, 1990 for a Workshop summary), reviewed the outcomes of applying a wide variety of different rangeland rehabilitation techniques, ranging from mechanical to chemical to biological. Treatments such as blade-ploughing, herbicides and reseeding, often in combination, did not result in rehabilitated rangeland in the longer term. Many were deemed to be failures.

The challenge has been to improve our understanding of both failures and successes with rangeland rehabilitation, and to derive simple indicators to predict when and where success is most likely (see Friedel *et al.*, 1994 for an excellent central Australian example). One approach is to study the spatial organisation of rangelands, identifying vegetation zones and patches which function to trap, store and utilise scarce resources (Ludwig and Tongway, 1998). Often, such landscapes can be described as patchy, because vegetation-soil zones are easy to

observe and categorise into runoff-runon patterns at the 2 to 50 m scale. Many grassy rangelands, especially those on heavy clay or very sandy soils tend not to be patchy (except at very fine scales), but many woodland and savanna rangelands on crusted clay-loam, red-earth soils are, particularly in regions with low, erratic rainfalls (e.g. central Australia) and on gentle topography (e.g. slopes < 1%). This landscape function approach suggests that rehabilitation will be achieved by rebuilding patches which serve to capture and retain soil water and nutrients in runoff, and organic matter in wind-borne litter, rather than have these vital resources lost from the system (see Noble *et al.*, 1997, for details).

The aim of this article is to revisit, after ten years, an experiment which was conducted to test whether landscape patches could be reconstructed from simple and available materials (mulga, *Acacia aneura*, branches) and in such a way (oriented along contours) as to re-establish the processes of resource capture and storage, and the utilisation of these resources by organisms. Initial results, after conducting the experiment for three years, were promising. Patches of mulga branches placed on the contour accumulated soil and litter, and captured runoff, forming habitats favourable for the establishment and growth of perennial plants (Ludwig and Tongway, 1996; Tongway and Ludwig, 1996), and for populations of soil invertebrates (Greenslade and Smith, 1994). However, a drought beginning at the end of the three-year experiment (1991) tested the long-term effectiveness of these created patches. As branch piles collapsed and decayed, plants appeared to be dying out because they were continuously being grazed and disturbed by sheep and kangaroos (at a rate of about 0.7 dry-sheep equivalents/ha). Here, we can happily report that after ten years (August 1988 to 1998), created patches are still functioning very effectively. Perennial plant populations are still vigorous, and with removal of grazing in March 1997 and with good rains in 1998, the canopy cover of key plant species has greatly increased compared to that in 1988 and 1991, but only within created patches.

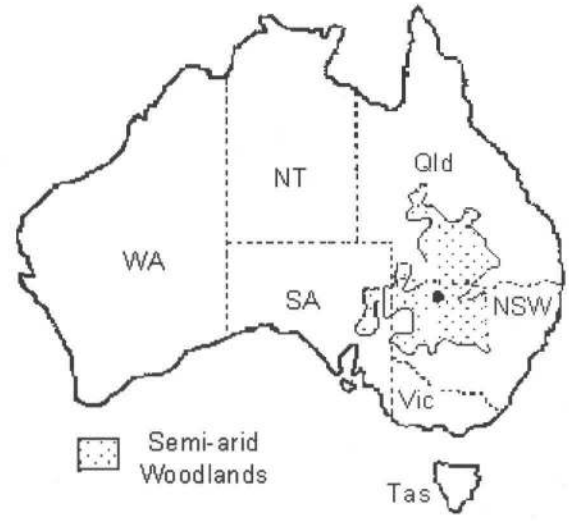

Figure 1. Location of the Lake Mere Study Area (•) within the semi-arid woodlands of eastern Australia.

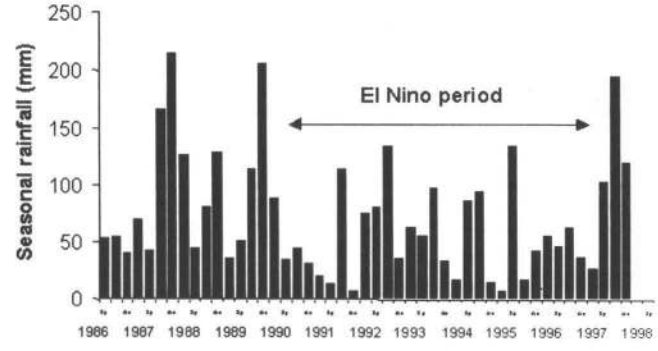

Figure 2. Rainfall for the Lake Mere Study Area, by season, 1986-1998.

The Experiment

In 1986, a 200 ha study area was established by CSIRO Wildlife and Ecology on Lake Mere Station (Fig. 1), located about 100 km west of Bourke, NSW. The study area is described in detail elsewhere (e.g. Tongway and Ludwig, 1990), but briefly, the topography can be described as gently undulating, with low stony ridges and gentle slopes (<0.5%) extending into weakly dendritic drainage lines (not incised). The vegetation is dominated by mulga, which is strongly patterned into groves or patches of mulga and open intergroves. The soils are highly weathered 'hard red earths', with a fine sandy clay loam surface texture and a gradational profile. Rainfall is highly variable from year to year and season to season (Fig. 2), but annually averages about 300 mm.

A grazing trial was established on the study area in November 1986. Details are provided elsewhere (e.g. Wilson, 1991a), but briefly, the study area was subdivided into 13 paddocks (labelled A-M). These paddocks were varied in size to obtain a range of stocking rates from 0.3 to 0.8 DSE/ha. Six of the paddocks had sheep and kangaroos, with the area of the paddock increased to keep the total stocking rate within the 0.3-0.8 DSE/ha range. During times of drought and feed shortages, these rates had to be temporarily reduced (sometimes to zero in heavily stocked paddocks). Forage and wool production and sheep weights were monitored every three months from 1986 to 1994 (see Hodgkinson and Freudenberger, 1997 and Wilson, 1991a, for results). Sheep and kangaroos were kept in some paddocks until March 1997, when all sheep and kangaroos were removed and kept out of paddocks A-E and L, while paddocks F-K were re-opened to the normal grazing levels of Lake Mere Station.

In August 1988, an experiment was established in paddock B to test our understanding of landscape function and rangeland rehabilitation. The objective was to see if fertile patches,

similar to those occurring naturally in mulga woodlands, could be recreated on a slope made bare by the grazing trial. Paddock B was stocked moderately high by sheep and kangaroos (0.7 DSE/ha). The slope selected for the experiment was barren (Photo 1). We wanted to test whether landscape processes and functions could be reinstated, that is, whether a pile of mulga branches positioned along slope contours would create aerodynamic drag to trap litter and would obstruct the flow of runoff to capture water and sediments, thereby forming 'fertile patches' favourable for microorganisms, animals and plants. The piles of branches would also protect those plants growing within the pile from being grazed, except for parts protruding from the pile.

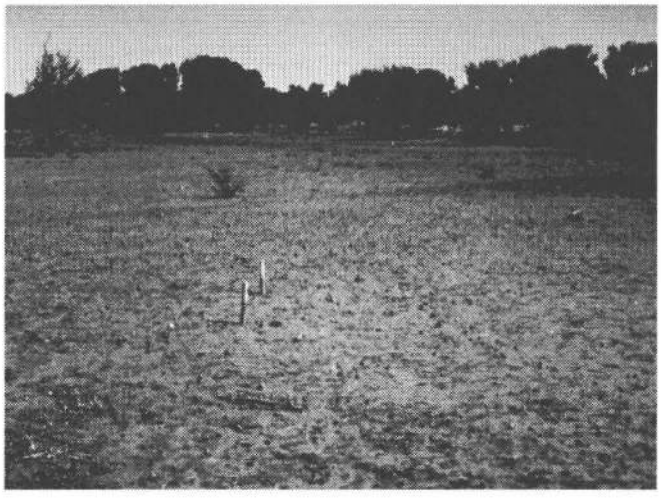

Photo 1. The bare slope in paddock B, Lake Mere Study Area, before the application of treatments (August 1988).

The experimental design was a replicated complete factorial for three treatments. Five transects were randomly positioned along contours on the bare slopes of paddock B (Photo 1). Each transect was partitioned into eight 2 m by 5 m plots. Three treatments, and their combinations, were applied randomly to these eight plots. The three treatments were, with and without: (1) mulga branches, (2) fertiliser, and (3) litter (Photo 2). Fertiliser and litter treatments were added to test whether nutrients and organic matter might also be important limiting factors for creating patches. The details of treatment applications are in Tongway and Ludwig (1996). Prior to application of treatments, soil samples were collected, soil surface levels were surveyed, and the densities and covers of all perennial plants were recorded in ten 1 m by 1 m quadrats within each 2 m by 5 m plot (Photo 3). These plant data were subsequently re-measured every season for three years through to the spring of 1991. Soils were re-sampled and surface levels were re-measured in the spring of 1991. [This experiment was also established in a portion of paddock M, which was essentially ungrazed from 1986 to 1991. However, since 1991 paddock M has been subjected to a number of different grazing impacts and, because of this inconsistent treatment, it is not considered here.]

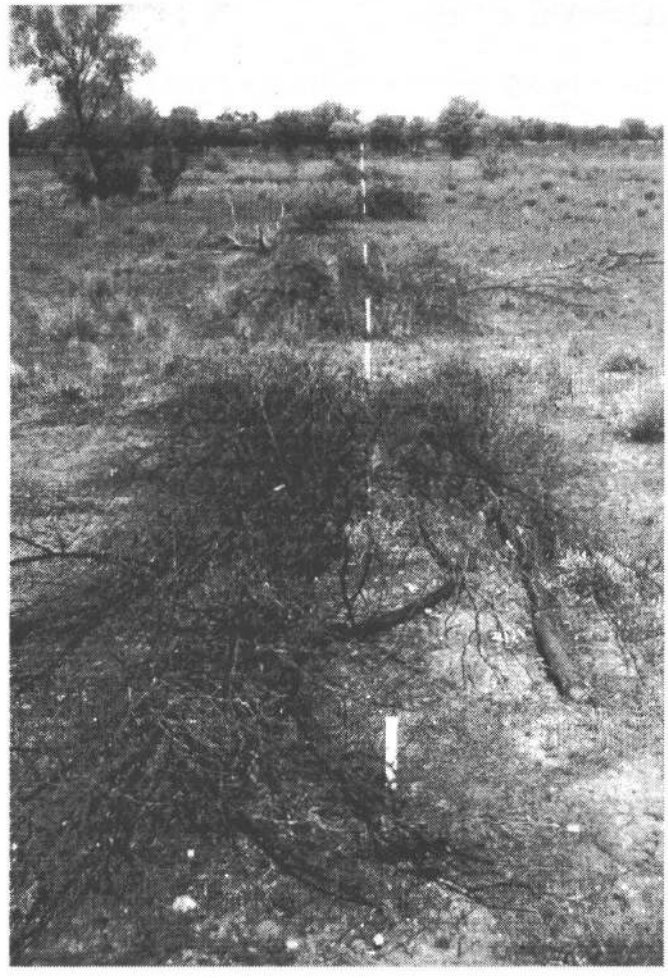

Photo 2. One of the five random transects in paddock B showing the application of mulga branch treatments (September 1989).

