



## *The Australian Rangeland Society*

### RANGE MANAGEMENT NEWSLETTER

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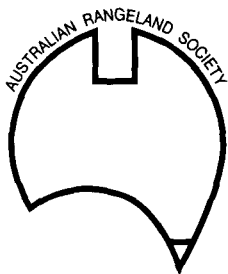
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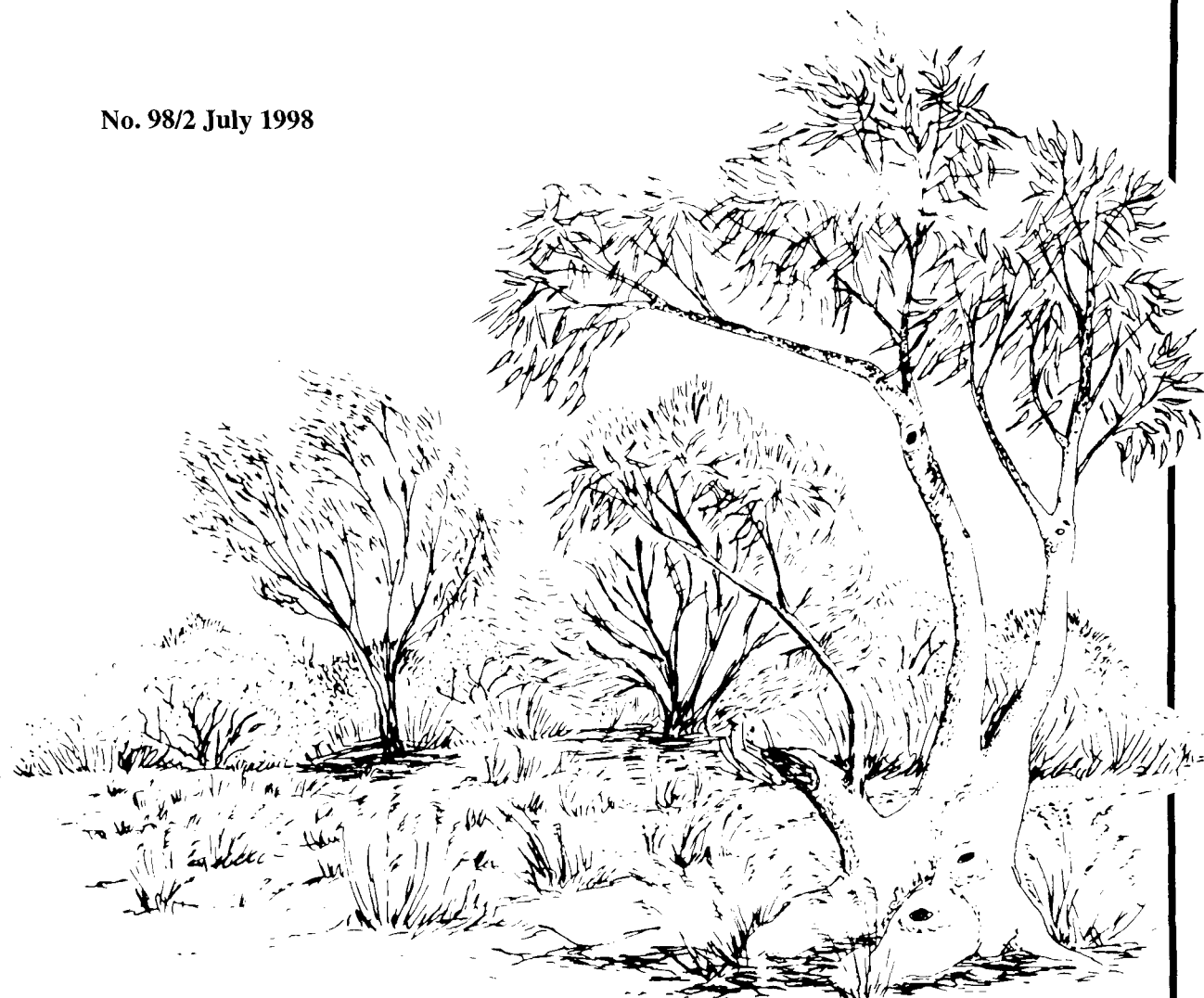


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# **Range management Newsletter**

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## FROM THE EDITOR

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

Welcome to the next newsletter for 1998. This issue has a focus on monitoring. In the first major article, Ian Watson critically examines how ground-based monitoring data can be used to detect and interpret change in the rangelands. The first step, of course, is to ensure that sites, once established, are re-measured - but Ian also stresses that it is important to understand what changes might occur in order to interpret the outcomes. Although written in the context of the Western Australian Rangeland Monitoring System, Ian provides many valuable guidelines which are transferable to the interpretation of datasets being assembled by other monitoring agencies.

Eda Addicott and Chris Hill then provide a practical example of how monitoring data, collected from the Carnarvon Ranges region in Queensland, can be analysed. These data show that there have been major changes in the vegetation, which are thought to be due to fire and grazing (the area changed from a cattle station to national park at the start of the monitoring program). However, teasing out the precise role of fire has been difficult because of inadequate information on fire history. This necessity to understand (and quantify) drivers of the vegetation demonstrates a very important point raised by Ian where he discusses the need to understand "causality" in interpreting change.

In the final word on monitoring, Janice Oliver describes how "rangelands monitoring" is being developed as one of the seven themes in the National Land and Water Resources Audit.

The third major article in this issue, written by Garry Cook, takes a global view of rainfall amount and variability, particularly as it affects the vegetation of the savannas. Garry compares and contrasts the savanna regions of northern Australia with those in southern and west Africa. He shows how there are some marked contrasts in the vegetation, which have more to do with rainfall variability throughout the wet season than total rainfall.

In other major articles:

- Kate Andrews provides an update on the community consultation process occurring in the Lake Eyre Basin.
- Alec Holm reports on his recent trip to the USA. Alec's trip was partly funded by an ARS Travel Grant.
- Kathryn Egerton-Warburton summarises her PhD studies, which characterised the performance of fine-wool Merinos in arid and semi-arid environments.

Finally, we have reports from the recent AGM and updates on progress towards the International Rangelands Congress next year. I am sure that you will find something of interest in this issue. As usual, feel free to respond with any comments you may have, and please keep your contributions coming. I am particularly happy to receive contributions of a different nature. My deadline for the next *Range Management Newsletter* is mid October.

## MONITORING WEST AUSTRALIAN SHRUBLANDS; What Are The Expectations Of Change?

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### Introduction

Are our rangelands improving or declining under current management? A simple question, yet difficult to answer.

Part of the reason for this is that we have a poor understanding of how much change might be expected to occur on a monitoring site during the interval between assessments. Without this, it is impossible to compare the observed with expected.

It is not simply a question of poor understanding: we have rarely asked the right question. Despite the good work that has gone into the research and development of range monitoring systems, there has been little focus on explicitly detailing expectations for change. We haven't asked - 'How much change do I expect to see on this site given typical circumstances, or given excessive grazing, or given drought?'.

Consider a population of 'good' shrubs on a monitoring site. If the population changes from (say) 105 to 90 over a five year period, is this a real change or is it simply the 'noise' one might expect to see in an arid-zone shrub population? If the change is 'real' (within the bounds of probability), is it the sort of change that might be expected given excessive stocking or is it the sort of change that might be expected given poor seasons?

### Interpreting Monitoring Site Data Isn't Easy

Almost all of my monitoring experience has been with ground-based shrubland sites of the Western Australian Rangeland Monitoring System (WARMS).

For the purposes of this article the acronym WARMS will refer to the permanent transects used in the shrublands of WA, although the system has a grassland component and consists of more than just ground-based sites. The data set is based on the population dynamics of the shrub species and includes the maximum crown width and height of individual shrubs (Holm *et al.*, 1987; Holm, 1993). The reassessment interval is five years.

From the mid 1980s to early 1990s I was an Adviser in the Gascoyne area of Western Australia. I installed a few new WARMS sites but more frequently found myself reassessing sites that had been installed in the years before my arrival (Figure 1). I did my best to interpret the changes recorded and then had the task of communicating my interpretations back to pastoralists. In an operational sense, this is an unusual experience. The history of range monitoring worldwide is that many more sites are installed than are ever reassessed. Of

those reassessed, many are part of monitoring research and development and don't require reporting to land managers.

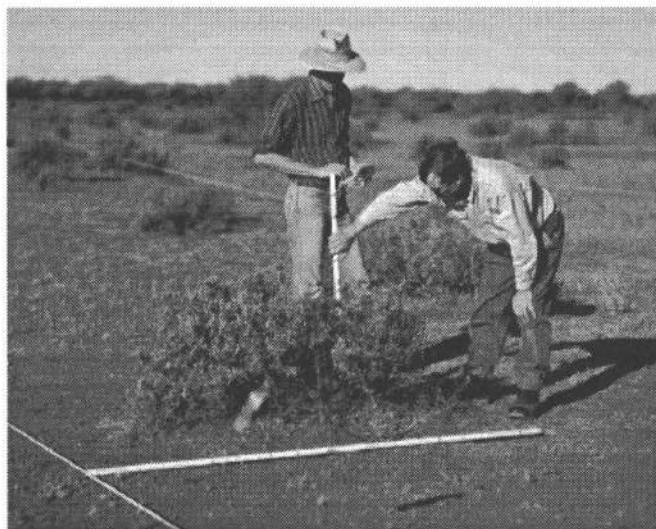


Figure 1. Assessing a WARMS shrubland site

I found the task of interpretation difficult. How did one interpret a site on which some 'good' species increased in numbers while other 'good' species declined? How much change was due to seasonal history and how much to grazing or other disturbance? Was I really looking at change, or was it just noise?

At the same time, I was part of the Boolathana grazing study (1983-1993) which had 137 WARMS-type transects spread across paddocks stocked with sheep at five different rates, and in exclosed areas. These transects were reassessed annually. Unlike true WARMS sites, we knew the stocking rate and had daily rainfall records. I wrote these data up in a thesis (partly to escape the terror of interpreting monitoring site changes for pastoralists) but now find myself overseeing WARMS statewide, and having responsibility for interpreting changes to a range of end users.

### Condition, Causality and Coefficients-of-Variation Distracted the Range Management Discipline

Monitoring is concerned with detecting change, yet the range management discipline was distracted from this goal during much of its journey towards the development of range monitoring systems.

Consider the question posed at the beginning of this article. It does not include an assessment of range condition, nor does it include determination of causality. However, it does include consideration of change over time.

### Condition

Much of the monitoring literature that emerged during the development of range monitoring systems in Australia and elsewhere over the past 25 years was preoccupied with assessing condition rather than change. That is, defining condition, developing methods for assessing condition and recognising appropriate condition states. It is common to find the word 'Monitoring' within the titles and abstracts of this literature yet little of the content reflects a focus on detecting change over time. Rather, it is mostly concerned with condition.

The definition of condition states has been considered 'vital' to range monitoring (Friedel *et al.*, 1988). However, it is possible to make a judgement about whether measured change is acceptable or not without recourse to pre-defined condition states. Fortunately, the philosophical basis of WARMS reflects this (Hacker, 1992). The objective is to measure changes in vegetation, attempt to understand why these have occurred and to interpret the result of that understanding for end users.

Of course, there is no single answer to the question originally posed. Whether the rangeland is improving or declining depends on the value-judgement filter through which the observed and expected changes are put. Put simply - are the things that we consider to be 'good' in the system increasing or decreasing?

### Causality

At the same time as the range management discipline was being waylaid by condition assessment, it was further distracted by the issue of causality. This directed attention towards one of the end points of monitoring and skipped over the more fundamental aspect of detecting change. Ascribing causal factors can only occur once the observed change can be analysed and understood.

Data from range monitoring systems will never allow testing of *a priori* hypotheses about cause; replication and controls are not possible. Data analysis can only ever build a case for a particular interpretation of causal relationships (Hacker, 1986). The case for (say) grazing will need to be based on an understanding of the rates and patterns of vegetation change.

### Coefficients of Variation

Further evidence that the range management system was not focussing on change can be seen by research into monitoring methodology. Methodologies were recommended based on those techniques that had the lowest Coefficient of Variation at a single time (Holm *et al.*, 1984). This research was a necessary first step but the next step wasn't taken; that of determining whether the recommended techniques were precise enough to pick up meaningful change over time.

In Western Australia, the technique recommended by Holm *et al.* (1984) was modified following the 1992 review of WARMS (summarised by Holm, 1993). Rather than simply counting all shrubs on the site, WARMS moved to a demographic technique that gave an unique identifier to individual plants on a

transect. This modification provided a much better opportunity to pick up small, but important, changes in the shrub populations (Watson, 1997).

## Expectations (Models) of Change on WARMS Sites

It is not necessary to interpret change on monitoring sites through textbook ecological models (Wilson, 1986; Hacker, 1992). However, any analysis and interpretation of observed changes *will* depend on some form of model, or expectation for change. When standing in the paddock, looking at a site after five years, mental models are used. Changes observed on a site are mentally compared with expectations of the rates and patterns of change gained through experience in that environment.

Interpreting monitoring site changes within an operational system such as WARMS requires more formal models. Fortunately there is a legacy of data and experience within Western Australia that can be used to build such models, going back to the 1950s when David Wilcox began measuring shrub populations in exclosures.

Once the underlying rates and patterns of change are described, progress can be made towards understanding the observed changes and interpreting the implications of these for end users. In the Western Australian shrublands, such a model might have the following components.

### *Rates of change are not constant from year to year.*

There are some years, such as in drought, when mortality rates will be high. Recruitment can also be high in a low percentage of years. In other years, either recruitment or mortality will be zero. There is a continuum between these extremes.

### *Change (i.e. mortality, recruitment and shrub size) can be expected to occur in every year.*

Although we often think of rangelands as event-driven, with high mortality in droughts and high recruitment in wet years, at least some change occurs every year. Cumulatively, over time, this background change can be as significant as the event-driven change (Watson *et al.*, 1997), particularly if the change is in a consistent direction such as applied by excessive grazing.