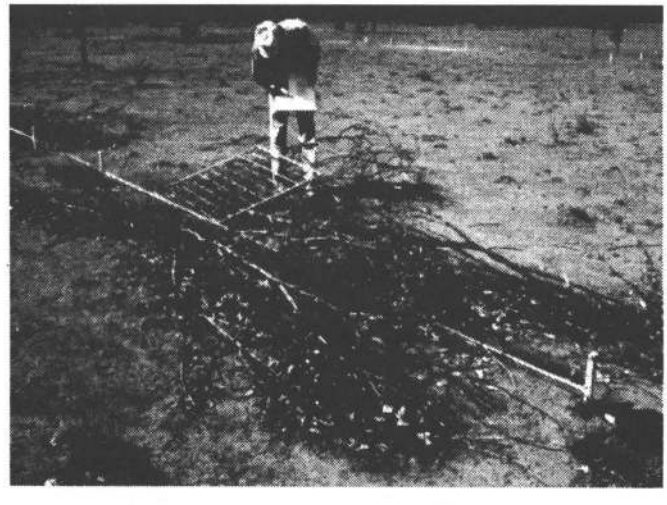

Photo 3. Charting the density and canopy cover of perennial plants in one of the 1 m² quadrats in the 10 m² (2 x 5 m) plots along transects in paddock B.

After Three Years

Results from the experiment in paddock B, over the three year August 1988 to September 1991 period, demonstrated how the mulga branch piles effectively trapped sediments in runoff, about 0.6 mm per year (Tongway and Ludwig, 1996). The plots with no branches lost an average of 0.9 mm per year, which raises some interesting speculation about rates of soil surface erosion under grazing, and what this might mean in the long term, especially since most nutrients such as available nitrogen are known to occur in the top few centimetres of the soil in many rangelands (Tongway and Ludwig, 1997).

After this three year 1988-91 period, water infiltration rate potentials were ten times higher within the branch patches compared to outside these patches (Tongway and Ludwig, 1996). The branch patches had become favourable habitats for many different types of soil invertebrates (Greenslade and Smith, 1994). Ants and termites formed biopores within these patches which enhanced infiltration rates (Whitford *et al.*, 1992). The greater biological activity within the branch patches was confirmed by soil respiration measurements - about ten times greater within patches (Tongway and Ludwig, 1996).

The fertility of branch patches also increased over the three years compared to non-branch plots (Tongway and Ludwig, 1996). The concentration of organic nitrogen and carbon was significantly greater in the top few centimetres of the soil collected from the patches. Cation exchange capacity and electrical conductivity were also significantly greater within patches (see Tongway and Ludwig, 1996 for a discussion of these differences).

From 1986 to 1990 perennial grasses, forbs and subshrubs established and grew strongly within the mulga branch treatments, but not in the plots with no branches (Ludwig and Tongway, 1996). The fertiliser and litter treatments had no significant effects on plant growth, except when in combination with the branch treatment. The *El Nino*-induced drought, which began towards the end of 1990 (Fig. 2), caused the foliage cover of all plant-types to dramatically decline, even within branch patches (Photo 4). Paddock B was still being stocked by sheep and kangaroos at a moderately high rate, which undoubtedly contributed to the decline in plant cover as animals sought feed. However, declines in plant density were less evident, as plants survived within areas protected by branches.

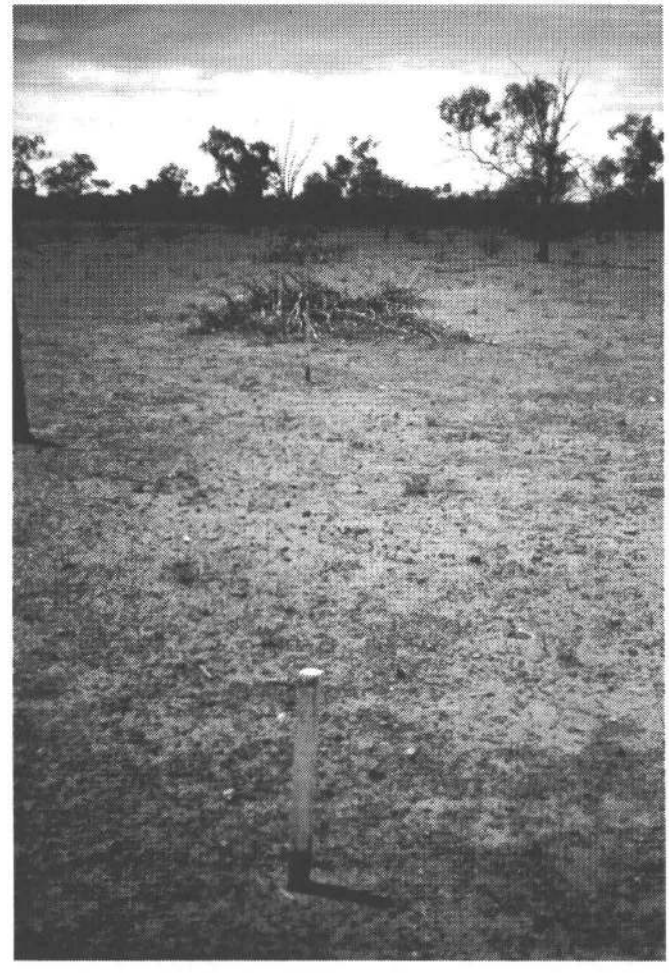

Photo 4. Except for within mulga branch piles, perennial plants remained rare on the slopes of paddock B after three years (September 1991).

Ten Years On

After the intensive season-to-season measurements from 1988 to 1991, perennial plant covers and densities were measured yearly until 1995, and then after a gap of two years, again in 1998. Measurements for ten quadrats in each of the eight plots along each of the five transects in paddock B were made in either late winter, spring, or early summer, depending on the timing of any growth pulses, and other time commitments.

After 1991, the run of generally poor seasons continued until 1997. Plant growth in 1991 and 1995 was particularly poor (see Photos 4 and 5, respectively). Then came the big '*La Nina*' drought-breaking rains in late 1997 and in 1998 (Fig. 2). These rainfalls triggered a pulse of plant growth, particularly within the ten year old branch piles (Photo 6; colour photos showing green-plant patches against a red-soil background are available from the authors).

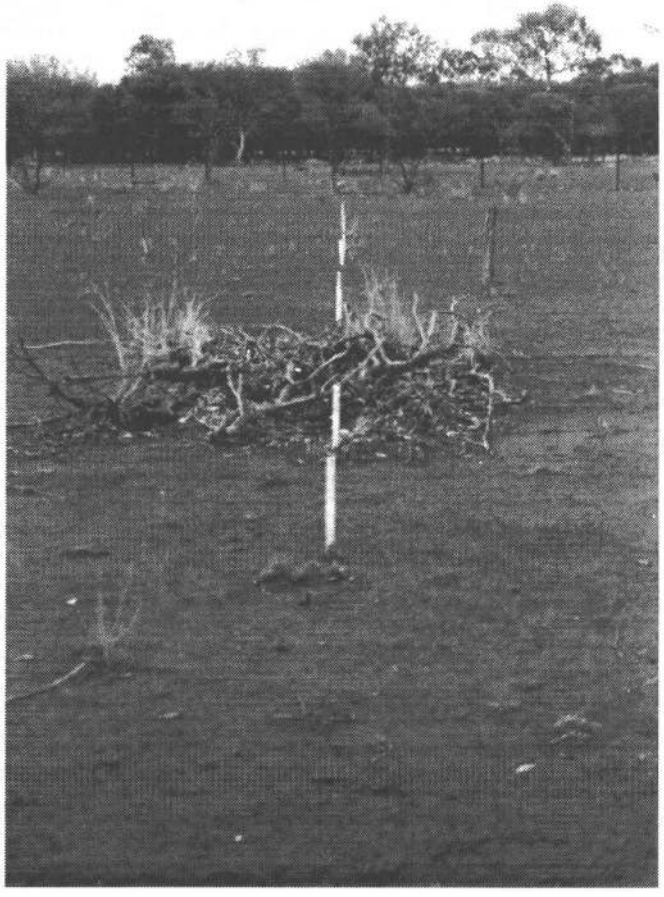

Photo 5. After seven years, and a run of poor seasons and continued grazing by sheep and kangaroos, perennial plants remained rare on the slopes of paddock B, except within mulga branch piles (November 1995).

Photo 6. Ten years on, perennial plants are especially abundant within mulga branch piles on the slopes of paddock B (August 1998). Plants seen between these patches are mostly ephemeral forbs and grasses.

Growth patterns for four of the many perennial plant species recorded will be used to illustrate how responses differed between the created mulga branch patches and non-branch plots. Repeated measures analysis of variance indicated that all four species had highly significant responses to the mulga branches treatment ($P < 0.01$; Table 1), and sometimes to fertilizer, litter, or the interactions of these with branches. In plots without branches, mulga mitchell grass (*Thyridolepis mitchelliana*), a palatable C3 plant, declined from about 2% cover in 1988 to nearly 0% in 1991, and with grazing remained very low in cover into 1995 (Fig. 3; actually, it remained low until late in 1997, when grazing was removed and the good late-1997 and 1998 rains came – David Freudenberger, *pers. comm.*). However, even with the good rains, its recovery was small (only increasing to about 1% cover), except within the old branch patches where it reached about 9% cover by late August 1998 (if follow-up rains occur, it is likely to peak at an even higher cover during the warmer spring months). Mulga oats (*Monachather paradoxa*) is another palatable C3 grass that had a growth pattern over the ten years very similar to that of mulga mitchell grass (Fig. 4). However, mulga oats appears to be more resilient to grazing as it had a greater recovery in non-branch plots with the good rains in 1998.

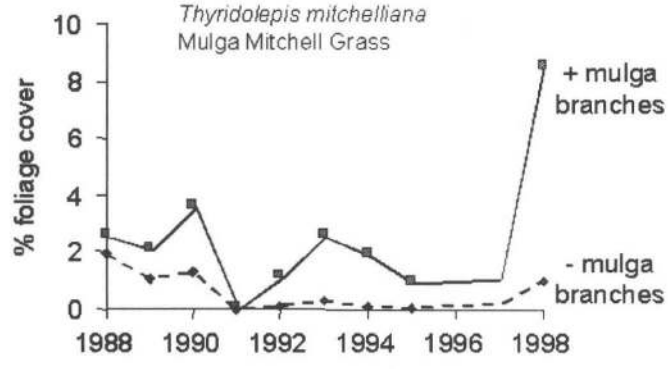

Figure 3. Foliage cover changes over ten years for mulga mitchell grass in plots with and without mulga branches, paddock B, Lake Mere study site. Although not measured, cover stayed low from 1995 to 1997 (David Freudenberger, CSIRO Wildlife & Ecology, pers. comm.*).*

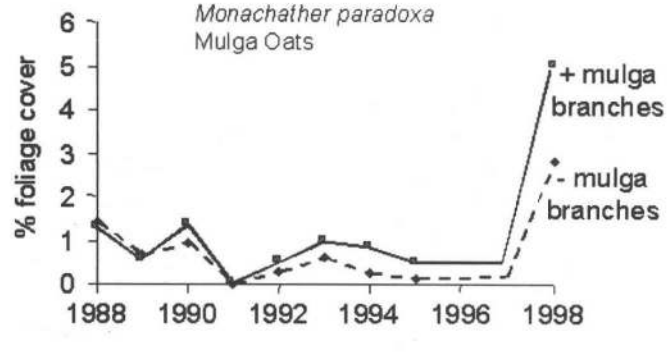

Figure 4. Changes in foliage cover over ten years for mulga oats in plots with and without mulga branches, paddock B, Lake Mere study site. Although not measured, cover stayed low from 1995 to 1997 (David Freudenberger, CSIRO Wildlife & Ecology, pers. comm.*).*

*Table 1. Repeated measures analysis of variance F-values for the significance of years and treatments (mulga branches, NPK fertilizer, mulga litter) on the foliage cover of four perennials assessed during nine spring seasons (1988-1998), and where * is P < 0.05, ** is P < 0.01 and *** denotes P < 0.001.*

Source of Variation	*Maireana villosa*	*Monachather paradoxa*	*Thyridolepis mitchelliana*	*Eragrostis eriopoda*
Across Repeated Measures[1]				
Years[2]	298.5***	216.4***	151.8***	24.6***
Between Treatments[3]				
Branches	272.9***	20.0***	136.1***	7.9**
Fertilizer	17.9***	11.6***	2.5	6.9**
Litter	8.7**	0.1	19.2***	0.0
Branches x Fertilizer	13.7***	2.0	0.7	9.6**
Branches x Litter	11.4***	0.0	45.4***	2.3
Fertilizer x Litter	2.2	1.5	0.1	0.0
Branches x Fertilizer x Litter	0.6	4.4*	7.1**	0.4

[1] For across repeated measures the significance of F-values is based on 8/3136 degrees of freedom.
[2] The interactions between year and the three treatments (branches, fertiliser, litter) were always significant ($p < .05$). This is expected due to the large changes in plant cover across years, especially into and out of the 1991-95 drought. For brevity, these interactions are not shown.
[3] For between treatments the significance of F-values is based on 1/392 degrees of freedom.

Woollybutt (*Eragrostis eriopoda*) is a relatively unpalatable C4 grass, which was common on the slopes of paddock B, although it tends to be more abundant on sandier soils (Ludwig and Tongway, 1995). The growth response of woollybutt was very similar to that of mulga mitchell and mulga oats, declining under grazing when unprotected by piles of branches and pulsing most strongly within the branch patches with the good 1998 rains (Fig. 5).

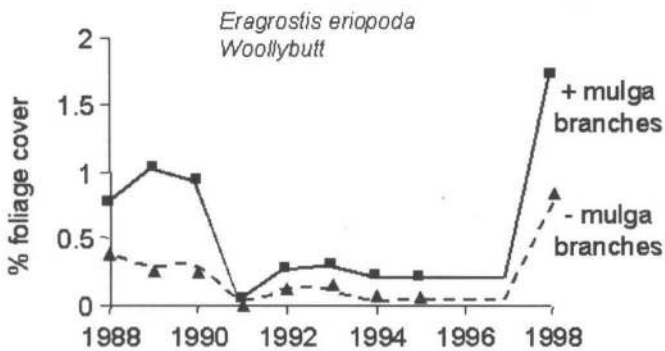

Figure 5. Foliage cover changes over ten years for woollybutt in plots with and without mulga branches, paddock B, Lake Mere study site. Although not measured, cover stayed low from 1995 to 1997 (David Freudenberger, CSIRO Wildlife & Ecology, pers. comm.).

Silky bluebush (*Maireana villosa*) is a perennial forb (or, when woody at the base, a sub-shrub), which is highly palatable and actively selected by sheep (Wilson, 1991b). Although present in paddock B, its cover was very low (even at the start of the experiment) until the good rains of 1998. Then with release from sheep grazing in 1997, it had a tremendous pulse of growth (Fig. 6), reaching nearly 30% cover in the branch plots. It remained very low in cover on the non-branch plots, and elsewhere in the paddock. Silky bluebush, a chenopod with a winged fruit and small seeds, probably requires a relatively good topsoil and a litter-covered seedbed to successfully establish (David Freudenberger, *pers. comm.*). It probably also requires good soil moisture levels to grow, conditions found within the mulga branch patches after the 1998 rains.

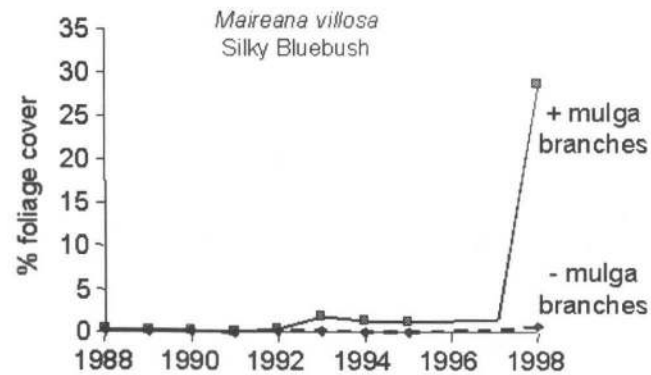

Figure 6. Changes in foliage cover over ten years in silky bluebush in plots with and without mulga branches, paddock B, Lake Mere study site. Although not measured, cover stayed low from 1995 to 1997 (David Freudenberger, CSIRO Wildlife & Ecology, pers. comm.*).*

Implications for Range Management

A look, after ten years, at piles of mulga branches placed in small rectangular patches (oriented along contours) within a paddock, grazed until 1997, documents that these patches are still functioning to capture water and sediments in runoff, and litter in winds. These resource-rich patches provide habitats favourable to a variety of organisms, such as perennial plants. These habitats allow these perennial plants to survive through droughts and continuous grazing pressures from kangaroos

and sheep, so that when good rains come, and when grazing is reduced, recovery is rapid. Regrowth is not as evident outside of such fertile patches, and tends to be limited to those plants (ephemeral forbs and grasses) adapted to establishing on hard, infertile soil surfaces.

Given enough time and a run of good seasons, plants with these adaptations might eventually form small patches on bare slopes. For example, kerosene grass (*Aristida contorta*) is able to 'drive' its seeds into hard surfaces, and thus colonise bare slopes. It is typically quite ephemeral, but given a run of good rains will live for a few years, perhaps long enough for individual plant tussocks, or clumps of tussocks, to form an obstruction to surface flows, trapping resources and starting patch processes (Anderson and Hodgkinson, 1997). However, these patches themselves might be relatively ephemeral under the pressures of grazing and drought.

Our Lake Mere experiment documents that small patches (10 m^2), formed from mulga branches, are quite robust – after ten years they are still functioning to capture sufficient resources (when the rains come) to generate large pulses of plant growth. Of course, creating fertile and productive patches in experiments is quite another matter to rehabilitating rangelands in practice. However, some rangeland managers do cut branches from mulga during droughts to provide emergency feed for sheep. Where this is done, managers could plan to create rectangular mulga branch piles in places where rehabilitation is most needed (Noble *et al.*, 1997). The piles could be placed along contours to maximise their effectiveness for trapping runoff.

Larger landscape patches could be created in places where the practice of chaining to thin dense stands of mulga, or other trees and shrubs, is used (Noble *et al.*, 1997). The aim would be to chain in strips along contours, so that piles of uprooted trees and shrubs would 'harvest' runoff from unchained upslope strips, leading to an enhanced growth of the perennial grasses which establish within these piles and strips. This practice has been applied in a few places by range managers with apparent success (Photo 7).

Photo 7. Mulga country chained in strips along contours.

Acknowledgements

We thank Robert Palmer for providing the rainfall data for Lake Mere. We also thank Robert Eager for analysis of the rainfall and plant data. We appreciate David Freudenberger's encouragement to continue long-term ecological research on the Lake Mere study site, and for sharing his knowledge about the site.

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TAKE NOTHING BUT PHOTOS, LEAVE NOTHING BUT FOOTPRINTS
How Much Environmental Change Do Tourists Notice and Do They Care?

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Looking for Wilderness

Tourists visiting the outback for a wilderness experience may notice more than we give them credit for. One of the difficulties of managing tourism in natural areas is that, as a place increases in popularity, the concentration of tourism can cause detectable environmental degradation. This in turn may degrade the quality of the visitor's experience, as with increasing wear and tear, the site loses the very attractiveness that made it so popular in the first place.

Much of the research into tourism in natural areas has concentrated solely on either the impacts of visitors on the environment *or* visitor perceptions of environmental change. Rarely have we linked the two. This makes it difficult to assess the extent of measurable environmental change that visitors are or are not aware of. In a recent study, CSIRO aimed to investigate the current relationship between environmental change and visitor perceptions. We examined the association between physical measures of change in the environment and the annual number of visitors to a site, and also whether visitors to such sites perceived changes to the environment, and their attitude towards these changes.

The Study Area

The western MacDonnell Ranges, due west of Alice Springs in central Australia, contain a variety of physical attractions including gorges, cultural sites and waterholes. We studied ten tourist attractions along a single access route (Figure 1). All attractions were within a few hours drive from Alice Springs and varied in annual visitor numbers from 135,000 to less than 1000 (Table 1).