### *Average annual rates are low.*

At Boolathana almost half the shrub species had mortality rates (averaged over all treatments, including a severe drought, and from very heavy stocking to exclosure) of about 1.5% per year or less (Figure 2). This is equivalent to about 7% or less over 5 years. Recruitment rates will be slightly higher, but of the same magnitude, if populations are to remain stable.

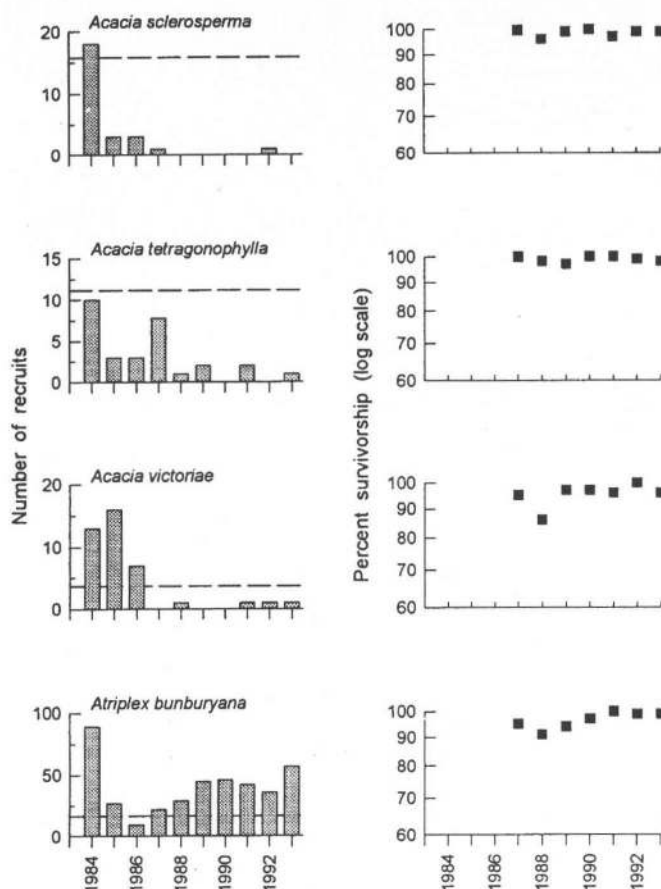


Figure 2. Number of recruits in each year and annual survivorship of a sample of species from the Boolathana grazing trial. Dashed lines on the recruit charts correspond to 10% of mature plant counts in 1986. Data were aggregated across all stocking rate treatments. Annual survivorship was only available from 1987 onwards due to changes in sampling methodology. Recruit data were available for all years.

### *Different species have different turnover rates.*

More change is expected between reassessments for some species compared to others. For example, bladder saltbush is very dynamic, mulga is not.

Rates and patterns of change are influenced by environmental and management factors.

Heavy grazing and drought will increase mortality rates of susceptible shrubs. Such a statement is simplistic, yet putting numbers on the rates and identifying interactions between environmental and management factors is critical to understanding observed changes.

### *Increased mortality may be high in relative terms but low in absolute terms.*

For example, excessive grazing (or drought) may double the mortality rate of susceptible shrubs. However, this may only mean an increase in mortality rate from 1.5% per year to 3.0% per year. If such an increase was maintained over the entire reassessment interval then the cumulative mortality would have increased from 7% to a maximum of 14%. However, the

excessive grazing (or drought) may have only lasted one or two years and the increase will be less. (If sample size is small it is difficult to detect such an increase.)

***Younger and smaller plants have higher mortality rates.***

Recruits, small plants and those that have been substantially reduced in living canopy (by grazing or drought) have a greater chance of dying from one assessment to the next compared with older, larger and more robust individuals.

***Mortality is relatively predictable, recruitment patterns are often inexplicable.***

Mortality rates are relatively constant (Figure 2). Increases or decreases are expected depending upon circumstance, but the change from the base rate is rarely extreme. By contrast, recruitment is highly variable in time, space and magnitude. During a single reassessment interval, recruitment can vary from zero to several times more than existing population levels. Recruitment can be very patchy within a single transect and ostensibly similar transects, even close together, can have large differences in recruitment. Although one might expect years of high rainfall to result in high recruitment for a range of species, data from grazing trials and exclosures show that the years of highest recruitment are often different for different species.

***Changes in total population size are often irrelevant.***

Since recruitment is so inexplicable, it is important not to take too much notice of changes in total population size. Understanding the observed changes is best done by examining mortality and recruitment patterns separately.

***Canopy size changes are predictable.***

When heavily grazed and/or under moisture stress, plant canopies decrease in size. In the absence of heavy grazing and/or in good years, they increase.

***There will be no decline or improvement on most sites in most years.***

There will be little or no detectable change on most sites in most years. There will be contra-indications on most sites in most years, i.e. some 'good' species will have improved and some declined. Overall, the judgement will be that most sites haven't changed significantly. One consequence of this is that range monitoring summaries often make dull reading.

While the above statements list the major components of a model for expected change on WARMS sites, there are many factors for which we have little understanding. These include:

- data on extreme events (which comprise the tails of frequency distributions for the components above),
- knowledge of neighbourhood effects on mortality and recruitment, and
- the role of density dependence in seedling survival.

## **A Simplified Model of Change on WARMS Sites**

A simplified rendering of expected change on WARMS sites is shown in Figure 3. The model shows expected change on a monitoring site given negligible grazing impact (heavy line) and high grazing impact (finer line). Analysis and interpretation of actual change on a specific site might begin by comparing the observed change with that expected under the model.

For the purposes of this article, assume that a monitoring site was assessed at time  $t_0$  and reassessed at time  $t_1$ . The finer line (high grazing impact) represents the actual trajectory of the site over time, the heavier line the model of expected change in the absence of excessive grazing.

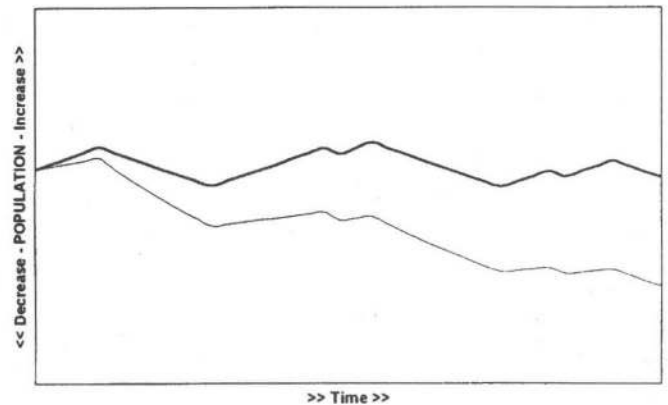


Figure 3. The population of shrubs (of high pastoral or conservation value) over time. The heavy line represents negligible grazing impact, the finer line represents high grazing impact. In this simple model both populations increase during wet years and decrease during dry years. High grazing impact halves the rate of population increase (1.0125 vs 1.0250) and doubles the rate of population decrease (0.950 vs 0.975) in relation to negligible grazing impact. The model assumes that grazing effects are additive, i.e. there is no interaction between weather experienced and grazing. There is no spatial component (e.g. density dependence or neighbourhood effects) to the model.

The first task is to make an assessment of whether there has been real change or whether the difference between the lines simply represents noise. This is not easy. There is no simple way to determine what the Confidence Intervals for these lines are, although they can be generated by building a mathematical model and running it sufficiently often to produce a probability distribution for each line.

Notwithstanding this, it is possible to make some general statements about the ability to detect change.

Change can be detected more easily as the time between reassessments increases, since the expected size of change will be larger over longer time intervals. There will be some point at which the Confidence Intervals for each line separate (even if we don't know exactly when this is). At that point one can determine that the two lines are different, within the bounds of probability.

However, there is a cost to having a long reassessment interval. The ability to determine when most of the change occurred will decline as the time between reassessment

lengthens. Knowing the time of change is an important part of understanding causality. For example, much of the change may have occurred during a period of several years when the lease was known to have high stock numbers. Building a case for causality would be difficult if the reassessment interval was, for example, ten years since it would be difficult to link the observed change to the heavy stocking.

Change will be easier to detect if the species on the site are known to have high turnover rates. Bladder saltbush sites can be reassessed more frequently than mulga hardpan sites. Alternatively, it is possible to be more confident of change on bladder saltbush sites if the reassessment interval is the same for both.

Large sample size makes change easier to detect. Consider an expected mortality rate of 10% over five years under negligible grazing impact. Under high grazing impact, the observed mortality rate might be double (i.e. 20%). If there were only 10 plants on a monitoring site, this would mean detecting a difference between expected survivorship of 9 plants and observed survivorship of 8 plants. If the initial sample size was 100 plants we can be more confident that there is a real difference between an expected 90 survivors and the observed 80 survivors.

Change will be easier to detect if the grazing effects are large. On sites where excessive grazing is suspected or the suite of species is particularly susceptible to grazing, it will be easier to make a judgement about change. Alternatively, the same judgement can be made sooner than on sites where grazing effects are small.

## Formalised Expectation of Change

We all use mental models to assess and interpret changes we observe. However, there are benefits to making models for monitoring sites more explicit, even to take them the next step and code them mathematically. The benefits accrue both during model building and model running.

The process of building models captures field experience. It teases data from filing cabinets and cardboard boxes; it forces the model builders to focus on those components of the population dynamics that are driving the change. Model building also provides an opportunity for those involved to thrash out the shape of important relationships (such as the frequency distribution of recruitment in space and time).

Model running provides the means by which different probability distributions can be incorporated into a single outcome, something only the best human minds can do. By running the model many times, a distribution of probable outcomes can be built. From these, Confidence Intervals can be determined - which allow statements to be made about change. Such statements are strengthened by knowledge of the statistical error involved.

The model can also be used to help design the monitoring system. For many systems, critical issues such as reassessment frequency are determined by available resources (Hacker, 1992). Running the model under a number of different scenarios makes it possible to balance the trade-offs between

limited resources, which control reassessment frequency and sample size, with the ability to detect change.

## Relevance to Systems Other Than WARMS

This article has been about vegetation assessment on WARMS shrubland sites, but it is also relevant to monitoring of other attributes and other environments.

Detecting, analysing and interpreting change within any monitoring system is much easier if there are explicit statements of expected change against which to compare. The statements can be complex when combined into a decision-support tool, but they can also be simple, consisting of no more than verbal 'rules' based on experience.

## Acknowledgements

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# FROM GRAZING PROPERTY TO NATIONAL PARK

## Changes In Vegetation Communities

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### Introduction

This article outlines some changes that appear to have occurred in vegetation communities after a change of land use from grazing to conservation, i.e. formation of a national park.

The Mt Moffatt management unit is a section of Carnarvon National Park in the Central Sandstone Belt of Queensland, approximately 210 km north of Roma. Part of the sub-humid rangelands, it is dominated by eucalypt woodlands with a grassy or shrubby understorey. The area was grazed by beef cattle up until 1979, at which time it was gazetted as national park and destocked. Since 1979, the only grazing by exotic herbivores has been by small herds of brumbies. These are controlled with a periodic culling program.

There has been much discussion and some anecdotal evidence to say the section has changed from having a predominantly grassy understorey to a predominantly shrubby one in the time that it has been national park, and that a change in fire regime is the predominant cause (Stanton 1992).

The aim of the study reported here was to determine whether the structure and diversity of vegetation at Mt Moffatt had changed and whether the changed fire regime was the principal cause.

### Methods

Vegetation monitoring sites were established during the early 1980s, shortly after the area became national park. Results of measurements taken in 1983 were available. In 1995, the sites were re-measured using a similar methodology. However, because of difficulties with exact duplication of methods and concerns with representativeness and replication, the results are of general interest only.

#### Data collection methods

All ground-layer species were identified and recorded in ten quadrats with a transect of 50 m by 2 m. In 1983, individual plants were counted (i.e. density) and in 1995, percent cover classes were measured. Thus, a direct comparison of the two ground measures was not possible. Woody plants were divided into two categories: less than 2 m and more than 2 m tall. In the less than 2 m category, individual plant heights were measured, while all plants taller than 2 m had their diameter at breast height measured.

These measurements allowed changes in structure and diversity of vegetation communities to be assessed. An attempt was

made to relate these changes to the fire regimes prevailing under national park management.

### Analysis

#### 1. Site data

Of the 18 original sites, 17 were revisited. One of these (site 6) was not used because a road re-alignment had disturbed the site.

The remaining 16 sites were grouped into three categories based on the Carnarvon National Park vegetation map (Addicott and Moye, 1997): alluvial deposits, sandy soils and basalt soils. Sites in each group are shown in Table 1.

Table 1: Sites grouped by substrate type

Sites on sandy soils	Sites on alluvial deposits	Sites on basalt soils
1, 3, 5, 10, 15, 11	2, 4, 12	7, 8, 9, 14, 16, 17, 18

The change between 1983 and 1995 at each site was calculated as a percentage for the following categories:

- ground layer diversity;
- density and diversity of canopy species in the mid-layer (species such as ironbarks, that form the canopy, but are still in the sapling or younger stages and occur with shrubs in the mid-layer); and
- shrub density and diversity.

Diversity was calculated simply as the number of species present.

#### 2. Comparing changes across years

The number of sites in each category was graphed against the amount of positive or negative change, where negative change means a loss of diversity or density. Presenting the monitoring data in this way allows tracking of trends in vegetation community changes. For example, the data in Figure 4 (presented later in this article) are skewed to the right indicating an increase in shrub density.

If the system has shown little or no change, the majority of graph columns will be centred around the 'no change' area. If the system is losing diversity or density, the majority of columns will be towards the 'loss' end of the scale.

#### 3. Fire history

Oral accounts of the burning regime at Mt Moffatt while it was a grazing property indicate an annual burning program.

Between 1983 and 1995 the only fire history data available for each site are fire maps, which were drawn by hand after some ground-level observations following each fire. Because of the generality and inaccuracy of the mapping and inherent patchiness of most burns, problems arise in knowing whether

the actual site was burnt in an area that is mapped as being burnt. For this exercise, if an area is mapped as burnt, then the sites within that area are assumed to have been burnt.

Whether a site was burnt or unburnt in a particular year for which mapping exists was the only variable available for analysing the fire history. This variable was used as an exploratory way of classifying sites with similar fire regimes by using the classification program TWINSpan (Hill, 1979) which groups sites of similar fire history.

## Results

Major findings from the analyses of diversity and structure are summarised below.

### Ground layer vegetation

A general decrease in the diversity of the ground layer has occurred, but this is not a strong trend (Figure 1). The main loss has been in the alluvial sites, which have all lost species diversity.

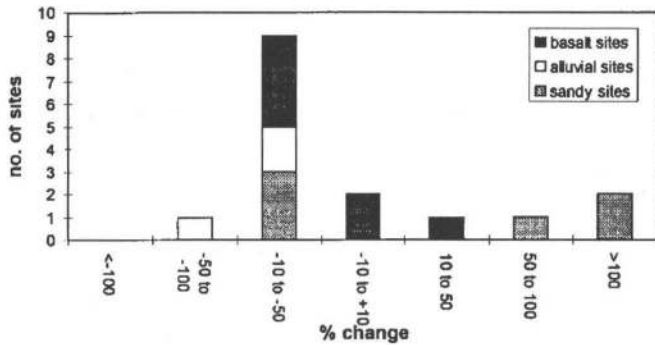


Figure 1. Percentage change in ground layer diversity.

### Canopy species in the mid-layer

There has been both a loss of diversity of canopy species (Figure 2) and a loss in the density of canopy species (Figure 3) in the mid-layer. This loss has mainly occurred on the sandy soil sites.

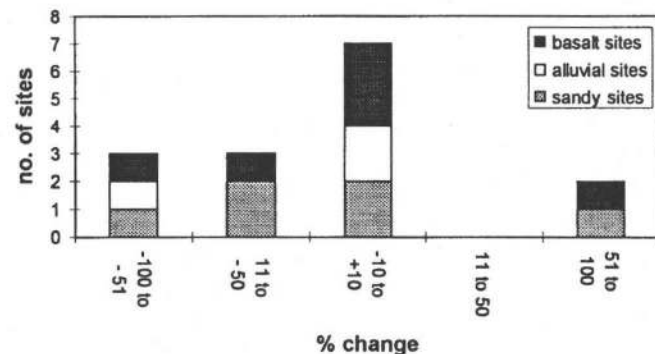


Figure 2. Percentage change in mid-layer canopy species diversity.

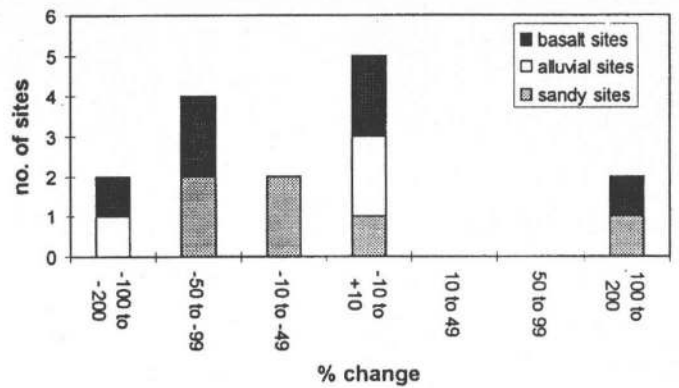


Figure 3. Percentage change in mid-layer canopy species density.

### Shrubs

A dramatic increase in shrub density and diversity across the park has occurred on all soil types (Figures 4 and 5). The largest increase appears to be in the alluvial and sandy soil sites.

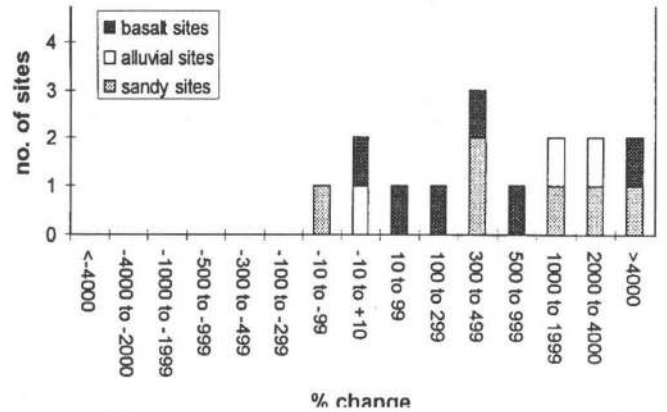


Figure 4. Percentage change in shrub density.

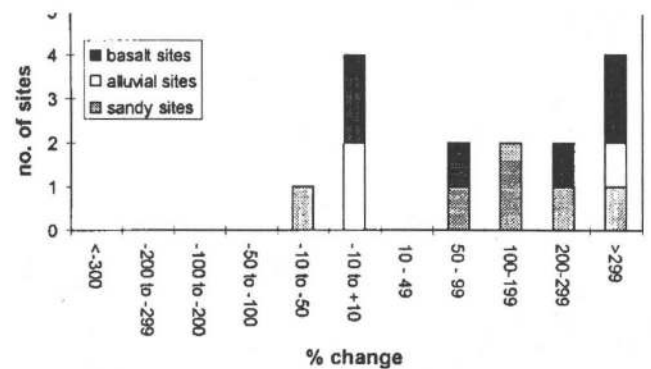


Figure 5. Percentage change in shrub diversity.

### Fire history

The TWINSpan classification of fire histories identified four major fire regimes (Figure 6).

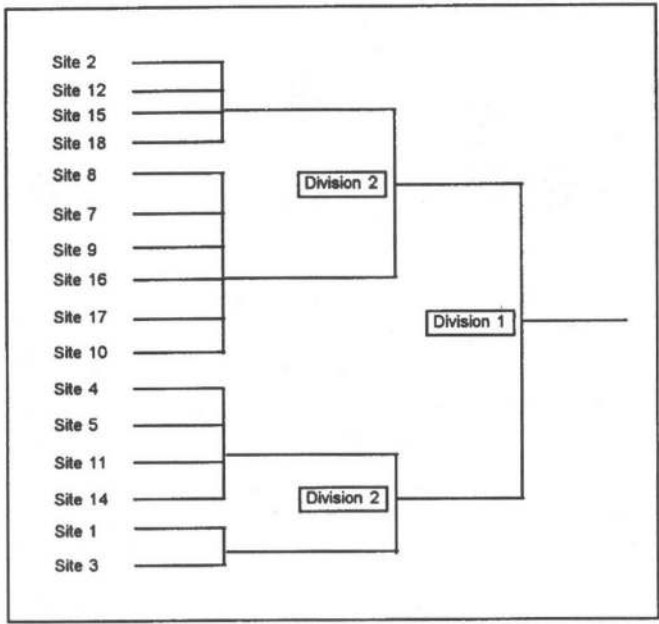


Figure 6. Groups of sites with similar fire regimes.

Fire histories of the sites within each fire regime are shown in Table 2 and can be categorized as:

- Fire regime 1 - sites burnt between 1984 and 1986, and then again in the later years of the records.
- Fire regime 2 - sites burnt least frequently, and then mainly in 1992-3.
- Fire regime 3 - sites burnt most frequently.
- Fire regime 4 - sites burnt annually between 1986 and 1990.

The method used here appears to hold potential as a way of classifying sites into similar fire regimes. However, the results cannot be used in any explanation of the vegetation changes found because of the lack of good information about fire history.

Table 3 shows a possible way of looking at changes that have occurred in types of sites (e.g. sandy soils) in a particular fire regime (e.g. fire regime 1) for a particular analysis category (e.g. ground layer diversity). Using such a stratification it should be possible to conduct more detailed statistical analyses, subject to there being a sufficient number of sites in any one cell of the table. This was not done here because of the limited amount of data and the lack of good fire history information.

Discussion

The vegetation communities appear to have changed across the park since 1983, with the alluvial and sandy soil systems seeming to be the most dynamic. Additionally, a general trend seems apparent for all communities: as shrub density and diversity increase, ground layer diversity and canopy species in the mid-layers (diversity and density) decrease.

The increase in shrub density across the park is not only the result of an increase in the original species but also the appearance of new species of shrubs.

The loss of canopy species in the mid-layers of all sites points to lack of recruitment of canopy species across the whole park. This may eventually lead to transitions from open forests, to

Table 2: Fire history of sites, with row blocks showing sites that TWINSpan has grouped together into similar fire regimes (U = unburnt, B = burnt)

Fire regime	Site	Year							
		84/85	85/86	86/87	87/88	88/89	89/90	90/91	92/93
1	2	B	U	U	U	U	B	B	B
	12	U	B	U	B	U	B	B	B
	15	U	B	U	U	U	B	B	B
	18	U	B	U	U	U	U	B	B
2	8	U	U	U	U	U	U	U	U
	7	U	U	U	U	U	U	U	B
	9	U	U	U	U	U	U	U	B
	16	U	U	U	U	U	U	U	B
	17	U	U	U	U	U	U	U	B
	10	U	U	B	U	U	U	U	B
3	4	U	B	U	B	B	U	U	B
	5	U	B	U	B	B	U	U	B
	11	U	U	U	B	B	U	B	B
	14	B	B	B	U	B	U	U	B
4	1	U	U	B	B	B	B	U	U
	3	U	U	B	B	B	B	U	U

Table 3: A possible way of relating sites with similar fire histories — this example for ground layer diversity.

Fire regime (from TWINSpan)	Sandy sites (with % change)	Alluvial sites (with % change)	Basalt sites (with % change)
1	15 (+150)	12 (-38) 2 (-53)	18 (+15)
2	10 (-23)		8 (-19) 7 (-43) 9 (+7) 16 (0) 17 (-30)
3	5 (+133) 11 (-32)	4 (-46)	14 (-48)
4	1 (-22) 3 (+16)		

woodlands, to open woodlands, to (possibly) shrublands or grasslands. Such major change needs to be considered with park management objectives in mind.

If managers were designing this monitoring program now, more alluvial sites would be included to gain a more even spread of sites across the substrate types. However, these results show one way of helping prioritise current and future monitoring programs and management strategies. Monitoring emphasis has been placed on the more changeable alluvial and sandy soil systems, and current management practices are taking the more dynamic nature of these into account.

As can be seen from the cautionary notes in the introduction and lack of accurate fire history records, it is extremely difficult, if not impossible, to attribute any causes to these changes. The most common reason given for changes, such as increasing shrub density, is a change in fire regime (Stanton, 1992). However, without accurate fire history records this is impossible to verify.

Although not presented here, the data collected also allow comparisons of changes in dominant species at the sites. A general increase in kangaroo grass (*Themeda triandra*) occurred across the park. Generally, kangaroo grass is one of the first species to be lost under grazing (Landsberg *et al.*, 1996), hence a change to this species could be expected under national park management. So, it is also possible that observed changes in structure and diversity of shrubs are due to the change in grazing regime rather than fire regime, or a combination of the two.

With better fire history information for individual sites, it is hoped in future to add the variables of 'time since last fire' and 'intensity of fire', and use TWINSpan (Hill, 1979) to find sites exposed to similar fire regimes. We should then gain a better understanding of the effect of fire regimes on species composition and structure of vegetation on this national park.

National parks in Queensland inherited the burning practices prevalent at the time from the Division of Forestry (Department of Primary Industries). Essentially, this was four-year rotational

block burning in winter, resulting in this area in high-intensity fires. This practice was intended as the fire management strategy at Mt Moffatt from the time it was gazetted as national park until 1993. However, fire history analysis shows this was probably not achieved. This may well be due to incomplete records, or it might point to the inherent difficulty and impracticality of trying to impose a set fire regime on vegetation communities that have different fuel build-up rates and different fire responses.

Results such as these lead to questions about the direction in which we want vegetation changes to go, and the vegetation state for which we want to try to manage. These will apply whether the land is being managed for grazing or conservation. They will also apply regardless of the ecological process being discussed and whether changes are due to fire, grazing, or another management technique. For national park managers, maximum diversity and a mosaic of vegetation structures across a fire management unit are generally the desired outcomes. In terms of these results, this would mean columns on the previously presented graphs grouped around the 'no change' area. An undesirable result would be all sites showing uniform direction.

The question of what state we want the vegetation communities in the 'no change' area to be in is not answered by these results and this question is under continuing debate. There is insufficient available information on a broad range of issues (for example, fauna species present, and the ramifications of any changes to fauna and/or flora diversity) to identify one particular state as being desirable.

These issues are broader than just the management of one particular patch of land: the issue of what changes are happening to the broader landscape outside the national park should also form part of the debate. For instance, if areas off the national park are being managed to maintain or increase grass cover, it may be that the national park should be managed to maintain or even increase shrubbiness. It is important to apply the precautionary principle to national park management to try to maximise diversity in as many variables as possible.

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## RAINFALL RECKONING IN RANGELANDS: The Case Of North Australian Savannas

Garry Cook, CSIRO Wildlife and Ecology, PMB 44, Winnellie NT 0822

### What a Lot of Rain We Had!

The last several years have seen record summer rainfalls in Darwin. The local newspaper regularly counts down the last few millimetres to see if the previous record will be broken. Such high rainfalls are also invariably followed by stories about how the record rains will lead to high fire risk from the vigorous grass growth. But how much of this is relevant to land managers or, in fact, even true? Are years of high rainfall necessarily good for rangeland productivity?

Much of the research into climate variability and potential climate change in northern Australia has focussed particularly on cyclones and the Australian monsoon, which bring long periods of intense rain and most of each season's rainfall. This information has obvious importance for riparian and wetland ecosystems as well as for predicting floods for engineering purposes. However, during these very wet periods, soil water is not limiting and variations in rainfall during this period probably have little effect on terrestrial systems. Therefore ecologists and agriculturists in this region often place greater emphasis on storm rains before and after the monsoon. These rains are isolated in time and space, but they determine the seasonal extent of water limitations.