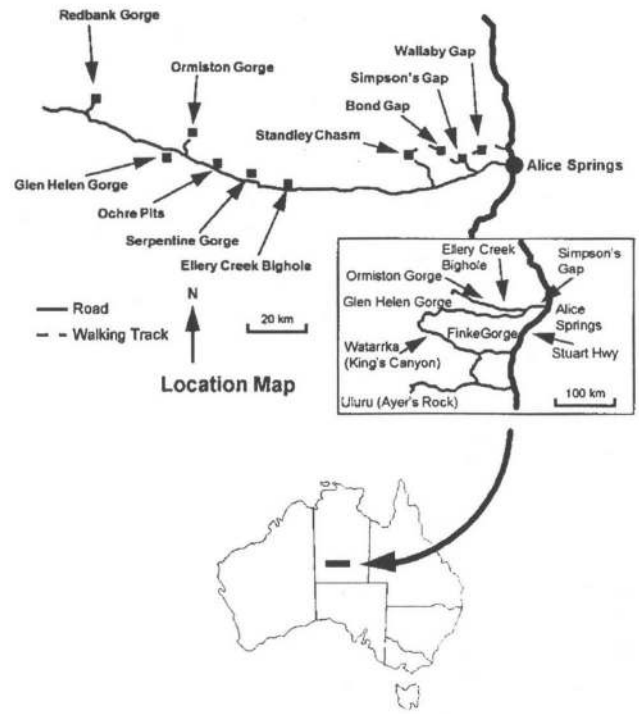

Figure 1. Location of the ten study sites in the western MacDonnell Ranges.

Table 1. Study sites and the total numbers of visitors to those sites in 1994. Visitor numbers have increased modestly since then, however their proportional distribution between sites has remained the same. Road count data collected by the Parks and Wildlife Commission of the Northern Territory. Marked sites (*) indicate where visitors were interviewed.

Site number	1994 visitor numbers
1	134,339*
2	128,216*
3	102,196*
4	>100,000*
5	83,621*
6	46,552*
7	29,059*
8	25,428
9	<1,000?
10	<1,000?

Measuring Signs of Environmental Change

Indicators of environmental change following tourism were measured at the ten sites in June and July 1997.

There was a great variety in layout and topography of each site so areas to be compared were standardised by determining an area of 'greatest likely tourism impact'. This area was within

20 m of the attractions themselves (typically waterholes) and for 20 m either side of the main route(s) of traffic away from the attraction for approximately 70 m (usually one or more formally built walking tracks toward a carpark).

Thirty plots, each 2 x 2 m, were randomly chosen within the area from a grid of points 10 m apart. For each plot the presence/absence of possible visitor impacts including plant damage (shrubs and ground plants), erosion (soil compaction, footprints in sand, gullying), direct visitor impacts (rubbish, formal tracks, informal side tracks, visitor amenities) and the presence of introduced species (weeds and feral animals) was recorded.

How Much Environmental Impact Did We Measure?

A relatively high percentage of plots (31.6%) were completely unaffected by any of the measured signs of environmental change, even though the sampling was done in areas predetermined to be areas of 'likely highest tourism impact'. The most widespread impacts in intensively used areas were the spread of side tracks (with associated erosion and ground plant damage), and the presence of buffel grass (*Cenchrus ciliaris*), an introduced plant species (Table 2). Overall, however, the level of impact was relatively low.

Table 2. The percentage of all plots affected by the most widespread environmental changes.

Environmental variable	% of total number of plots affected
informal tracks	31.3
groundcover damage	26.0
sand compression	24.7
buffel grass	19.3
soil compaction	13.3

Did Places With Higher Visitor Numbers Have More Environmental Change?

There was an increase in the level of environmental change with increasing tourism activity (as measured through annual visitor numbers) for some of the measured environmental variables (results not shown here), most notably the soil compaction associated with informal side tracks. We devised several indices of combined tourism impact, all of which increased at sites with higher visitor numbers. The index shown here (Figure 2) was calculated by adding, for each site, the total number of plots affected by each independent environmental variable. Introduced species were not included in this index, as the species identified in the study area were more likely to be associated with the surrounding land-uses other than tourism.

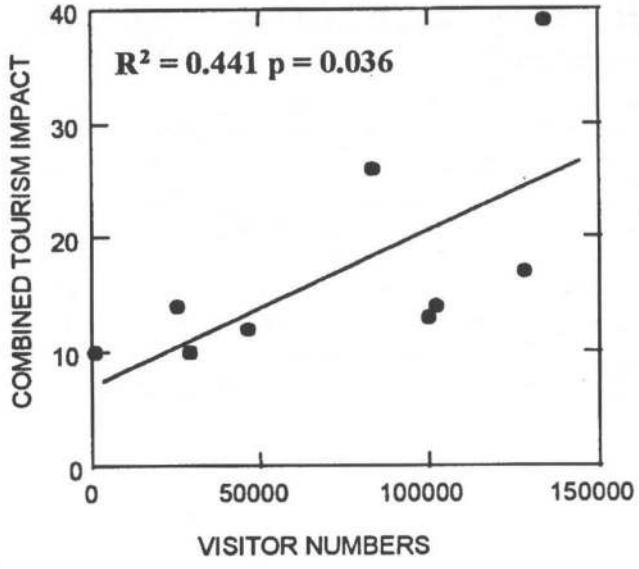

Figure 2. The relationship between overall environmental impact and increasing annual visitor numbers. See text for the definition of the index of environmental impact.

Measuring Visitor Perceptions of the Environment

Visitor perceptions were measured through a questionnaire conducted by an interviewer. There were two sample periods; May and August 1997.

Visitors were sampled in several ways. Some visitors (60%) were interviewed on site in the western MacDonnells themselves. Only seven of the ten sites had daily visitor numbers high enough to allow efficient sampling. Other visitors were interviewed whilst staying in Alice Springs before and/or after visiting the western MacDonnells. This group included visitors travelling to the sites in the following ways: by coach tour, 4WD bus tour, ecotour, and private or hire car (the latter group were staying in camping areas or motels in Alice Springs).

The survey questionnaire was in three sections addressing:

- the expectations that visitors had before visiting the area,
- the environmental changes they perceived, and
- their touring details and cultural, historic and demographic backgrounds.

Not all visitors answered all environmental questions; 36 visitors were only interviewed before visiting the area and for these visitors, we only collected data on expectations and demographics. The total number of visitors who were asked each question is indicated on each figure.

How Did Visitors Rate the Environment at Each Site?

Visitors were asked to assess the state of the environment on a five point scale from 'poor' to 'good' at one of the sites they had visited. Superficially the distributions seem similar - overall, most visitors rated most sites as 'good' (Figure 3). A closer examination reveals that the distributions change systematically with decreasing visitor numbers. Sites with higher annual visitation (Sites 1 and 2) have a much greater spread across the full range of ranks, whilst sites with lower annual visitation, for example Site 7, were more likely to be rated as 'OK' or better.

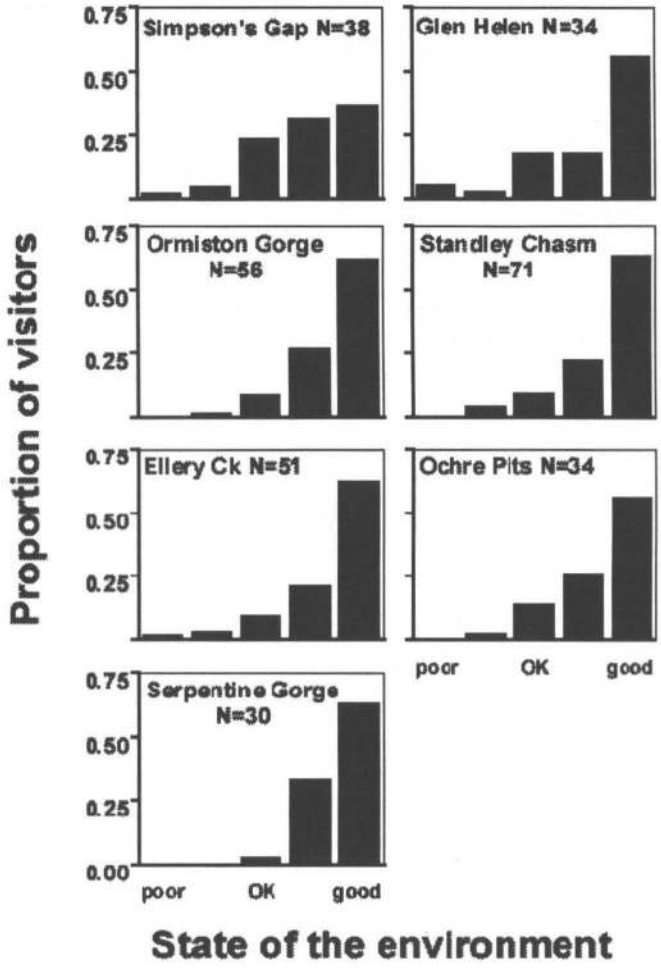

Figure 3. Visitor assessment of the state of the environment at each interview site. The Kruskal-Wallis test statistic is 11.97 ($p<0.06$, $df = 6$), which indicates that it is unlikely that these distributions are all the same. Numbers of visitors interviewed about each site are indicated. Sites are arranged by decreasing annual visitor numbers from top to bottom.

This result indicates that the population of visitors to the western MacDonnells as a whole is responding to the subtle differences in environmental impact measured across the seven sites. A significant proportion of the visitors associated more environmental change with sites that had higher visitor numbers and less environmental change with low visitor-number sites.

Which Environmental Impacts did Visitors Particularly Notice?

Visitors were asked to assess whether the site they had chosen was 'worse', 'the same' or 'better' (than other western MacDonnell sites they had visited) for environmental factors including plant condition, ground/soil condition, informal tracks, weeds, the number of people, water quality (where relevant), cattle and horses, and rubbish. The majority of visitors did not distinguish between sites for these categories: the response 'the same' was the clear mode for all categories.

Two sites did show differences in their distributions for some of the variables. The distributions of visitor assessments of plant damage, crowds, and rubbish at Site 7 were different to the distribution made up of visitor assessments at all other sites (Table 3). Similarly, Site 2 was different from other sites for plant damage, soil damage, informal tracks, cattle and horses, and weeds. At Site 7 (low annual visitor numbers), the distribution indicated that people were more likely to rate it as 'better' than the other sites. At Site 2 (higher annual visitor numbers), visitors were more likely to rate it as 'worse'. These two sites were assessed to be at the opposite extremes for measured environmental change out of the seven sites.