In Figure 1, the number of days from the first rains to the last rains in each of the last 20 rainy seasons in Larrimah is graphed against rainfall amounts. The graph shows that the duration of rains in the summer rainy season is not related to the amount of rainfall. The results are similar for other centres in the monsoonal north. Because runoff is high from the intense rainfall during tropical storms and monsoons, looking at rainfall amounts is clearly a poor and potentially misleading way of characterising rainy seasons in the tropics. This will be particularly so where runoff water drains to the sea, rather than to inland basins. The ecosystems in such inland basins will respond to increased amounts of rain within rainy periods.

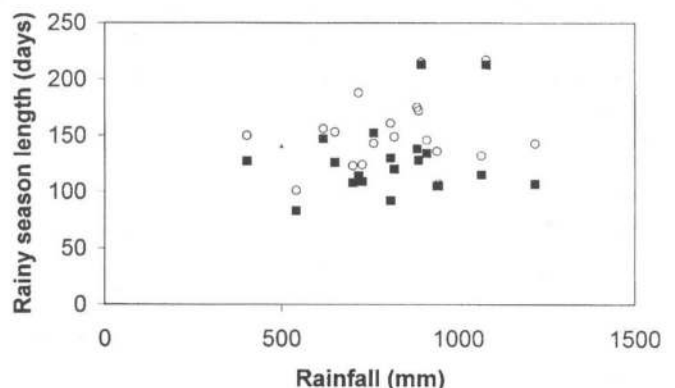


Figure 1. The relationship of rainfall amount and the length of the period between the first and last 25 mm (■) and 50 mm (○) of rainfall in the rainy season. The data are for Larrimah, which is about 120 km south of Katherine, NT.

## It's Ages Since We Saw the Sun!

Taylor and Tulloch (1989) and Mollah *et al.* (1991) have made detailed studies of inter-annual variability in rainfall patterns at Darwin and Katherine in the NT, respectively. Although inter-annual variability is very important for many ecological and agricultural processes, the long-term climatic regime is also an important determinant. The most comprehensive attempt to date to compare the average lengths of growing season across northern Australia is that of McCown (1981) who used a plant growth model to characterise the average "green season" length. His "green season" began with early rains in the pre-monsoon period but finished well after the major late rains because many perennial pasture species continue to respond to stored soil moisture. However, many annual grasses and woody plants become dormant soon after the end of the rains, well before soil water availability decreases substantially. As well, the weather becomes conducive to fires well before the end of McCown's green season and fires are common from April onwards. Because some of McCown's assumptions are not applicable to wooded savannas, we looked for other ways to quantify the length of the rainy season using simple data inputs.

In recent work, Richard Heerdegen (Massey University, NZ) and I (Cook and Heerdegen, *in prep.*) characterised the rainy season of stations along the North Australian Tropical Transect (NATT). This transect has been established along the gradient of decreasing precipitation southwards from the north Australian coastline (Figure 2). Instead of focussing on the amount of rainfall, we looked at the distribution of raindays. The probability of dry spells derived from the distribution of raindays is quite relevant to northern Australia because evaporation rates are high throughout the year. Accordingly, we determined the probability of dry spells throughout the year and used these probability curves to describe geographic variation in seasonal patterns of rainfall.

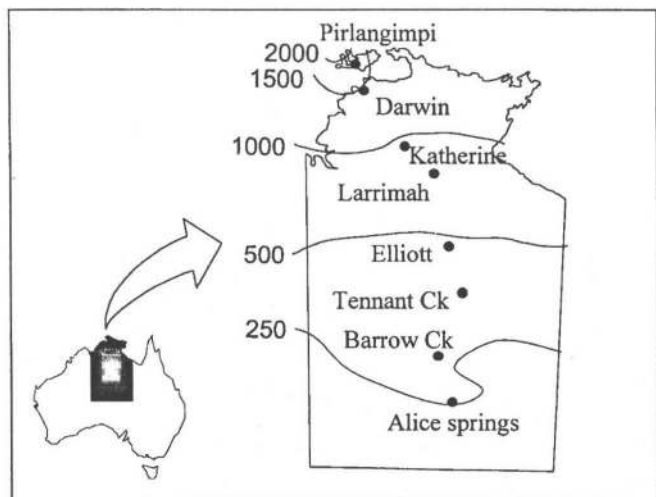


Figure 2. Location of the North Australian Tropical Transect. Rainfall decreases substantially from north to south.

We defined the wet season as that period when the chance of 10-day dry spells is less than 10%. This period corresponds approximately to the time when the monsoonal trough is over northern Australia. As shown in Figure 3, the wet season starts

in early December around Darwin and lasts for three to four months. As we move southwards, the wet season quickly becomes shorter and starts later. This season, as defined, ceases to occur just south of Larrimah between 15°S and 16°S. This roughly corresponds to the southern limit of the monsoon tall-grass savannas. These savannas are subject to very frequent dry-season fires. The tree stratum is typically dominated by *Eucalyptus miniata*, *E. tetradonta* or *E. tectifica*, with the herbaceous stratum often dominated by annual native grasses of the genus *Sorghum*.

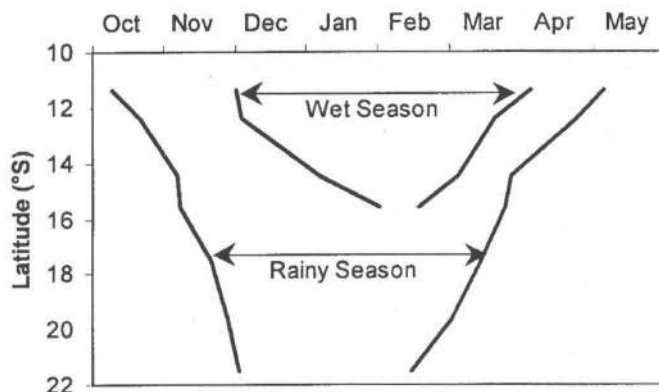


Figure 3. Changes in the dates and duration of the wet season and rainy season with latitude in the Northern Territory.

The rainy season was defined as that period when the chance of 10-day dry spells is less than 50%. This season includes the wet season, but for much of its duration it is characterised by frequent short dry-spells. The rainy season as we defined it starts at approximately the same time as McCown's green season, but ends much earlier (Figure 3). In the Darwin and Katherine regions, the time of leaf flushing and of leaf senescence corresponds approximately to the start and end of the rainy season (Williams *et al.*, 1997). This season ceases to occur south of Tennant Creek, which is the southern limit of many native deciduous trees. It is also approximately where the dominance of tussock grasses such as *Chrysopogon fallax* and *Sehima nevosum* and eucalypts gives way to *Triodia* hummock grasses and acacias.

## Where in the World Does That Leave Us?

In many parts of the world, rangelands are coming under increasing pressure from rising human populations, while in other parts, land is being abandoned. Changing climate, due to rising greenhouse gas levels in the atmosphere, will also impact on the rangelands. Being able to predict and manage these changes will be vital to ensuring food security, sustainable production and biodiversity conservation. The International Geosphere-Biosphere Program is coordinating research along major environmental gradients around the world to help address these global issues. Australia's contribution to this work is the North Australian Tropical Transect (NATT), which runs southwards through the Northern Territory. Mean annual rainfall decreases from about 2000 mm on Bathurst Island to about 250 mm in Alice Springs. This rainfall gradient mirrors companion transects in west Africa and in the Kalahari in southern Africa.

Comparisons of the patterns of climate and vegetation along the NATT and other parts of northern Australia with those of west and southern Africa give several important insights into the north Australian rangelands. Of the two African transects, the west African transect has more in common with northern Australia, with its dominance of lateritic soils and its generally low altitude.

Distinct zones of savanna vegetation have long been recognised in west Africa. The three of relevance here are the Sahel, the Sudan and the Guinea zones. By contrast, latitudinal zonation in north Australian savanna is not recognised to the same extent. The different relationships between the amount of rainfall and the duration of the rainy season between the two regions probably have much to do with this. Nevertheless, three analogous Australian zones could be the hummock-grass and mulga zone, the tussock-grass savanna zone, and the monsoon tall-grass savanna zone. Figure 4 shows the relationship between the amount of rainfall and length of the rainy season for northern Australia and west Africa as well as the approximate boundaries of different vegetation zones.

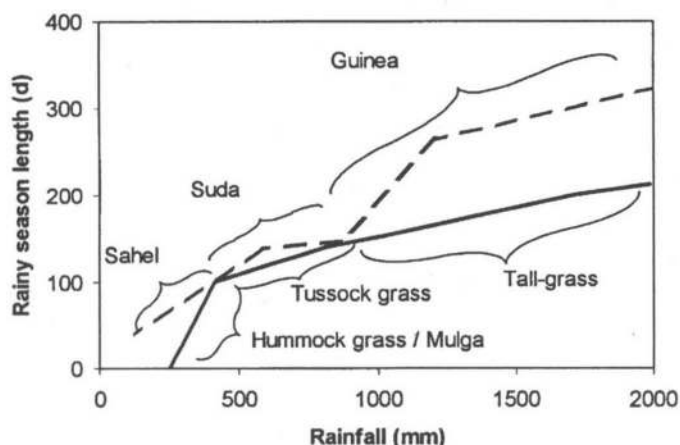


Figure 4. The relationship between the amount of rain and length of the rainy season in northern Australia (solid line) and west Africa (dashed line), showing the approximate boundaries of different vegetation zones.

Moving southwards from the Sahara Desert, the first zone encountered is the Sahel. Mean annual rainfall of this zone is similar to that in the region between Tennant Creek and Alice Springs. However, unlike central Australia, rain in the Sahel is totally summer dominant. In the Sahel, summer-growing annuals dominate in the spaces between perennial grass tussocks whereas in central Australia, winter-growing ephemeral forbs are common in some years.

The boundary between the savannas of the Sahel and the Sudan in west Africa is relatively arbitrary and is based on the gradual increase in rainfall amount and seasonal duration with distance south. In contrast, the equivalent northern boundary between the central Australian arid zone and the monsoonal tropics is far less arbitrary being marked by the substantially reduced probability of winter rainfall. The Sudan zone of west Africa has vegetation that is structurally similar to that in much of northern Australia where rainfall is between about 500 and 1100 mm. The seasonality of rainfall in the two regions of north Australia and west Africa is similar.

The Guinea zone of tropical Africa, with rainfall exceeding 1100 to 1200 mm, often supports a matrix of rainforest and tall

perennial grassland. In both southern and west Africa, the boundary between drier (Sudan) savannas and the Guinea zone is a marked disjunction in rainfall seasonality. The Guinea savannas have two wet periods separated by a drier, but still rainy, period. In Australia, there is no such disjunction and both the amount of rainfall and its seasonal duration continue their gradual increase northwards. Overall, this means that the rainy season of the Guinea zone is much longer for any given amount of rainfall than is the case in northern Australia. In fact, the savanna regions in the far north of the Kimberley (WA), the Top End (NT) and the Cape York Peninsula (Qld) have the longest dry seasons for the amount of rainfall of almost anywhere on the planet. This has profound ramifications for the vegetation. North Australia is dominated by frequently burnt savanna, even in the wettest areas north of about 14°S where mean annual rainfall ranges from 1100 to 2000 mm. In contrast, the African Guinea zone, with similar mean annual rainfalls, is typically a matrix of rainforest and tall perennial grasslands. In the absence of fire in Guinea savannas, forest quickly invades the grasslands within years to decades, whereas the north Australian savannas show thickening of woody vegetation but little change in species composition.

## So What?

The duration of the rainy season can explain much of the difference in vegetation structure and response of vegetation to management in Africa and Australia. For comparisons between years, the duration is arguably much more relevant than total amount of rainfall.

Climate change in response to the increasing amounts of greenhouse gases in the atmosphere will have more rapid and noticeable effects on savannas if seasonality of rainfall, rather than amount, is affected. For example, lengthening of the rainy season at the high rainfall end of the NATT would produce an entirely new climate for this region, and could cause vegetation to become more like that of the Guinea zone of Africa. Increased rainfall within the same period would change riparian systems, but may leave interfluvial vegetation relatively unchanged. Similarly, any change in the balance of summer and winter rainfall in central Australia could greatly affect species composition of the arid rangelands.

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# EXPLODING THE MYTH?

## Finer Wool Production In Pastoral Areas

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This article is a summary of activities undertaken for my PhD award over the period 1991 to 1994. The major driver of the work reported here was a decline in wool prices in the early 1990s, the wool market having scaled to new heights in 1987 only to hit the bottom four years later. The purpose of the fairly applied activities undertaken was to assess a number of options for specialist wool growers (in the sense that their major income is derived from wool, and opportunities to diversify income on-property were relatively limited) which might lead to increased returns from wool.

The work, conducted with the support of the University of New South Wales (UNSW) and CSIRO Division of Wool Technology (DWT), addressed two main issues:

1. Production (technical feasibility).
2. Marketing aids.

### Background

The arid and semi-arid areas are synonymous with a large-framed Merino. Sheep of the South Australian strain (Bungaree or Collinsville based) are typically run in the pastoral zone, although Peppin types appear equally at home in the pastoral belt of NSW and Queensland. The wool clips are invariably medium to strong quality, of the order of 22 to 26 microns in diameter, with greasy fleece weights of around 5 to 7 kg (Cottle, 1991). It has been suggested that sheep which produce the more readily sought fleeces of 21 microns and finer don't normally have the constitution for survival in the arid and semi-arid zones. Whilst this observation has been made on the basis of experience, there has probably been a certain degree of folklore associated with it - just how much is obviously a matter for debate. The purpose of this work was to challenge some of the traditional assumptions with respect to sheep for the arid areas.

### What Did We Do?

On the production side of things, we established field trials at two locations - Hay and Fowlers Gap (200 km north of Broken Hill) - to evaluate the performance of fine wool (approximately 19.5 µm) sheep with respect to wool characteristics, bodyweight and reproductive performance. Additionally, half of the sheep at each site were fitted with sheep coats to assess the potential improvements in wool characteristics (particularly wool style) which may result from protecting the fleece in this environment. The sheep were sourced from the Southern Tablelands of NSW (Young), and were introduced to the trial as hoggets. During the period of the trial, seasonal conditions were very dry in 1991/2 (130 mm rainfall at Fowlers Gap) whilst 1992/3 was quite wet (329 mm rainfall) compared with "normal" rainfall of 199 mm.

Further, as style issues had been identified in anecdotal evidence with respect to not using finer wool sheep in the pastoral zone, we conducted an assessment of the processing potential of coated and uncoated wools from Fowlers Gap (the more extreme environment of our two sites).

On the marketing side of things, we looked at our ability to predict clip characteristics based on simple relationships between rainfall and wool characteristics over long runs of seasons. The objective was to be able to predict wool characteristics approximately six months out from shearing to allow forward contract selling of station wool.

### What Did We Show?

As a result of the field trials, we were able to establish that fine wool sheep can perform to **fine wool** expectations in the pastoral zone, i.e. production levels could be considered comparable with those in more traditional fine wool environments. The range in mean production characteristics (by shearing time, and coat treatment) for the two years at Fowlers Gap are shown below.

Table 1. Fleece characteristics of fine-wool Merino sheep over two years at Fowlers Gap.

	GFW (kg)	Yield (%)	CFW (kg)	FD (µm)	SL (mm)	SS (N/ktex)
Year 1	2.6 - 3.4	50 - 61	1.5 - 1.9	17.5 - 19.4	73 - 79	27 - 39
Year 2	3.7 - 4.7	49 - 59	2.1 - 2.7	19.5 - 20.6	86 - 92	34 - 40

GFW = Greasy fleece weight (kilograms)

CFW = Clean fleece weight (kilograms)

FD = Fibre diameter (microns)

SL = Staple length (millimetres)

SS = Staple strength (Newtons per kilotex)

It was suggested that the major difference between fine wool produced in the tablelands and that produced in the pastoral zone was related to wool style (particularly dust). The key issue in terms of selection of sheep for any environment is one of fleece value (\$/head) which can be achieved via a combination of fibre diameter and clean fleece weight.

The use of coats for a 12 month period resulted in improvements in style (reduced dust and weathering). However, these improvements in style had little effect on the processing performance of wools in this trial (given that the effects of staple strength, staple length, fibre diameter and vegetable matter were accounted for).

Predictions of value determining raw wool characteristics have generally been based on complex relationships between vegetation, feed intake and wool growth rate. I was able to develop simple predictions of fleece value based on fibre diameter, vegetable matter content and yield based on seasonal rainfall received for the year prior to shearing. Such forecasts could be regarded as "gross" estimates of likely production, but with further refinement they could form the basis of forward marketing strategies.

## Implications for Wool Production in the Pastoral Zone

Results of this work, together with wether trials conducted by NSW Agriculture in the Broken Hill area, have provided "food for thought" with respect to the selection of Merino bloodlines or strains for the pastoral zone. In recent times, some pastoralists in the Broken Hill area have switched to Peppin-based bloodlines. Whilst the original trial ewes have since been sold, the fine wool progeny at Fowlers Gap are now being mated with Peppin-blood rams. There is continuing interest in the performance of non-traditional bloodlines in the pastoral environment, both in NSW and WA.

## Acknowledgments

This work was conducted with the support of IWS (AWRAP) by way of a postgraduate scholarship. My studies were supervised by Dr Neville Jackson (CSIRO) and Assoc. Professor David Cottle (UNSW).

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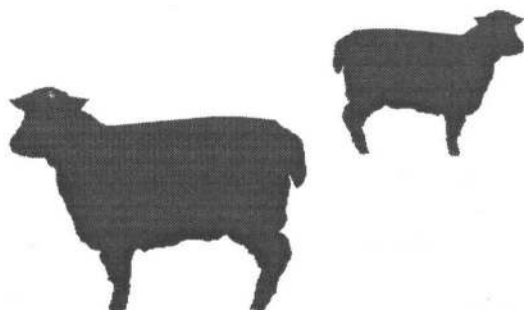
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## UPDATE FROM THE LAKE EYRE BASIN

Kate Andrews, PO Box 592, Longreach QLD 4730

## Introduction

Over the last couple of years residents of the Lake Eyre Basin, government representatives and other interest groups have been working together to determine whether to establish catchment management or an alternative in the Basin, and if so, how. The first step has been finding out what the major natural resource management issues are in the basin and whether people believe there is a need for a framework to manage these issues. Due to the logistical challenges of the Lake Eyre Basin; namely size, low population density and multiple State and administrative borders, it is inappropriate to simply apply a catchment management model from elsewhere. The second step, therefore, is to ask people what they think would be an appropriate regional framework. What would work for the people and the environment of the Lake Eyre Basin? This will of course change over time as issues, technology and people change. Any framework or process that is established will need to adapt to meet these changing needs and must be able to respond to feedback.

As a result of the work of the Lake Eyre Basin Steering Group and its consultation process, a decision was made at a public meeting in Birdsville last year to establish catchment management in the Basin. A general framework was designed and accepted with the consensus of the meeting. This is a two-tiered model comprised of up to six catchment management groups and a Lake Eyre Basin Coordinating Group. Following another round of public meetings, two catchment groups have been formed - the Cooper Creek Catchment Committee and the Georgina/Diamantina Catchment Committee.

## About the Basin

The Lake Eyre Basin is one of the world's largest internally draining river basins. It is a very large and sparsely populated area covering one sixth of Australia, about 1.2 million km<sup>2</sup>. Much of the Basin falls in Australia's semi-arid and arid zones. It encompasses a range of bioregions including the Channel Country, the Stony Plains, the Mitchell Grass Downs and the Simpson-Strzelecki Dunefields. One of the major river systems of the basin is the famous Cooper Creek. This, and other large, inland river systems are characterised by high flow variability, high transmission losses downstream and very low gradients. When the rivers flood they cover vast areas. In April 1990 the Cooper system inundated an area of about 18,600 km<sup>2</sup>, equivalent to about one quarter of Tasmania.

The Basin contains areas of high environmental and economic value, and much cultural heritage. It comprises parts of Queensland, South Australia, the Northern Territory and New South Wales. Land uses include pastoralism, Aboriginal activities, mining, petroleum exploration and production, conservation and tourism. Managing the Basin involves

complex issues and the coordination of ideas from many individuals, agencies and non-government bodies.

The issues that we face with regard to regional planning in the Basin are ones which confront the rangelands far more than the rest of Australia. They include scale and distance, sparseness of population, and multiple State and administrative borders. These are challenges we are trying to meet in working towards an appropriate model for regional integrated natural-resource planning and management in the Lake Eyre Basin.

## The Lake Eyre Basin Steering Group

The Lake Eyre Basin Steering Group was initiated in 1995 at a public meeting held in Birdsville. The meeting was convened by the National Parks Far North Consultative Committee (South Australia) and attended by many different interest groups, including government and non-government people.

Concerned by conflict between different groups and the potential for World Heritage listing, community members wanted to do something constructive and bring together the different interests to work towards sustainable use and management of the natural resources in the Basin. Participants of the meeting decided to establish the Lake Eyre Basin Steering Group.

The Steering Group brought together a diverse range of stakeholders and interest groups across State borders (Figure 1). It included representatives from the pastoral industry, the Queensland and South Australian governments, conservation groups, mining and petroleum industries, Landcare groups, Aboriginal organisations and local government.

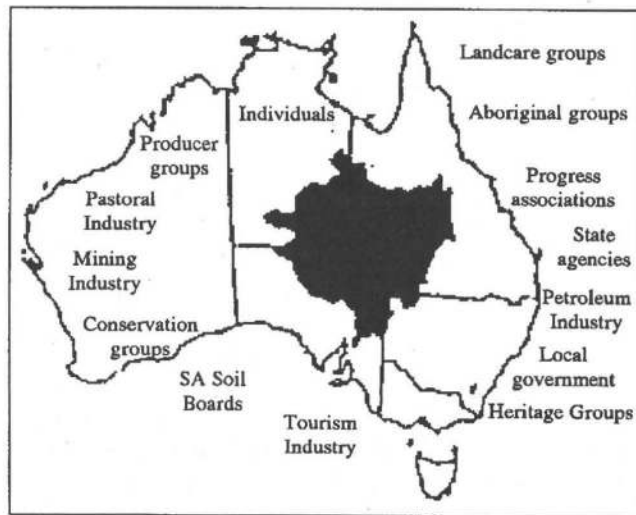


Figure 1: Some of the interest groups of the Lake Eyre Basin

The Group was supported by a Project Officer (me), appointed in September 1996, and was initially funded through member contributions. A successful funding application to the National Landcare Program ensured continuation of this position for up to three years.

The Steering Group's tasks included:

- preparing an information paper on the present management and resources of the Basin;
- consulting with the community and interested groups about options for catchment management; and
- preparing a discussion paper on those options.

Through consultation, the steering group sought to find out whether establishing a catchment management framework for the Lake Eyre Basin would be worthwhile and, if so, what form it should take.

## Towards a Framework: The Community Consultation Process

As outlined above, an options paper was produced containing the outcomes of consultation with some of the communities within the Lake Eyre Basin (Figure 2). It summarised the results of 14 meetings held across the Basin, and discussions held with many individuals. Approximately 160 people attended the meetings and about 50 people were consulted outside of these meetings. The paper outlined options for integrated natural resource management or catchment management frameworks as suggested by community members and the steering group at the meetings.

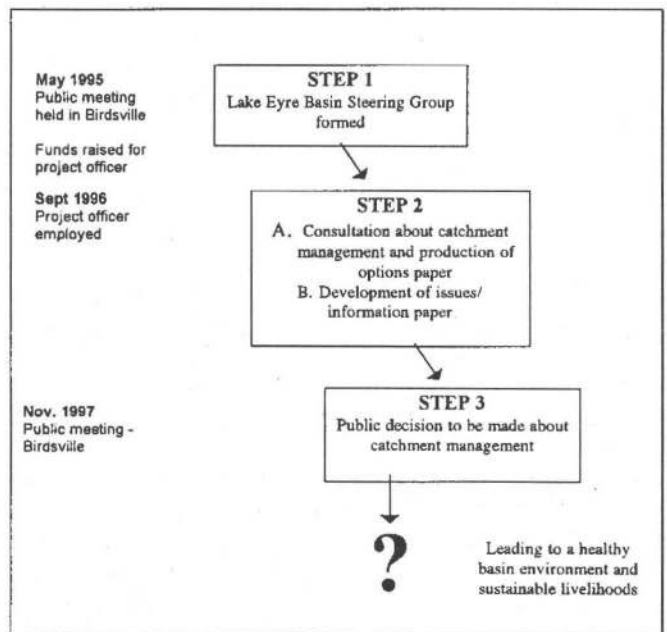


Figure 2: Outline of the community consultation process

Information about the Lake Eyre Basin Steering Group and consultation opportunities was distributed through radio stations, newsletters, newspapers, mailouts, phonecalls, posters and talks to various community groups. Information sheets outlining the consultation process and discussing catchment management were produced and distributed widely.

A draft of the options paper was sent to those who attended the meetings, others involved in discussions, and to relevant organisations and interest groups for their comments. The final version was distributed before the Birdsville meeting last November, as were copies of the issues paper.

The views of those who attended the meetings held within the Basin may not reflect the views of all interest groups. If workshops had been held in Adelaide or Brisbane we might have found that different issues were raised or emphasised. There was not a lot of involvement in the public meetings by Aboriginal, environmental or tourism groups.

## Natural Resource Management Issues

At the public meetings, participants were asked what they thought the major natural resource management issues were for the Lake Eyre Basin. The responses helped identify the issues to be considered in determining the most suitable options for future management of the Basin.

Examples of major issues raised, and how they relate to catchment management, include:

### *Weeds and pests*

These were identified as issues at every meeting. Developing regional strategies could certainly help coordinate and implement on-ground work and activities, making individual efforts more effective.

### *Surface water management*

This was another major issue raised, particularly in Queensland and South Australia. Once again, catchment management may help by providing a process for: long term planning; ensuring all points of view are heard; ensuring that decisions are based upon adequate information; and avoiding multiple *ad hoc* decisions that result in long term negative impacts on the catchment and its people.

### *Security of tenure*

This is a vital issue to people in the rangelands and was voiced at meetings throughout the Basin. It is an issue that we are less able to deal with directly through catchment management. What we may be able to do is provide a forum for communication between groups.

Issues identified are not all specifically resource management issues. They also reflect social and economic concerns. Environmental, economic and social issues are interrelated, and in this process we will inevitably have to deal with all three. Any goals we may wish to set as part of a catchment management process will need to take account of environmental, economic and social issues and implications.

## Outcomes

Approximately 100 people from across the basin and from Adelaide, Brisbane and Canberra attended the Birdsville meeting held in November 1997. It was a great success with the following specific outcomes agreed to through consensus.

The Lake Eyre Basin Steering Group, having fulfilled its Terms of Reference, ceased to exist following the meeting. A transition task force now exists to establish the agreed

framework. General consensus was reached by the meeting that two levels of management were required:

1. An over-arching Lake Eyre Basin Coordinating Group.
2. Five or six Catchment Management Groups that are not constrained by State borders (existing local groups such as the South West Strategy and the Marree Soil Board to feed into the Catchment Management Groups).

A drafting committee was formed at the meeting to help with the process. It was agreed that this group would continue as the transition task force to guide the transition phase. It consists of about twelve individuals representing different groups and with skills to contribute to the process.