Table 3. Visitors were asked to rate each site as 'better', 'the same' or 'worse' for each environmental variable. Visitors were more likely to rate Site 7 (low visitor numbers) as having less impact than other sites for the variables listed. Conversely, they were more likely to rate Site 2 (high visitor numbers) as worse.

Environmental change	Site 2 *(1994 visitor numbers = 128,216)*	Site 7 *(1994 visitor numbers = 29,059)*
plant damage	Site 2 > other sites	Site 7 < other sites
soil damage	Site 2 > other sites	no difference
informal tracks	Site 2> other sites	no difference
weeds	Site 2 > other sites	no difference
cattle / horses	Site 2 > other sites	no difference
crowds	no difference	Site 7 < other sites
rubbish	no difference	Site 7 < other sites

What Did Visitors See as the Major Threats to the Environment?

Fifty-three per cent of visitors answered 'yes' to the question 'Do you think there are any major threats to the environment in the area that should have special attention?', and a further 11% said they were unsure (Table 4). Of the 201 visitors who went on to list their reasons, 145 visitors (72% of respondents, i.e. at least 45% of ***all*** visitors) identified problems directly related to tourism and 89 visitors (44% of respondents, 27% of all visitors) specifically commented that there were too many visitors. Although the impact of tourism was seen as the primary environmental issue in the study area, the effect of introduced plants and animals was also recognised as an important issue (28% of respondents, or 17% of all visitors).

Table 4. Threats to the environment in the western MacDonnells area as identified by the 53.4% of visitors who responded 'yes' and the 10.8% who said they were 'not sure' to a question asking whether there were any threats. Percentages are expressed out of the total 201 visitors who listed threats (note that some people listed more than one threat so the percentages in the right hand column sum to greater than 100%).

Perceived threats to the environment in the West MacDonnells		No of visitors
Tourism		145 (72%)
too many people	89	
vandalism / erosion / track proliferation	40	
lack of education / guides	15	
4WDs	10	
rubbish	11	
development / roads / hotels	9	
water quality	5	
wildlife disturbance	4	
plant damage	4	
coaches / organised tours	4	
need more rangers	3	
Exotic plants and animals		56 (28%)
feral animals e.g. cats, dogs	31	
cattle	31	
introduced plants	8	
unspecified (plant or animal)	3	
Broader environmental issues		16 (8%)
greenhouse / climate change	2	
development / industry / mining	3	
fire	10	
killing rabbits - effect on birds of prey	1	
acid rain	1	
Other		3 (1%)
litter in Alice Springs / car bodies along roads	2	
too many conservationists	1	

What Management Options did Visitors Suggest?

A wide and detailed variety of management options were put forward by visitors in response to the question 'If you'd like to make sure that the best parts of the environment were still here in ten years time and it was up to you, what would you do?'. Seventy-four per cent of visitors identified at least one management strategy consistent with the goal of reducing the impacts of tourism on the environment (Figure 4), and a further 23% simply responded that they would like to keep the western MacDonnells natural and maintain the sites in their current state.

The majority of specific management suggestions given by visitors were focused on visitor management (61% of visitors), more than half of which were suggestions for direct controls including restrictions on numbers of visitors, access, camping, four-wheel driving, charging entry fees and having a higher ranger presence. After 'keeping the status quo', the most common responses to this question specifically addressed the spreading of tracks (40% of visitors) (Figure 4). Visitors were clearly opposed to allowing the area to develop away from its natural state and recognised that 'track spreading' was a primary concern.

Figure 4. A histogram of the management options identified by visitors when asked the open-ended question "If you wanted to make sure the best parts of the environment were here in ten years time and it was up to you, what would you do?". 74% of visitors identified one or more of these.

Can We Generalise From These Results?

A broader comparison was included in the questionnaire to determine whether visitors' perceptions of the environment were particular to this place or indicative of a more general trend. This question asked people to consider the degree to which the western MacDonnell Ranges have been changed by tourism, compared with a self-identified area of nature-based tourism elsewhere in Australia.

A similar pattern to the comparison within the western MacDonnells (Figure 3) is revealed for the comparison between our study area and other major tourist destinations within Australia (Figure 5). Whilst visitors rate the western MacDonnells towards the lower end of the scale (changed less) in comparison with tourist hot spots (North Queensland, the Blue Mountains, Kakadu and the Great Barrier Reef), the distributions for the sites with lower annual visitor numbers (the Flinders Ranges, Grampians and Kimberleys) indicate that visitors were more likely to rate the western MacDonnells as having changed 'about the same' or 'much more'.

Implications of the Study

Previous studies on visitor perceptions of the environmental impacts of tourism have often concluded that visitors are not very perceptive of the impacts they are having on the natural areas they visit, or that the impacts they do notice are primarily the direct impacts of other visitors, like rubbish and vandalism (Lucas, 1979; Manning, 1985; Marion and Lime, 1986). We found that many visitors to the western MacDonnell Ranges did not distinguish in either a general sense, or for specific environmental impacts, between the site that they were at and other sites visited in the area, despite a measurable increase in environmental impacts at sites with higher annual visitor numbers. To this extent, our results were consistent with previous work.

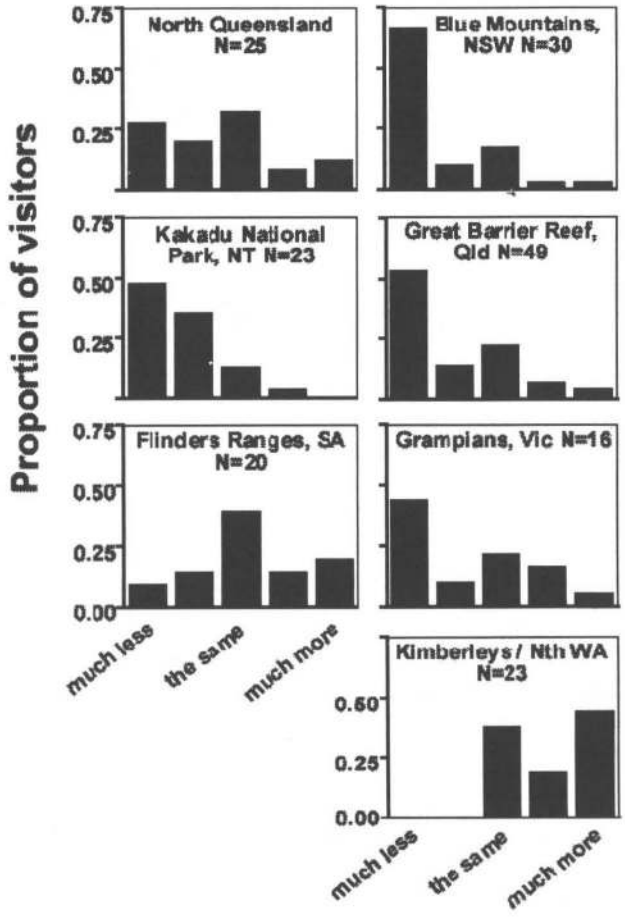

Figure 5. Visitors were asked to nominate another area in Australia of nature-based tourism and asked to rate the degree to which the western MacDonnell ranges (annual visitor numbers approx. 135,000) had been changed by tourism in comparison to the other area. Here the top seven locations are shown in order of decreasing annual visitor numbers. The Kruskal Wallis test statistic (48.54, $p<0.001$, $df=6$) indicates that it is unlikely that these distributions are the same.

Our study departed from the conclusions of many previous studies, however, when we considered the varying levels of perception of environmental change among the visitors to this area. This can be viewed as a matter of degree ranging from the broadest understanding of general environmental issues down to the perception of immediate site conditions and impacts. Seventy-four per cent of all visitors identified one or more management options which would reduce environmental change in the area. Fifty-six per cent were aware of relevant environmental threats (tourism or introduced species), and 45% listed a threat associated with tourism. Forty per cent of visitors identified management options to address track spreading and erosion, the major environmental impact identified by this study. We estimated (Figure 3) that at least 15% of visitors distinguished between high and low visitor number sites in terms of quite subtle differences in environmental impact. This estimate increased to at least 50% of visitors who distinguished between different Australian nature tourist sites on the basis of differences in tourism impact (Figure 5). We have shown that their distinction between sites was associated with increasing visitor numbers.

The differences from the conclusions of previous work could be explained by the design of our survey, which, by focusing in detail on specific localised environmental changes, may have been more sensitive to the varying levels of visitor perception. An increasing awareness of environmental issues amongst nature visitors over the past twenty years may also explain some of the differences. Some studies have indicated an increasing environmental awareness through time among visitors to wilderness (Lucas, 1985; Hammitt *et al.*, 1996).

Conclusions

We found that environmental change due to tourism in the western MacDonnell ranges is relatively limited at present. Sites with higher visitor numbers tended to have a greater level of environmental change, however. An impact which increased with visitor numbers and could present a significant management problem in the future was informal track spreading (with associated ground plant damage and soil compaction).

Visitors to the area demonstrated a general awareness of the impact of tourism, even in an area which has been relatively unchanged. This ranged from a majority of visitors who were aware of the major environmental issues in the area and were knowledgeable about management options to address specific problems, through to a significant minority who distinguished extreme sites on the basis of specific impacts.

In one sense these visitors present a potential paradox. They see tourism as a threat, and yet they want to be able to visit such natural areas. Future research could aim to: (i) quantify visitor responses to specific environmental issues (since many of our questions were open ended); (ii) investigate the point at which these issues of environmental change become critical in terms of changing visitor location choice; and (iii) look at how we could manage these areas in the context of the critical level of environmental change for visitor satisfaction, other competing management objectives, and equity of visitor access.

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LETTER TO THE EDITOR
Response to Fleur Tiver's Article *RMN* 98/1

Len Boladeras, Barwidgee Station, Leonora WA 6438

Dear Editor

The cause of this letter is some of Fleur Tiver's Ph.D. findings as expressed in her article *RMN* 98/1, April 1998. She refers to *RMN* 97/3, November 1997 and states that Carolyn Ireland's findings with respect to western myall are not necessarily applicable to other rangeland species. In my view, Carolyn's article is specifically about western myall and no reasonable reader of that article could justifiably extrapolate the findings to other species.

This is not so with Fleur Tiver's article. My impression of, and concern with, her article is that it seems to convey a message that many of the conclusions may be applied to rangeland management in general. This is not my experience.