## The Lake Eyre Basin Coordinating Group

The following Terms of Reference for the Lake Eyre Basin Coordinating Group were agreed upon at the Birdsville meeting. The Lake Eyre Basin Coordinating group will:

- Promote ecological and economic sustainability in the Basin.
- Develop and communicate a shared strategic vision across the Basin.
- Act as a forum for Basin-wide issues.
- Be a communication channel with governments.
- Integrate priorities for action plans and funding.
- Manage a communication strategy for the Basin to facilitate knowledge flow and development.
- Provide information to support catchment groups and individuals.
- Apply social justice principles so that diverse views are respected and considered.
- Liaise with other statutory groups with related responsibilities.
- Build the capacity of the Basin community to undertake community-based strategic planning.

The meeting agreed that the Coordinating Group would be constituted as follows:

- An independently appointed chair.
- Chairs (or nominated members) of catchment groups (six).
- (Four) other selected individuals to fill required knowledge/skills gaps.
- Up to five government observers (QLD, SA, NT, NSW, Federal).
- Catchment group representatives must form the majority on the group.

A selection process is underway for the position of chairperson for the Coordinating Group.

## The Catchment Management Groups

During March and April 1998 further meetings were held around the Basin - this time to discuss and establish catchment management groups. There are likely to be some differences between the regions in how the groups are formed and the roles they play, however they will need to be consistent with the aims and principles of the framework. Participants of the Birdsville meeting were clear that the catchment groups

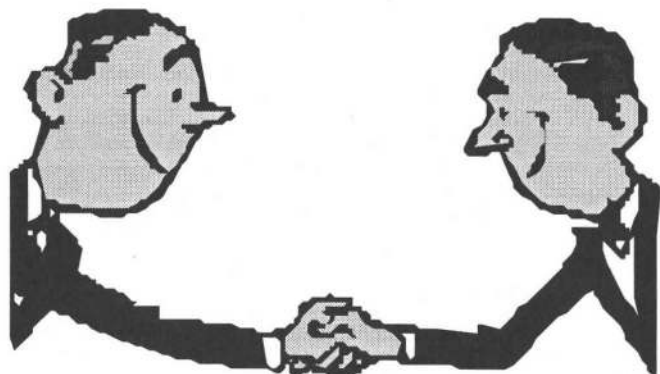
should not be determined by State borders and that they should be inclusive of different groups and view points.

At this stage two catchment groups have been established: one for the Cooper catchment and one for the Georgina and Diamantina systems. Public meetings were held in locations at the top, bottom and middle of these catchments and the roles, guidelines for operation and membership of the committees were discussed. The suggestions coming from the meetings were recorded, summarised and then used as the basis for decision making at the final public meetings, held in the centre of the catchment, where the committees were formed. To ensure participation from across each catchment and a range of views, membership was divided into geographic and interest-group representation. It was agreed that the structure and group membership would be reviewed after twelve months.

Meetings were also held in Alice Springs, Oodnadatta, Marree and Broken Hill. At all of these meetings participants were supportive of the establishment of catchment committees in the Cooper, and the Georgina and Diamantina systems. They were, however, exploring ways most appropriate for their regions to be involved and this did not necessarily involve setting up catchment committees. Discussions will continue.

## Conclusion

Through a participatory process involving residents, government representatives and interest groups, a catchment management framework has been initiated and designed for the Lake Eyre Basin. The framework is presently being established. Many different people and organisations have put an enormous amount of time, effort and resources into the process and encouraging involvement will continue to be a key part of catchment management. There is a lot of work ahead to achieve on-ground outcomes but as long as the process and framework remains responsive to the communities and interest groups of the Lake Eyre Basin, there is much that can be achieved.



## REPORT TO THE AUSTRALIAN RANGELAND SOCIETY

### A Travelling Fellowship to the USA

*Alec Holm, Ecosystems Research Group, Department of Botany, University of WA, Nedlands WA 6907*

A travel grant from the Australian Rangeland Society enabled me to travel to the USA in March - April 1998. I attended the International Conference on Landscape Ecology in Michigan. I then visited Colorado State University, University of Wyoming, New Mexico State University and Texas A&M for discussions with researchers on the assessment of landscape function, modelling and remote sensing.

Two things stood out for me: the increasing importance of non-traditional uses of rangelands and the widespread shrub encroachment of grasslands. There were interesting interactions between these, which we will see.

### **"When do you stop aiming to get bigger and aim to get better?" - Eugene Odum**

Firstly to the conference - which was a lean affair: no freebie drinks! It was also a bit cold for this warm-climate guy - well below freezing for most of the time and no sign of the sun at all!

It was surprising for me to learn that between 1850 and 1880 Michigan logged every tree in the state - a similar story in many northern states of the US. Since then, until very recently, there has been widespread reforestation. Today, with galloping urbanisation, there is a second wave of clearing and there are areas of the States with higher rates of clearing than most South American countries - e.g. Florida is currently clearing about 100,000 acres/year (Thomas Hoctor, University of Florida). Virginia Dale (Oak Ridge National Laboratory) presented a graphic slide of the shrinkage of the world relative to our population since 1990. She, and others, consider that land use and management actions constitute one of the biggest global changes occurring today yet many land decisions are made without regard to ecological impacts. Tom Hobbs (Colorado State University) made us aware that the population in some parts of the States (e.g. Colorado) was growing faster than anywhere in the third world.

Leonore Fahrig (Carleton University, Ottawa, Canada) identified recent trends in ecology as:

- recognition of spatial pattern,
- attempts at large-scale applied problems, and
- addressing experimentation and statistical rigour.

Recent trends in landscape ecology are more mainstream and have more linkages with environmental issues and conservation ecology. Leonore stated that she was concerned about the narrow job characteristics of a landscape ecologist gleaned from 71 job advertisements over the fall of '97: all GIS, remote sensing and modelling.

Throughout the conference there was emphasis on the need to move up in scale. Eugene Odum (University of Georgia - his CV is just awesome!) stressed that understanding systems was not enough when moving up from the landscape to the regional scale and we also require an understanding of "transferring functions" between landscape elements. Paul Seerbach from Michigan Department of Natural Resources felt that landscape ecologists provided a "birds-eye view of the land". "Models are teachers and help maps come alive. Landscape ecologists develop a common knowledge platform for disparate disciplines (e.g. geology, geomorphology, hydrology etc)."

Eugene Odum stated "we don't pay for 'nature's work' in our food, clothing etc". The goods and services of nature are taken for granted and these costs are not included with the costs of production. He believes "we can't avoid 'overshoots', we have already overshoot, but how can we recover? When do you stop aiming to get bigger and aim to get better?"

Issues to do with conservation and management of wildlife are a big deal in the States. Landscape ecology and ecosystem management is to do with "huntin' and fishin'" - Kay Cool, Director of Natural Resources, Michigan. And this, to me, was the case for the conference which was dominated by wildlife ecologists. Many of the presentations were to do with defining or modelling habitat, gap analysis and the processes that support wildlife.

An example of the importance placed on wildlife is the program now underway to protect the habitat of the endangered spotted owl - 7.7 m acres for 2200 pairs of owl across three states - which will see about \$US1 billion in lost income from timber products. This is a good point for me to leave the conference and travel south.

### **(In the States) "Ecosystem Management is to do with 'huntin' and fishin'" - Kay Cool**

In the North and West, federal lands are widespread and access to "wildlands" is relatively easy - one just needs to pay for a license to hunt a deer and go out and get it. East of the Rockies the story is a little different because most of the land is privately owned (98% in Texas). It is fascinating to see how urban peoples' desire to experience nature (and there are some bizarre experiences) are changing the way the rangelands are used, managed and valued.

I visited the Texas A&M Agricultural Experiment Station at Sonora. It is on the Edwards Plateau, an area of 10 m hectares supporting perennial bunch grasslands on shallow limestone soils. Annual rainfall is about 550 mm, of which two thirds falls in summer. Severe overgrazing from the early years of grazing up to about the 1950's drought resulted in loss of topsoil and grasses. Invasion of overgrazed areas by *Juniper* spp and *Opuntia* spp (prickly pear) since the early 1960's have seen a continued decline in livestock numbers. The area now supports about 2 m goats, 2 m sheep, 1.6 m white tailed deer and 0.5 m cattle.

Sonora is about 1.5 hours drive from the major city, San Antonio, and in recent years there have been significant changes in land uses, coupled with off-farm environmental considerations. Income from selling access to hunt deer, turkey and javalina (bush pig) is rapidly approaching income

from traditional livestock. Butch Taylor (Texas A&M, Sonora) estimates that the income on Sonora from livestock is about \$US14/ac compared with \$US7/ac for hunting deer. Hunters pay ranchers \$US2500 for a four-day hunting season which allows them four deer, two turkey and one javalina. Accommodation, meals and the preparation of shot animals is included in this price. Hunters will pay \$US500 to take one turkey! ("Hunting" is a bit of a misnomer - hunters are set up in elevated blinds (probably in all their gear with rugs around their legs) and the animals are attracted to a spot about 50 m away by a corn feeder. The selected animal is dispatched and the farm staff do the rest!)

This change in land use has created interesting conflicts in the management of the range. Livestock prefer open grassland while the juniper-invaded shrubland is preferable wildlife habitat. Another consideration is the recharge of the deep aquifer that supplies water to San Antonio. Grassland provides on average 100,000 acre feet (whatever that is in cubic metres) of recharge water, while juniper shrubland provides none. At present there is no way for these off-site values to be translated to the land owner. On the other hand, conservation values are readily captured through wildlife permits and for access to bird-watching in some favoured areas (especially those that have rare and endangered bird species). However in the city of Austin, Texas, a referendum is to be held seeking to raise \$US60m through an additional waste disposal levy of \$US1.40/mth/household to buy conservation easements on farmer/ranch properties. These will be used to establish management conditions to maximise recharge of aquifers that supply Austin.

A more recent change in land use on the Edward Plateau has been the purchase of small lots (20 acres) by city dwellers who just want to "get away from it all". These people prefer juniper-invaded shrubland to grassland and will pay a significant premium for these lands over grasslands.

Further south and east Tim Ginnett, a wildlife specialist at the Texas A&M Agricultural Experiment Station at Uvalde, said the trend here is for urban dwellers to buy up entire ranches for hunting. In fact, south of Uvalde the balance between using the land for traditional livestock and for wildlife is now very much in favour of wildlife and the traditional rancher is being squeezed out. There is conflict between these owners who allow predators, such as coyote, to build up, and surrounding ranchers. (Uvalde is the divide between the oak/juniper invaders to the north west and the Acacia/mesquite invaders to the south east along an increasing rainfall gradient from west to east).

Elsewhere I saw large swathes of Wyoming where cool-season grasslands (250 mm rainfall zone) had been replaced by *Artemisia* sp (sagebrush). Good news for sheep and wildlife but no joy for cattle. Further south in New Mexico the perennial grasslands, again in 200-250 mm rainfall zones, were massively invaded by creosote bush (*Larrea tridentata*).

Jonathan Phillips (Department of Geography, Texas A&M) put forward the idea that many of the USA grasslands are now out of sync with the current climatic pattern which is different from when they were formed. Any perturbation is likely to easily flip these grasslands into the more resilient shrubland system. Steve Archer and his team at Texas A&M have completed some great work dissecting the transitions from grassland to shrubland. If you want to see a great personal web

site, have a look at Steve's at <http://cnrit.tamu.edu/rlem/faculty/archer/> - where a summary of their findings can be found.

## We NOAA Fans Will Have a Ball!

Finally, to touch on one of the key issues I really went to address: I detected a widespread disenchantment, despair almost, over the lack of progress with effective rangeland monitoring in the States. Fred Smeins (Professor, Rangeland Ecology and Management, Texas A&M) felt that the two federal agencies, National Forest Service and Bureau of Land Management, were still struggling to move from the largely discredited traditional approaches of yesterday. Trends are still downwards despite the best intentions of field staff, often the result of political interference over-riding recommendations of field officers. The Environmental Protection Authority's attempt at national monitoring through the EMAP program was a disaster. Walt Whitford (USA Environmental Protection Authority, Eminent Scientist - Rangelands) believes that EMAP folded due, in part, to lack of expertise in the Agency. The system should have built on existing systems using experienced staff of other agencies.

On the positive side, Jeff Herrick and Arlene Tugal (US Department of Agriculture) and Walt Whitford's group are looking to see if some monitoring component of soil health can be incorporated in the Natural Resources Inventory Program. The NRI is a land use inventory at 600,000 sites randomly selected within each quarter-section block throughout the USA. Inventories of land use were completed in 1982, '89, '92 and '97. The NRI monitors change in land use, not condition. One of the research components is to assess whether purposeful site selection would provide more useful information than randomly selected sites. An objective is to see if they can identify two or three robust indicators of soil health that could be routinely sampled within the NRI program.

Elsewhere, the use of remote sensing for assessing land cover change, invasion of woody species and global carbon balances has got up a real head of steam. Hopes are high for the broadscale use of data from the new Earth Observing System (EOS) AM1 satellite (also PM1) to be launched by NASA in September. This will support MODIS (Moderate-Resolution Imaging Spectroradiometer) which will give everything NOAA gives and more: 250-1000 m resolution, data freely available through the Internet, one to two day repeat cycle and much better geo-referencing. We NOAA fans will have a ball!

## With Sincere Thanks

The hospitality Jenny and I received from fellow rangeland workers in the States was extraordinary. Dennis Ojima in Fort Collins, Bill Reiners in Laramie, Walt and Judy Whitford and Jeff Herrick at Las Cruces and Steve Archer and Bob Whitson all helped arrange our trip and made us most welcome. Many others made time available to talk to me and to show me their field work. It was a great experience and one that I should have done ten years ago!

I am grateful to the Australian Rangeland Society for their support. I was also supported by the University of Western Australia and through my fellowship with the Meat Research Corporation.

## ALICE SPRINGS GROUP MARKETING FIELD DAY

*Andrew Phillips, Department of Primary Industry & Fisheries,  
PO Box 8760, Alice Springs NT 0871*

The Alice Springs Pastoral Industry Advisory Committee (ASPIAC) is an advisory group of pastoral industry representatives to the NT Department of Primary Industry and Fisheries (DPIF). This group held a very successful field day in Alice Springs in mid February on the potential of group marketing schemes to expand marketing options for local beef producers. All guest speakers had direct industry experience in group marketing. More than 60 people attended, including 38 pastoralists representing 21 local stations (approximately 25% of stations in the district), DPIF staff, media representatives and others. An interim steering committee of 11 members was formed after the field day to set future directions, including the immediate need to obtain more specific information on beef marketing options for producers in central Australia.

### Highlights from the presentations of speakers on the day were:

**Bruce McKenzie** (University of Western Sydney)  
*Advantages of Group Marketing*

Bruce stressed that specialists are needed for marketing in today's global economies. The difference between past and present marketing is **complexity**. Marketing requires a team approach as individuals cannot possess the full quota of skills required. Characteristics of successful marketing groups include:

- Year-round provision of the product to the client. The consumer will be loyal to the supply, not the supplier.
- A label assists recognition of the product.
- Personal relationships are important: within groups and with agents; marketing groups must be familiar with the client's culture; there must be trust and sharing of information; and there must be a sense of common ownership.

Necessary ingredients for successful group marketing include:

- A need to understand marketing systems and the complexity of these systems.
- Lateral thinking.
- Understanding the politics - including knowing the implications of culture, history and religion of a target market.
- A willingness to "learn into the future" - capacity to adapt now and continue to change as circumstances require.
- A leader from amongst the group.

**Darryl Croser** - *beef producer and marketing group organiser from Mt Gambier (SA)*

Darryl was an excellent speaker who really got his message across about how the groups he was involved with were receiving the benefits of group marketing and group purchasing.

He stressed that opportunities must be producer-driven because they have the most to gain. Successful marketing involves finding out what buyers and consumers want and then producing it using market feedback to improve the product. The first goal of a group could be to improve profitability and this might be achieved through:

- Decreasing the cost of inputs by using the power or leverage of group purchasing - e.g. tenders for the bulk purchase of fuel, vehicles, insurance etc.
- Increasing returns through value adding of meat products and the hide.

Darryl then went on to describe how the "Table Rite" marketing alliance worked. This group involves 250 producers, four meat processors and 91 independent supermarkets. It is a large group and it has been difficult to get all participants working together. Despite these difficulties, the alliance has definite advantages including increased sales because the product is guaranteed. Also, problems identified along the marketing chain are able to be addressed as they are identified.

**Peter Keith** - woolgrower and chairman of the *Tablelands Wool Marketing Group* (Bathurst NSW)

Peter described how this group successfully follows their wool from the farm gate through the processing pipeline to the garment stage; and then markets the garments. Peter emphasised that the same principles can be directly used for marketing beef. Important points from Peter's presentation were:

- Research the whole chain before you form a group marketing / processing venture.
- Be prepared for disappointment.
- Start with a small market.
- Continually self-assess.
- Identify the market - what market?, what price?, what style?
- Plan - your growth, your partners (i.e. whether to include them as equity partners or to employ them), your future partners (manage your customers, not sales), your directions and your policies.

**Steve Millard** - Pastoral Manager - *NAPCO* (Brisbane)

Steve provided an overview of the North Australia Pastoral Company's (NAPCO) operations and marketing opportunities. An essential requirement is to look after the customer. The QA program, Cattlecare, is regarded as a form of insurance that will enable accredited producers to avoid discounts if future residue problems (such as the "cotton trash scare") occur. Steve emphasised that big sale lots have bargaining power compared with small lots and tend to produce better quality feedback from points further down the marketing chain. Steve also worked through an example of how NAPCO calculates costs and returns from different market options on a per kilo basis. Producer feedback from the day was very positive about this exercise.

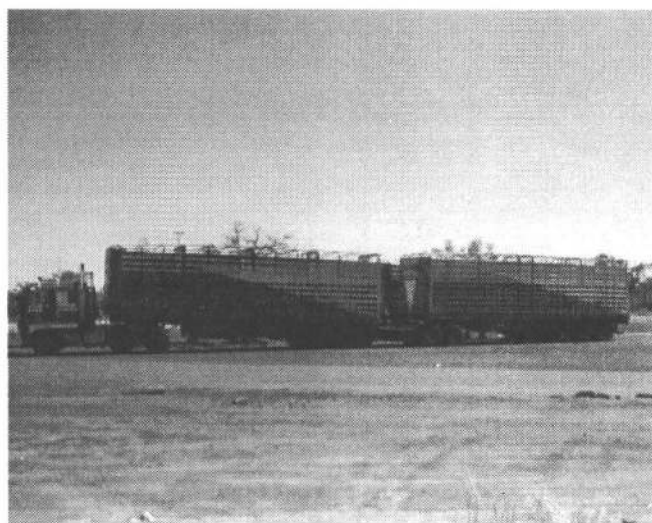
**John Hickey** - Field Manager for *Computer Aided Livestock Marketing (CALM)* in Roma (QLD)

John gave a brief run-down on the descriptive language used by CALM, how sale catalogues are put together and the information required by assessors. John made the point that "knowledge is power" and this could be accessed by using assessment and description to deliver what was required. Group marketing live cattle on CALM is gaining momentum in Queensland where a "critical mass" forces buyers to take notice of the sales. John emphasised that this was an option for producers in central Australia.

Following his presentation, John gave a practical demonstration of the assessment procedure using live cattle.

## Developments Since the Field Day

The interim steering committee, which is now known as the Central Australian Producer Action Group, has continued to develop ideas that are appropriate for this region. It is currently organising a feasibility study which will investigate a range of market options with a view to further developing the most promising market(s). The tasks that the Producer Action Group have set themselves are very difficult so solutions will not be easily achieved. However, they are to be commended for tackling their marketing problems in the face of the ongoing cost-price squeeze that is faced by all Australian primary producers.



## BOOK REVIEW

### *The Romance and the Reality: A Guide to Managing Queensland's Stock Routes*

Editor: Rodney H. Edwards. 127 pages. Published by Queensland Department of Natural Resources, 1998.

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

"...heat, flies and dust... - these images form the basis of our beliefs in the rural tradition of droving down the stock routes. Well before Patterson wrote *Clancy of the Overflow*, the stock route network had formed part of the Australian identity and the ethos of the bush. Still used for their traditional purpose of travelling stock, stock routes form a rich and irreplaceable network of overland routes that link the bush to the city." The foregoing are the opening sentences from the publicity flyer for the book *The Romance and the Reality: A Guide to Managing Queensland's Stock Routes*. The book's main purpose is to provide guidelines for appropriate use of stock routes by drovers and other users, and to assist administrators in their management of these routes. However, the book takes a much broader perspective, particularly in its latter chapters, where it deals with such things as:

- the potential impact of pest animals and plants on stock routes,
- the role that stock routes play in the conservation of cultural and natural heritage, and
- the potential value of stock routes as corridors which can assist in conserving biodiversity.

This broader perspective and the fact that much of the length of Queensland's stock routes traverses the rangelands suggests that the book may be of relevance to some with an interest in the rangelands.

The book has a glossy A4 format, is well structured and written, and is particularly well illustrated with many quality colour prints interspersed throughout the text. The various chapters track through the historical development of stock routes, their present administration and the life of the modern-day drover to the more ecological aspects of management and conservation on stock-route lands. A useful feature, particularly for drovers working in unfamiliar territory and for outback travellers more generally, is the inclusion of grid-section maps which show the locations of stock routes, watering points and shire boundaries superimposed on the normal road map cadastre.

The text flow is interspersed with historical memorabilia, snippets providing insights into life on the road (e.g. a typical day - start at 4 AM!) and bush poetry (such as the Drovers Rule - "start 'em early, steer 'em straight, feed 'em plenty, camp 'em late").

The latter chapters describe how stock routes now cater for multiple land use through tourism and recreation (e.g. four wheel driving and trail riding), the conservation of natural and cultural heritage and as reservoirs for the potential conservation of biodiversity. This last aspect is demonstrated through the conservation principles of refugia, fragmentation, corridors and connectivity. The ideas are illustrated with examples drawn from remnant areas of native vegetation in the agricultural areas (e.g. Darling Downs) and the same principles may also have credence in some areas of the rangelands; if not now, then perhaps at some time in the future.

While applauding the editor's efforts to emphasise the ecological and cultural significance of Queensland's stock routes, I felt that this treatment introduced a dichotomy between the practical and theoretical aspects of the material presented in the book. In the former case, there are insights into the life of the both the yesteryear and modern-day drover. Some of this material, and particularly the previously mentioned maps, is undoubtedly useful to today's drovers and others who travel or use the stock routes. In the latter case, the treatment of ecological and conservation theory is somewhat superficial and those with a genuine desire to know more about, for example, conservation corridors and habitat fragmentation, would need to access other resource material. Still, it would be unrealistic to expect a detailed treatment of such theoretical concepts in a book which is primarily aimed at practical people and, to its credit, the book does end with a comprehensive section of "further reading" to expand on the various ideas and theories covered.

*The Romance and the Reality* provides a well illustrated account of the past and present values of Queensland's stock route network. The publicity flyer concludes by saying that the "Guide is an essential handbook for drovers, landholders, Councillors, managers of transportation and vegetation corridors and anyone interested in the rural traditions of outback Australia". While being a little more circumspect, I appreciated the book for its treatment of droving as a modern-day profession and for introducing present-day users to the broader ecological and cultural values of these corridors of public land. I recommend the book to all with an interest in Queensland's stock routes and to anyone looking for an introduction to the principles of managing public land within its broader context of environmental, ecological and cultural values.

The book costs \$29.95 and is available from:

Service Centre Outlet  
Department of Natural Resources  
Locked Bag 40  
Coorparoo Delivery Centre QLD 4151

Ph: (07) 3896 3216, Fax: (07) 3896 3510  
email: JarrettHR@dnr.qld.gov.au

# AUDITING OUR LAND AND WATER RESOURCES

## The Rangelands Monitoring Theme

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

### Introduction

To stop degradation of our natural resources, we need to know the present state of these resources and what effects our use has on them. This understanding will be essential if we aim to use our resources sustainably. Therefore we need to generate appropriate information. This information can best be achieved by monitoring.

With this in mind, the Federal Government is funding a National Land and Water Resources Audit through the Natural Heritage Trust.

The Audit will collect information on a number of attributes relating to our natural resources, including values and uses as well as agricultural production, rates of land degradation, trends in water quantity and quality, and condition of vegetation. This will allow us to analyse our natural-resource policies, incentives and regulations, and to examine the effects of our resource use for social, environmental and economic purposes.

In the process, the Audit will develop a national information system, produce resource assessments and collaborate with other relevant initiatives.

The Audit will also highlight any needed remedial action and development opportunities.

### Strategic Plan

A print version of the Audit Strategic Plan was released for review in June. The Strategy can also be accessed via the Audit Website at <http://www.nlwra.gov.au>.

The Strategy outlines the direction of the Audit and lists actions and "performance indicators" for each of the Audit objectives. The objectives were set down in December 1997 by Primary Industries and Energy Minister, Anderson and his colleague, Environment Minister Senator Robert Hill, who together comprise the Natural Heritage Trust Board.

The Audit will concentrate on seven themes during its four-year period to June 2001. These are:

- Surface and groundwater management - availability, allocation, use and efficiency of use.
- Dryland salinity.
- Vegetation cover, condition and use.
- Rangelands monitoring.
- Land-use change, diversity and sustainability of agricultural enterprises.
- Capacity of, and opportunity for, farmers and other land managers to implement change.
- River, estuary, catchment and landscape health.

For each theme, the Strategy lists some of the key questions facing natural-resource decision-makers and gives the rationale behind selecting the theme for concentrated investigation within the Audit.

### Developing the Rangelands Monitoring Theme

For rangelands management, monitoring must be able to detect threats to ecosystem integrity and ecology promptly, during a particular event, to facilitate timely stock management and overall ecosystem management. This relates to implementing management alternatives and resultant costs, as remedial action after degradation often costs more than the land value.

In developing a national rangelands strategy, the most appropriate techniques for rangeland monitoring have been debated. This has shown that two levels of information are needed:

- Property managers need access to information at the local-paddock scale.
- State and other administrators need access to regional information to strategically assess overall effectiveness and likely returns on investment.

During the Audit Needs Analysis Project, an essential set of issues relating to tropical rangelands across Queensland, the Northern Territory and Western Australia were recognised. The issues were:- overall ecosystem health; decline in system function associated with shrub invasion; loss of perennial pastures; soil compaction; and the need to monitor and manage total grazing pressure.

Many rangelands managers from these regions believe that the Audit is in a unique position to promote an Australia-wide rangelands monitoring system. Agencies suggest that once initiated by the Audit, continued monitoring by States and Territories would provide information for appropriate management of rangelands.

The key questions facing Australia's natural resource managers on rangelands monitoring relate to the monitoring frameworks and economic management implications. Key questions include:

#### *Monitoring frameworks*

- What is the most effective and efficient monitoring system for Australia's rangelands at national, regional and property levels?
- How can the Audit most effectively provide a benchmark of rangelands condition upon which to base a monitoring program?

#### *Economic management implications*

- What standards, protocols and investment are required across all sectors and at what scales to ensure ongoing adoption of the monitoring program and timely resource management actions?
- Where is economic productivity declining associated with shrub invasion, loss of perennial pasture, soil compaction or other key causes?

- What are the full costs of monitoring and managing pastoral lands, how does this compare under various commodity price scenarios to the net value of production from pastoral lands, and who pays?
- How does income from non-pastoral sources compare with, and how is it affected by, income from pastoral sources?