The results showed that for 41 of the 59 species investigated, (this is a lot of species) **increased** (my emphasis) levels of sheep grazing is associated with lowered regeneration rates. I do not doubt this, especially if the country was already stocked at close to its sustainable maximum. The question is, from what base figure were the numbers increased and what degree of increase was required to give these results? And were the remaining eight species palatable or not? Were all of the 41 species palatable? Degradation - lowered regeneration rates - could also occur from trampling and compaction if the increased levels of grazing were extreme enough.

It was interesting to read that kangaroo grazing is comparatively unimportant and this is to be expected from a co-evolved herbivore. Is it? Probably so in pre-European arid rangelands where natural water was scarce and cyclical drought took its toll on the population. We now manage rangelands in a comparatively artificial environment where it seems logical to me that artificial water points generally maintain kangaroo populations at comparatively high levels, such that their impact upon vegetation resources is significant.

The Australian Nature Conservation Agency's 1987 and 1990 aerial survey data and Australian Bureau of Statistics figures indicated kangaroos comprised 49% of grazing pressure. Three years of survey data in the North Eastern Goldfields of Western Australia showed that kangaroos comprised 35% of grazing pressure there. Norbury *et al.* (1993) indicate that unless effective kangaroo control methods are implemented along with stock and feral goat control, the recovery of degraded rangeland pastures is likely to be severely limited. Gardiner (1986) suggests that management strategies based upon the removal of stock would seem to be insufficient to guarantee improving range condition, particularly if the populations of kangaroos are not similarly controlled. Gardiner also found that kangaroo grazing impacted upon both shrubs and grasses.

With respect to feral goats and sheep, in the past I have spent much time droving and shepherding feral goats. They certainly canopy graze, but spend a lot of time grazing at lower levels too. A good indicator of goat impact on rangeland vegetation is to observe them, compared to sheep, during extended drought. The first significant occurrence is that sheep are too poor to serve at the dinner table. Goats, still in good condition, are eaten instead. Next, sheep will commence expiring whilst the goats are successfully rearing twins. As the drought progresses sheep losses accelerate, goat losses are minimal and some still manage to rear their kids. This is the sequence of events if management intervention is insufficient or delayed for too long. I suspect that given a sufficiently long drought without management intervention, then at its conclusion most of the sheep would be dead and most of the feral goats would still be here.

In some rangeland environments, feral goats comprise 20-30% of total grazing pressure. As an uncontrolled grazer, they exacerbate the effect of drought, have a significant impact upon recruitment after the drought breaks and inhibit recovery and recruitment during times of spelling from domestic stock. I would suggest that feral goats are certainly capable of causing harmful long term effects on the vegetation population structure, including chenopods.

For 41 of the 59 species, **increased** (my emphasis) levels of sheep grazing is associated with lower regeneration levels. However, most of the chenopod species appear to be able to regenerate successfully under the present grazing regime. Is it significant that this success is under the present grazing regime whereas the former is described as associated with increased levels of sheep grazing?

I have not previously encountered Fleur Tiver's perception of 'woody weeds'. If one compares the pregrazing state to the current state, then yes, 'woody weeds' may be described as a symptom of grazing. In future it might also be possible to argue that, in some regions, grazing strategies are the symptom. The case put seems to be that in absolute numbers there are no more 'woody weeds' now than there were pregrazing; it only appears to be so because species composition has changed due to grazing. Or put another way, it is simply that there are now less of the things that are not 'woody weeds'. In fact, the case is advanced even further by the statement "My results show that regeneration of nearly all species is negatively affected by sheep grazing, and that there are no true 'increaser' species". Given that this was in fact so, then there should be less 'woody weeds' now than prior to the introduction of domestic and feral herbivores. Are there?

If increaser species do not exist, then all species must be decreasers. And yet it is stated that "certain species have been able to preferentially invade....". If these particular species cannot be described as 'increasers' then their home or parent populations must have suffered mortality in excess of the total count of the 'new' population. 'Increasers' in my area include needle bush (*Hakea preissii*) which grows on mineralised greenstones and in chenopod shrublands, poverty bush (*Eremophila foliosissima*) found on the more sandy wanderrie

country and punty bush (*Senna nemophila*) which occurs mainly in calcrete areas. Under conservative stocking rates, I have not observed these species to be decreasing. In fact, I'm certain some are increasing and I have no evidence to suggest they are increasing in some areas and decreasing in others. With respect to Barwidgee, one positive (although it is early days yet) is that after a four year period of destocking, water point closure and vigorous feral goat control, one particular monitoring site has shown a marked decrease in poverty bush and a significant increase in broadleaf wanderrie (*Monachather paradoxa*) and woollybutt wanderrie (*Eragrostis eriopoda*).

Fleur Tiver, your results turn upside down my 35 years of observation, learning and instruction from rangeland scientists in these various matters. I am reasonably certain I have never been a casualty of failing to consider new ideas. However, in this instance and with all due respect, I must disagree with you. Is the 'woody weed' situation and feral goat and kangaroo impact so very different in South Australia? If it is, then I protest no more, as I do not have experience in South Australia's rangelands. Perhaps there are very few kangaroos and feral goats present in the study area?

In her conclusion, Fleur Tiver makes mention of the pastoral management technique of additional water points for the purpose of distributing stock over the whole of a paddock and suggests this may not be such a good idea. There are numerous reasons why she is absolutely correct in this and I would like to see more rangeland scientists promoting preservation of biodiversity via this alternative view.

LETTER TO THE EDITOR
Response to Len Boladeras' Letter

(in response to my article *RMN* 98/1, April 1198, which was an invited response to Carolyn Ireland's article of *RMN* 97/3, November 1997)

Fleur Tiver, School of Environmental Management, University of South Australia, Mawson Lakes SA 5095

Dear Editor

I hasten to add that I hope my article of *RMN* 98/1 was not taken as being the answer to "rangeland management in general"; I was certainly not attempting to provide one! In fact, the longer I work in the field of plant ecology, the more convinced I am that very great care indeed should be taken when applying conclusions from one location to another. Bearing that in mind, I think I made the point quite early on that the findings referred to the South Australian chenopod shrublands.

Unfortunately, not all folk (scientists included here) are as discerning as Len has been, and although no "reasonable reader" of Carolyn's article (or mine) would be justified in extrapolating the findings to other species, the unfortunate fact is that findings from one species are quite frequently extrapolated not only to other species, but to other locations as well. Part of the reason for this is that little or no data have been published on most rangeland species so that writers are obliged to fall back upon what is available when seeking supporting material for particular arguments. I believe that one of the great challenges facing ecologists is the task of winnowing out some basic ecological principles from the mass of location-dependent published data. Hopefully the dialogue that Carolyn, Len, myself and others are engaging in is getting us closer to some ecological truths which may be able to be applied more generally.

Len raised a number of more specific points, many of which I hope he will find answered in our more detailed article (Tiver and Andrew, 1997, *J. Appl. Ecol.* Vol. 34, pp 903-914) which I have sent him. If anyone else would like a copy, I am happy to provide one.

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Broken Hill, August 2000

Jim Noble, CSIRO Wildlife and Ecology, GPO Box 284, Canberra ACT 2601

A steering committee comprising Geoff Woods and Marie Miller (NSW Agriculture), Geoff Cullenward (Department of Land and Water), Dinitee Haskard (Regional Tourist Association), Kerry Holmes (National Parks and Wildlife Service) and Jim Noble (CSIRO), met recently in Broken Hill to discuss preliminary plans for the 11th Biennial Conference to be held there in 2000. This followed a decision by the Council of the Australian Rangeland Society to accept the proposal put forward by a group of New South Wales members earlier in April. Representatives from a number of organisations likely to be involved in the conference will be approached in the near future with a view to holding another meeting next February in Broken Hill to elect an Organising Committee for the conference. The date for the conference, still to be confirmed, has been tentatively set down for the week commencing August 21st, two weeks before commencement of the Olympic Games in Sydney.

The timing of this conference, and its location in New South Wales, has particular historical significance. Not only will it be an opportunity for the ARS to officially recognise the centenary of Federation, but also the centenary of the establishment of the 1900 Royal Commission enquiring into the condition of the crown tenants of the Western Division of New South Wales. The Royal Commission was significant because it was the first formal initiative undertaken by any government in Australia to look specifically at land use and land administration in the arid pastoral zone. It not only took evidence from a total of 311 pastoral holdings in the Central and Western Divisions but also held sittings in Brisbane, Sydney, Melbourne and Adelaide.

Although the conference program is obviously still to be developed in any detail, it is envisaged that it will be broadly structured around the dominant issues confronting landholders and governments involved in the use and administration of rangeland resources, both in 1900 and one hundred years later in 2000. In this regard, the Steering Committee would welcome ideas and suggestions from the Society's membership for an appropriate conference theme to be used on official stationary and information circulars. Any suggestions could be sent direct to Geoff Woods, NSW Agriculture, PO Box 459, Broken Hill NSW 2880.

Broken Hill is seen as an ideal location for a symbolically important conference such as this with excellent conference and accommodation facilities available. It is well known not only for its mining history following the discovery of the original ore body by Charles Rasp in 1883, but also for its pastoral history, being close to many of the major rangeland types in arid Australia. It is also located in a region of considerable cultural significance as evidenced by the recent decision to devolve management of Mutawintji National Park to the land's traditional owners. The Steering Committee hopes that this conference will ultimately prove to be a major event attracting the attendance of most Society members, as well as many others, in what will obviously be a time of considerable nation-wide activity.

DR IAN BEALE RETIRES FROM CHARLEVILLE PASTORAL LABORATORY

Peter Johnston, ARS President, Sheep and Wool Institute, Queensland Department of Primary Industries, Locked Mail Bag 4, Moorooka QLD 4105

An era ended at the Queensland Department of Primary Industries Charleville Pastoral Laboratory in September when Dr Ian Beale said farewell after 33 years of service with the Department.

Born in Mitchell and attending school at Mungallala State School, Ian is a true 'mulga lands' man.

Ian's career in rangeland management has been based at Charleville where he was a pasture agronomist. He started his career examining the management and productivity of mulga communities in south-west Queensland. This work has been particularly valuable in the ongoing legislative debate about tree clearing in Queensland. As Officer-in-Charge of the Charleville Pastoral Laboratory from 1980 to 1992, Ian oversaw numerous research projects which changed the way people now understand the mulga lands. This included work on animal diet selection, grazing management and long-term livestock carrying capacity.

One of the most common catch cries over the years in the Charleville office has been "ask Bealie, he'll know" on any topic from pastures to computers or Alpha Romeos to Caterpillar tractors. Considered a guru at his craft by his peers and clients, Ian's wealth of knowledge, experience and respect is etched in western Queensland.

However not all of Ian's time has been devoted to Queensland's rangelands. In the USA he completed a PhD. and other studies in range management. In Brazil he was employed as a rangeland consultant, and in the Peoples Republic of China, he was part of a team conducting a feasibility assessment of an Australian agricultural aid project in the upper reaches of the Yellow River.

Ian has been a member of the Australian Rangeland Society since its inception in 1975 participating in most of the society's conferences since then. Ian was also on the organising committee of the 2nd International Rangeland Congress held in Adelaide in May 1984.

Ian, Janet and family are moving to their grazing property at Mungallala.

On behalf of the Australian Rangeland Society, I wish Ian and his family all the best for the future.

NATIONAL LAND AND WATER RESOURCES AUDIT
Rangelands Monitoring Theme

Janice Oliver, National Land & Water Resources Audit, GPO Box 2182, Canberra ACT 2601

Introduction

The National Land and Water Resources Audit (Audit) is a program of the Natural Heritage Trust, which addresses the need for a nationwide appraisal of the status and changes in condition of Australia's natural resources.

Work plans that describe a series of projects are being written for each of the seven Audit Themes. All the work plans are due for completion by December 1998. The Audit will be completed by June 2001.

For the Rangelands Monitoring Theme, the work plan was developed by Alec Holm, from the University of Western Australia. The aim of the projects within this theme is to "define the components of a national monitoring and reporting program that provide regular national reports and allow better decisions to be made affecting land use and management within Australia's rangelands".

The Rangelands Monitoring component of the Audit will address the following core issues:

- productivity,
- ecosystem function,
- biodiversity,
- extreme climatic events and fire,
- economic and social factors affecting land management, and
- institutional arrangements affecting land management.

Why a National Rangeland Monitoring Report?

Monitoring and reporting on rangeland condition is done by State and Territory government agencies. Each agency has its own system and there is no integrated, ongoing, national reporting on the state and change of Australia's rangelands.

Such reporting is necessary to meet obligations and agreements under the general umbrella of ecologically sustainable development, compliance reporting and accountability as required under the General Agreement on Tariffs and Trade (GATT). Assessment of the effectiveness of government policies and support mechanisms, such as the Rural Adjustment Scheme, also requires a national appraisal of the rangelands.

A national rangelands report may be included in State of Environment reports. Such a report would provide sound information on use, management and administration of the rangelands. A national report will also show progress towards the achievement of sustainable management of the rangelands.

It is expected that the Audit will put in place an enduring national rangelands monitoring and reporting program that builds on, and adds value to, the extensive network of monitoring sites throughout the Australian rangelands.

What Projects have been Developed?

The Work Plan developed for the Audit Rangelands Monitoring Theme describes five projects:

1. Assessment of change in ecosystem function, trends in intensity of use and history of climate and fire which impact on the ecosystem.
2. Determining trends in economic, social and institutional factors that influence land use and management in rangelands.
3. Developing an adaptive framework for monitoring biodiversity in rangelands.
4. Packaging and presentation of information and decision aids for value judgements by decision-makers.
5. Management, reporting, project assessment and improvement.

Further Information?

Contact Robert Scott at the National Land and Water Resources Audit on:

ph: 02 6257 3109;
fax: 02 6257 9518;
email robert.scott@nlwra.gov.au

or check out the Audit Rangelands Monitoring Work Plan on the Audit Web Site in the ***Themes*** section at <http://www.nlwra.gov.au>.

BOOK RELEASE
Forage Husbandry

by Wolfgang Bayer and Ann Waters-Bayer

(*Ed. The following is an extract from the preface of the Bayer's book, written by Tony Smith, editor of Macmillan's* Tropical Agriculturalist *series, in which the book appeared. The book is intended for field research and development program staff concerned with smallholder management of forage resources and participatory technology development, and teachers and students at universities and colleges of agriculture.*)

The *Tropical Agriculturalist* series is intended to provide up-to-date information for students, extension agents and farmers, written in an easy-to-understand manner. All the books are prepared by specialists who have worked in several tropical countries or regions. This volume is written by Wolfgang Bayer in collaboration with Ann Waters-Bayer, both of whom have considerable experience in forage husbandry and farming systems research and development in a number of countries in the tropics and subtropics.

There are many books written on pasture and forage production in temperate and tropical climates, but few have attempted to deal with the subject when applied to smallholder or non-commercial systems. The authors show not only how forage is grown, used and stored, but also how it is integrated into the overall farming systems. They refer to systems in which small-scale farmers cultivate land and keep some livestock, as well as to those in which pastoralists husband the available resources to sustain their livestock through the varying seasons of the year.

The book covers situations that exist in regions ranging from deserts to humid grasslands and from low to high altitudes, and deals with livestock systems ranging from nomadic pastoralism to intensive stall-feeding of animals. Particularly valuable are the case studies used to illustrate systems of forage husbandry ranging from management of natural grassland to the production of high-quality forage crops. This book should help the reader to understand various aspects of forage husbandry under numerous different situations in the tropics. It also indicates how forage husbandry systems are, and can be, developed in a sustainable way through a process of participatory research and innovation.

Book details:

Year of publication: 1998
198 pp,
216 x 138 mm,
paperback,
32 B/W photographs,
ISBN 0 333 66856 1,
cost - 7 pound sterling

Contents:

1. Introduction
2. Livestock keepers and their farming systems
3. Livestock and forage: some basic biology
4. Management of livestock and forage resources
5. Managing natural forage
6. Forage as auxiliary product from cultivated land
7. Cultivated forages
8. Forage conservation and supplementation
9. Research and development in forage husbandry

The book can be obtained through MacMillan Education Ltd, Houndmills Rd, Houndmills, Basingstoke, Hants RG21 2XS, UK.
Fax +44-1256-814642
Email: v.izat@macmillan.co.uk or
p.oflannagan@macmillan.co.uk
i.johnstone@macmillan.co.uk (bulk orders)

OBITUARY
Emeritus Professor Noel Charles William Beadle
20th December 1914 to 13th October 1998

Associate Professor R D B (Wal) Whalley, Head, School of Rural Science and Natural Resources, University of New England, Armidale NSW 2350

Many will be saddened to learn of the death of Emeritus Professor N C W Beadle at the Armidale Hospital after a long illness. He was one of Australia's outstanding botanists and plant ecologists and his influence lives on through the work of the many students who were associated with him.

Noel Beadle grew up on the edge of bushland in western Chatswood on Sydney's North Shore. His father had studied horticulture before coming to Australia and knew the Latin names of many plants and he used them at every opportunity. Noel therefore developed an early understanding of how plants are named and spent many hours roaming through the bush near his home becoming familiar with the individual plant species.

After attending North Sydney High School, he enrolled at Sydney University planning to study chemistry and become an industrial chemist. You would think that botany would be an obvious choice as one of his first year subjects because of his interest in plants. However, he chose it mainly because he thought it would involve excursions and he had never been out of the Sydney area. There were no excursions in first year botany nor in second or third year but he became interested in the subject. Perhaps as a result, field trips were always an important part of his own teaching and many students have been astounded and enthralled by his knowledge and enthusiasm, particularly when out in the bush.

After an honours year studying the respiration and carbohydrate content of tomatoes, he completed a Master of Science studying the same topics and was employed as a Demonstrator in the Department of Botany at the University of Sydney. He was beside himself with excitement when he was invited on a collecting trip by car, organised by the Linnean Society of New South Wales in 1939. This opportunity was a major event for a young man fascinated by travel but who had never been west of the Blue Mountains. The route was west to Broken Hill then north to Milparinka and Tibooburra and thence to Wanaaring, Bourke and back to Sydney. Noel was responsible for pressing and drying the 600 plant specimens representing about 300 species that they collected along the way. He later spent much time, often with the help of botanists from the National Herbarium, in identifying many of these specimens.

Later in 1939, the newly formed Soil Conservation Service advertised for a Research Officer and Botanist to work in western New South Wales. Noel was appointed to the position and was instructed to do a soil erosion survey of the western country. He made Condobolin his headquarters and commenced work using a 1937 Chevrolet car for transport. He

achieved far more than a simple erosion survey. He produced the first coherent classification and map of the vegetation of western NSW and his work was published by the Soil Conservation Service in 1948 as "The Vegetation and Pastures of Western New South Wales with special reference to Soil Erosion". This work became a benchmark for studies of its kind and his map is still used by many who marvel at its accuracy, given the conditions under which it was produced. His species lists are also extremely valuable for those interested in changes in vegetation over time.

Noel resigned from the Soil Conservation Service in 1946 to take up a position first as a lecturer and later as a senior lecturer in botany at the University of Sydney. He developed courses in ecology and became involved in teaching botany at all levels. His work on the factors affecting the distribution of the vegetation in the Sydney district and on the relationships among soil parent material, soil fertility and vegetation was outstanding. It made a major impact on the development of plant ecological thought in Australia.

In late 1954, Noel was appointed the Foundation Professor of Botany at the newly independent University of New England. He immediately set about structuring the teaching and research of the Department around the basic core of plant morphology, taxonomy and ecology. By the time he retired in 1979, many other aspects of botany were being taught and researched including plant pathology, embryology and plant physiology - all without detriment to the original morphology / taxonomy / ecology thrust. These core topics still remain critical to the teaching of Botany at the University of New England.

Noel was always acutely aware of the importance of adequate keys and floras to aid in the field identification of plant species. During his years in Sydney he spent much time devising botanical keys and giving them to his classes for testing. I was first involved in this process as a second year Agriculture student and was impressed by his vast knowledge of plants and his ability to construct keys which were relatively simple to use. This work resulted in the publication of the "Handbook of the vascular plants of the Sydney District and Blue Mountains" in 1962. He was unable to interest any commercial publishers in the venture and so financed it out of his own resources and it was printed in Armidale. This book was very successful and led to the "Flora of the Sydney District" first published by AH and AW Reed in 1972. His next venture was the "Students Flora of North-Eastern New South Wales" published by the Department of Botany, University of New England in six volumes. All of these works were used by generations of students and have now been largely replaced by "The Flora of New South Wales", edited by Gwen Harden who was one of his former students.

International recognition was enhanced following the publication of "The Vegetation of Australia" in 1981 as part of a world series. This was the first comprehensive monograph on the vegetation of the whole continent and embodied his knowledge gleaned from countless trips and student excursions. He always kept meticulous notes of his travels and used these extensively in his books. His final work was "Botany in the Backblocks", a limited edition skilfully edited by Gordon White and published by the Department of Botany, University of New England in 1995. This final work is a somewhat lighthearted description of the travels and experiences of a botanist with an eye for detail and an acute sense of humour. Of particular interest are his experiences when travelling in western New South Wales in good seasons and in droughts without the benefits of four wheel drive and satellite phones.

Noel Beadle never sought recognition for his contributions to science, but on occasions his peers and associates have seen fit to honour him. He received his D.Sc. from the University of Sydney for his work in western New South Wales, and upon his retirement the University of New England awarded him the title of "Professor Emeritus". He was awarded the Clarke Medal of the Royal Society of New South Wales in 1982 and the Medal of the Ecological Society of Australia in 1985 for his contributions to ecology. In 1988 the Soil Conservation Service of New South Wales, upon its fiftieth anniversary, made him a special presentation in recognition of his contribution to the Service and to dryland ecology generally. The University of New England elected him a Fellow of the University in 1993.

An outstanding trait of Noel's was that he never hesitated to use his own resources to promote the sciences of botany and ecology and to assist those less fortunate than he. He personally financed the publication of the first editions of his floras and much of his field work. Whilst Professor of Botany he provided an endowment for a prize to the top second and third year students in both botany and ecology and, when he retired, provided further funds for the establishment of scholarships for postgraduate students. The full extent of his generosity to numerous charities is unlikely to ever be known, but is wide ranging and substantial. It includes significant donations to the Royal Blind Society, Red Cross, Guide Dog Association, Multiple Sclerosis Society, the Armidale Hospital and the Guyra Hospital. He also donated a large block of land to the Armidale City Council, which has now been established as a park named "Beadle Grove" featuring native plants of the region. A local Rotary Club honoured him with a Paul Harris Fellowship and honorary membership in 1987 for his contributions to Rotary's Polio Plus program.

As a teacher, Noel Beadle was renowned for his ability to interest and encourage students in the science of botany, particularly in the field. His lectures were always stimulating and students were fascinated by his immense knowledge of botany, contrasting with the postage stamp size of the notes from which he lectured. His broad smile, sense of humour, personal warmth and generosity have endeared him to generations of students and staff alike. His passing marks the end of an era and he will be sadly missed by those who knew him.

NEWS FROM COUNCIL

Peter Johnston, ARS President, Sheep and Wool Institute, Queensland Department of Primary Industries, Locked Mail Bag 4, Moorooka QLD 4105

Council has met three times since May 1998 when I was elected to replace Eugene Moll as President. The following summarises some issues Council has addressed in that time.

The registered office of the Society is being moved from Western Australia to the Australian Institute of Agricultural Science and Technology's office in Melbourne. The Council has received verbal agreement from Ted Hayes, the Executive Director of AIAST, and we are waiting on written confirmation for this to happen.

The Society now has a web page as part of the International Rangeland Congress's web page. Thanks must go to Bruce Alchin and Gordon King for getting this underway. The site is http://irc.web.unsw.edu.au/ARS.htm

As mentioned in the last *RMN* (July 1998) Allan Wilson will be retiring from the position of Editor of *The Rangeland Journal* at the end of 1998. After a long search for a new Editor, Leigh Hunt (Chairman of the Publications Committee) advised Council in September 1998 that Associate Professor Wal Whalley has agreed to fill the position of Editor. Council would like to congratulate Wal and thank Allan again for the contributions he has made to the journal.

While on the topic of publications, Leigh advised that production of the joint electronic bibliographic database with the Society for Range Management (SRM) has been delayed. While all the data have been compiled and formatted, the delay was due to the SRM considering having the database produced by a professional publisher, rather than doing it in-house.

In October Council received a cheque for almost $10,000 being the final surplus from the September 1996 conference held in Port Augusta. Thanks to Carolyn Ireland (Chair of the South Australian Chapter of the Australian Rangeland Society) for tidying up this issue. On a similar note, the Society conference held in Gatton in December 1997 returned a surplus of approximately $10,000.

Next year marks the 25th year of the Society. In May 1999 Council will move to South Australia. Council is seeking ideas on how the Society should mark this year. I believe Gary Bastin is interested in producing a special issue of the *RMN*. Please send any ideas to Gary Bastin or Eda Addicott (Secretary).

AUSTRALIAN RANGELAND SOCIETY AWARDS

The Society has two awards to assist members with either:

- studies related to the rangelands, or
- with travel expenses associated with attending a conference (or some other activity).

Applications for each award normally close in November but this year the closing date has been extended to 31 January 1999. Any member of the Society interested in either award is invited to apply.

Australian Rangeland Society Travel Grant

This grant is intended to assist eligible persons to attend a meeting, conference or congress related to the rangelands; or to assist eligible persons with travel or transport costs to investigate a topic connected with range management or to implement a program of rangeland investigation not already being undertaken. The grant is available for overseas travel and/or travel within Australia. It is not intended for subsistence expenses.

Australian Rangeland Society Scholarship

This scholarship has the purpose of assisting eligible members with formal study of a subject or course related to the rangelands and which will further the aims of the Australian Rangeland Society. The scholarship is available for study assistance either overseas or within Australia. It is not intended to defray travel expenses.

How to Apply

Members interested in either grant should submit a written outline of their proposed activity. Applications should clearly address how the intended activity (i.e. travel or study) meets the aims of the Society. Applications should be brief (less than 1000 words) and should be submitted to Council before 31st January 1999.

Conditions

Applications for the **Travel Grant** should include details of the costs and describe how the grant is to be spent. Details of any other sources of funding should be given. Those applying for the **Scholarship** should include details of the program of study or course being undertaken and the institution under whose auspices it will be conducted. Information on how the scholarship money will be spent is required as are details on any other sources of funding.

Applications for either award should include the names of at least two referees.

Finally, on completing the travel or study, recipients are required to fully acquit their grant or scholarship. They are

also expected to write an article on their activities or experiences for the *Range Management Newsletter.*

Eligibility

No formal qualifications are required for either award. There are no age restrictions and all members of the Society are eligible to apply. Applications are encouraged from persons who do not have organisational support.

Travel or study assistance can be made available to a non-member where Council considers that the application meets the aims of the Society, and is of sufficient merit.

Overseas Travel or Study

There is a restriction on both awards for overseas travel or study assistance in that applicants must have been members of the Society for at least 12 months. Overseas travel can be to Australia, or study within Australia, by overseas members.

THE AUSTRALIAN RANGELAND SOCIETY
ACN 008 784 414
BALANCE SHEET AT 31 DECEMBER 1997

1996		
	SHARE CAPITAL AND RESERVES	
117,592	Retained profits	121,093
$117,592		$121,093
	Represented by:	
	FIXED ASSETS	
1,473	Plant & equipment (at tax value)	884
	CURRENT ASSETS	
10,788	Trading account - NAB, Orange	3,528
1,287	Trading account - BWA, Journal,	3,232
2,820	Trading account - WBC, Newsletter	2,413
366	Trading account - WBC, 1994 Conference	310
11,198-	Trading account - BSA, 1996 Conference	9,750
1,208	Trading account - CBA, Cobar	1,184
1,653	Trading account - ANZ, Victoria Park	1,450
1,589	Trading account - WBC, Adelaide	3,590
-	Trading Account - UCU, 1997 Conference	17,836
-	Sundry Debtors	1,070
30,309		44,363
	NON-CURRENT ASSETS	
1,885	Loan - 1997 IRC	-
	INVESTMENTS	
16,828	Deposit - NM, Mortgage fund	-
16,497	Deposit - NM, Income fund	-
53,500	Term Deposit - NAB, Orange	86,147
86,825		86,147
121,092	TOTAL ASSETS	131,393
	CURRENT LIABILITIES	
3,500	Trade creditors	10,301
$117,592		$121,093

THE AUSTRALIAN RANGELAND SOCIETY
ACN 008 784 414
STATEMENT OF PROFIT AND LOSS
FOR THE YEAR ENDED 31 DECEMBER 1997

1996		
	INCOME	
29,620	Subscriptions	33,822
3,160	Interest - NAB, Orange	2,633
27	Interest - ANZ, Western Australia	5
46	Interest - WBC, Adelaide	14
1,259	Interest - Bank SA, Port Augusta	418
938	Interest - National Mutual	1,476
25	Interest - CBA, Cobar	6
500	ARS Survey	-
630	Utah IRC Conference	-
(13,637)	Net profit/(loss) Journal	(13,468)
(7,126)	Net profit/(loss) Newsletter	(5,408)
(5,731)	Net profit/(loss) Conferences	(847)
9,7111		18,651
	EXPENSES	
4,000	Accountancy & Audit	3,850
111	AGM expenses	113
285	Bank Charges	607
982	Depreciation	589
210	Filing fees	-
3,000	Honoraria	3,430
2,752	Plant ID Course - SA Branch	-
1,985	Printing, stationary & postage	779
4,832	Scholarships & Grants	3,500
1,328	Subscriptions and donations	1,328
3,450	Survey and Research	-
-	Travel & Accommodation	954
1,000	Townsville IRC	-
79	Utah IRC	-
50	Hire of Venue	-
24,064		15,150
($14,353)	NET PROFIT/LOSS FOR THE YEAR	$3,501

AUSTRALIAN RANGELAND SOCIETY
MEMBERSHIP APPLICATION FORM

Please complete and return to the Subscriptions Manager, Rob Richards, PO Box 235, Condobolin 2877 NSW.

I, [name] .....

of [address] .....

.....

..... Postcode .....

apply for membership of the Australian Rangeland Society and agree to be bound by the regulations of the Society as stated in the Articles of Association and Memorandum.

❒ Enclosed is a cheque for AU$..... for full/part* membership for an individual/institution* for the calendar year 19.....

❒ Charge my ..... Mastercard ..... VISA ..... Bankcard ..... AU$..... for full/part* membership for an individual/institution* for the calendar year 19.....

Card No.: ..... Expiry Date: .....

Signature..... Date.....

* delete as appropriate

Membership Rates:

	Australia	**Overseas**	
		Surface Mail	**Air Mail**
Individual or Family -			
Full (Journal + Newsletter)	$60.00	$70.00	$80.00
Part (Newsletter only)	$30.00	$35.00	$40.00
Institution or Company -			
Full (Journal + Newsletter)	$90.00	$100.00	$110.00
Part (Newsletter only)	$45.00	$50.00	$55.00

Note -
Membership is for the calendar year 1 January to 31 December. All rates are quoted in AUSTRALIAN currency **and must be paid in AUSTRALIAN currency.**

For Office Use Only:

Membership Number.....

Date Entered in Member Register.....

Date Ratified by Council.....