## Coordinator

Alec Holm has been appointed as the coordinator for the Rangelands Monitoring Theme. His role is to develop the theme workplan by liaising and networking with the State, Territory and Commonwealth agencies. To initiate this, a workshop with representation from the State and Commonwealth agencies was conducted in Sydney on June 18 and 19. Further information on the outcomes of this Workshop and the draft Work Plan for Rangelands Monitoring will be presented in the next edition. In the interim, further information regarding the Rangelands Monitoring Theme can be obtained from:

Robert Scott or Colin Creighton  
National Land and Water Resources Audit

Phone: (02) 6257 9516  
Fax: (02) 6257 9518  
email: robert.scott@nlwra.gov.au or  
colin.creighton@nlwra.gov.au

WebSite: <http://www.nlwra.gov.au>

## NEW LWRRDC REPORT AVAILABLE

*Sue McIntyre, CSIRO Tropical Agriculture, Cunningham Laboratory, 306 Carmody Road, St Lucia QLD 4067*

A report that may be of interest to rangeland scientists has been published in the LWRRDC Occasional Paper Series. Entitled 'Diversity and sustainability in grassy eucalypt ecosystems', the report addresses the broad issue of ecological sustainability in the context of the grassy ecosystems of eastern Australia. Grazing by domestic livestock is widely considered to be the management factor of most importance to grassy ecosystems. However, other technologies and factors are increasingly influential in grazing management - livestock breeding, feeding technologies, cultivation, sown species, fertilisation, tree clearing and changed fire regimes. These processes are inextricably bound, both to each other, and ultimately back to grazing intensity.

In this report, literature is selectively reviewed for the following purposes:

- to identify the various elements of ecological sustainability;
- to assess potential indicators of ecological sustainability; and
- to identify the relationship between the indicators and productivity.

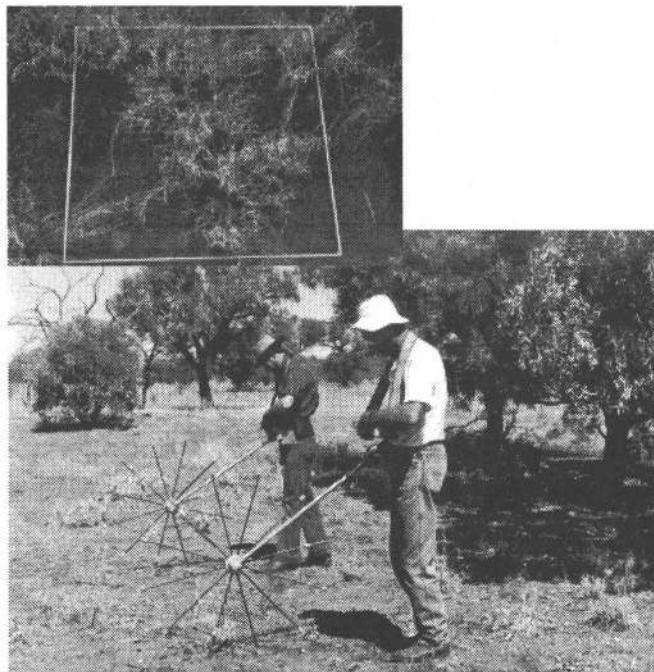
The authors discuss these issues in the context of the ecology and land-use in grassy ecosystems. The focal point of the discussion is the sub-tropical grassy ecosystems in Queensland, although many of the principles and issues raised are relevant to a wider range of communities and extend beyond the review region.

Examples of unsustainable management of the grassy ecosystems are most prominent in southern Australia, where land-use intensification is most advanced. In Queensland, there is a widespread perception that many of these problems are not relevant. In this paper it is argued that although development has not proceeded in Queensland to the intensities found in southern Australia, the processes of land-use intensification are in place, and the risks of unsustainable management are similar.

### *The report is titled:*

McIntyre, S. and McIvor, J.G. (1998). *Diversity and Sustainability in Grassy Eucalypt Ecosystems*. LWRRDC Occasional Paper Series No. 04/98 (49 pp.).

This report is available from the Department of Primary Industries and Energy Shopfront at a cost of \$10. Call toll-free on 1800 020 157 to order.



**A MESSAGE FROM THE VI<sup>TH</sup>  
IRC EDITORIAL COMMITTEE**  
*Be Part of the Editorial Team,  
we need your help!*

*David Eldridge, School of Geography, University of NSW,  
Sydney NSW 2052*

*David Freudenberger, CSIRO, PO Box 84, Lyneham ACT  
2602*

By now you would have seen the Circular for the VI<sup>th</sup> IRC. The Editorial Committee intends to have the Proceedings available at the meeting, so that Congress participants will have immediate access to all of the papers. There are real advantages to the Editorial Committee as well. A great deal of the hard work will have been completed by the beginning of the Congress, and we can enjoy the Congress knowing that we don't have to rush home and finish organising the Proceedings. There are obvious financial benefits too. We will save a considerable amount on shipping and postage if we don't have to mail out a bulky Proceedings, a fact which is obviously not lost on our Business Manager.

You will have noticed in the Circular that we have asked you to get two colleagues to review your paper before you send it to us. This is to avoid receiving papers which are sent straight to us without any peer review. However, we expect that about 10% of the estimated 600-900 contributed papers will need significant re-writing, particularly if English is not the author's first language. We need your help.

We would like as many members as possible of the Australian Rangeland Society to act as contributing editors for two to three short papers. Given our other responsibilities, this would be a big job for the two Davids to handle alone. Therefore the success of this exercise will depend on how well we can share the load.

If you are prepared to look at a couple of three-page papers please let either of us know. Otherwise we will be cajoling, conning and bludgeoning people for this task!

Remember, the Congress belongs to all of us, and its ultimate success depends on the involvement of the Australian members of the Society. Being a contributing editor is one small way in which we can all play a very significant role.

If you can help, please contact either one of us at the above postal addresses or via the following email addresses:

d.freudenberger@dwe.csiro.au, ph: (02) 6242 1607  
d.eldridge@unsw.edu.au, ph: (02) 9385 4400

**INTERACTIVE CD-ROM**  
*Remote Sensing of  
Central Australian Deserts*

*Vanessa Chewings and Gary Bastin, CSIRO, PO Box 2111,  
Alice Springs NT 0871*

Ever wondered what it is that satellites "see"? Or how it is that satellite data can be analysed to assess the condition of grazed country? Or perhaps on a different track, how to present your research results so that they are (hopefully) more interesting, appealing and accessible to the general public?

To answer some of these questions, a group of us at the CSIRO Centre for Arid Zone Research in Alice Springs have put together an interactive CD-ROM which (1) provides a generalised description of central Australia's environment (climate, landscapes and vegetation) and (2) explains how satellite and GIS data can be used to monitor grazing effects on these landscapes. The CD focuses on:

- the results obtained from recent research where satellite data have been used to separate grazing effects on the vegetation from that caused by natural variability, and
- how these results have been verified using aerial videography.

By combining the Internet (World Wide Web) format and CD-ROM technology, we have used the new educational tools of the 1990s to help communicate our research results to the public at large.

Our CD-ROM contains colourful images, maps, photos and, we believe, interesting and useful information about the central Australian environment. Sitting behind that, and accessible through hypertext links, are the scientific principles and published research literature which underpin our less formalised presentation of research information.

### **Purpose of the CD-ROM**

Although the CD-ROM is a report on research conducted in collaboration with Japanese scientists as part of Global Research Network Systems, the CD is mainly intended as an educational tool for high school and college / undergraduate students, and the general public. We hope that by using it as a learning tool, people generally will be better informed about our environment, the rangelands, and how modern technology such as remote sensing can assist in monitoring and managing these vast lands. Because the research described has focussed on the pastoral industry and the effects of grazing, we hope that the user will also gain a better appreciation of the pastoral industry. We also hope that some aspects of the research described will be of interest and use to the people who manage and are responsible for this land; that is, individual pastoralists through to government agencies.

## What is on the CD-ROM

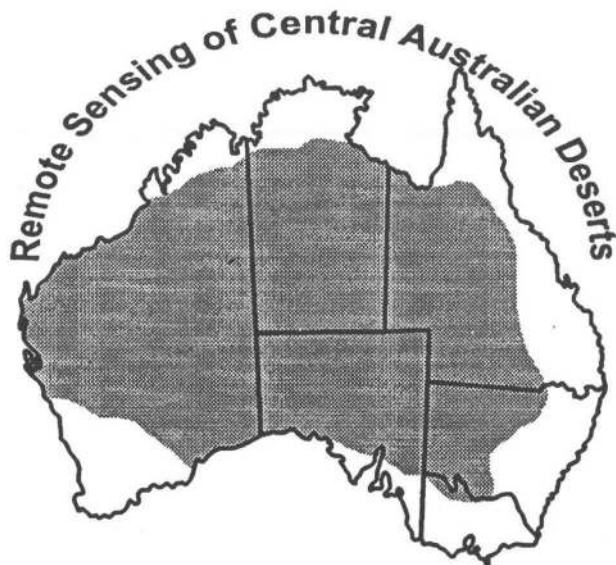
The CD is structured in two parts: an overview at the front followed by a series of interconnected sections which describe the environment, the various parts of our research using remote sensing and the results obtained. These sections are like the chapters in a book - but they are much more dynamic because they are interconnected by buttons (or icons) and hypertext links. Click on any button or highlighted text and go straight to that section. Click on a back-pointing hand to return to where you were.

The main parts to the information contained on the CD are shown in the box at the bottom of this column.

## How to Obtain a Copy

The CD is available free of charge from CSIRO in Alice Springs (until copies run out). However, we do need to charge \$10 per copy to defray the costs of postage and handling. Please contact our Information Officer, Julie Crough, to obtain a copy. Julie's contact details are:

CSIRO Division of Wildlife & Ecology, PO Box 2111,  
Alice Springs NT 0871  
phone (08) 8950 0122, fax (08) 8952 9587 or email  
Julie.Crough@dwe.csiro.au



### CD ROM with



Photos of central Australia



Science



Climate & vegetation



Satellite data



Aerial video and  
ground information



Maps

## LIVESTOCK - COPING WITH DROUGHT

### An Electronic Discussion

An electronic conference entitled "Livestock - Coping with Drought", scheduled for July 1998, will be hosted by FAO in association with the Overseas Development Institute (ODI) in the United Kingdom.

The conference will cover the major issues associated with drought and livestock. In particular, it will examine the response given to drought by livestock keepers, governments and non-government organisations.

Three main themes will be explored:

- the biological (including meteorological events, such as, El Niño), social and political impact of drought on the livelihoods of those affected;
- the way livestock keepers respond to drought and how they are adapting to what is often an increasingly hostile political and physical environment; and
- the response of governments, development agencies and NGOs to drought, for example, issues like the impact of humanitarian and emergency relief and more recent post-drought restocking programs.

From these themes, it is hoped that the major issues in responding to drought can be identified, possible solutions examined and their likely implications explored. The overall objective of the Conference is to provide a rational basis for planning livestock-related responses to drought.

The focus of the conference will be Africa and West Asia. Many of the issues discussed will, however, be common to other drought-prone regions of the world and participation from all interested parties is welcome.

The conference will be of particular interest to those involved with all aspects of keeping livestock in drought prone countries including: national planners and policy makers, multi and bilateral development and donor agencies, NGOs, scientists (animal scientists, rangeland agronomists, veterinarians, environmentalists, sociologists and climatologists) as well as interested individuals.

Relevant papers and contributions are welcomed and those interested should contact, as soon as possible, the conference moderators (see below). Additional information, including a tentative list of topics, can be found on the conference www page (see below).

To subscribe send an email to [mailserv@mailserv.fao.org](mailto:mailserv@mailserv.fao.org) and leave the subject blank and then put in the first line of the message the following: subscribe Drought-Live-L.

For further information please visit the conference www page: <http://www.fao.org/ag/aga/agap/lps/drought1.htm>

or contact the conference moderators: Roger Blench ([r.blench@odi.org.uk](mailto:r.blench@odi.org.uk)), Zoe Marriage ([zmarri@odi.org.uk](mailto:zmarri@odi.org.uk)) or Simon Mack ([Simon.Mack@fao.org](mailto:Simon.Mack@fao.org)).

## NEW MEMBERS

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Brisbane QLD 4001

Michael John Lyons  
"Buckeys Creek"  
Augathella QLD 4477

Mr Howard Henry Hendricks  
Conservation Development  
South African National Parks  
PO Box 110040  
Hadison Park  
8306 South Africa



# *The Australian Rangeland Society*

## REPORTS FROM THE ANNUAL GENERAL MEETING

ACN 008 784 414

### DIRECTORS' REPORT

*Manda Page, Director, Australian Rangeland Society,  
Department of Natural & Resource Systems Management,  
University of Queensland, Gatton College QLD 4345*

*(Ed. The following information has been edited from the  
complete Directors' Report presented at the 1998 AGM.)*

In accordance with resolution of the directors, the directors' report on the accounts and operations of the company for the year ended 31<sup>st</sup> December 1997 is as follows:

#### Review of Operations

The year 1997-1998 has been one in which the Society has played a prominent role in rangeland affairs nationally and in which our business affairs have been further consolidated. Council has met four times since the 1997 AGM with a quorum present on all occasions (an additional meeting will be held prior to the 1998 AGM). A meeting was also convened at the 10th biennial conference in Gatton.

A number of developments and activities during the 1997-98 year deserve special mention:

Membership of the Society remained stable with a total membership (including library subscriptions, corporate memberships etc) of 538 as of 31/12/97 compared with 573 at 31/12/96.

The 10th Biennial Conference was convened in Gatton (Qld) from 1- 4 December 1997. The theme of the conference was "Where the city meets the bush: the importance of effective communications". This was a successful conference and was a departure from the conventional conference format by offering a special symposium on the first day with a focus on the future of rangelands. In addition the usual scientific material was presented as papers and posters. There were 38 paper and poster presentations and approximately 110 people attended. The proceedings of the symposium are being published as a separate book.

The Society's publications, *The Rangeland Journal* and the *Range Management Newsletter*, have continued to flourish during the year under the capable guidance of their respective Editors and Associate Editors.

On the recommendation of the Publications Committee in 1996, Council resolved to enhance the international appeal of

the Journal by establishing an international Advisory Panel. The Panel will not exercise editorial control but members will promote the Journal in their home country and advise the Editor on matters such as appropriate referees for overseas manuscripts. These appointments to the Advisory Panel have now been made.

Further negotiation was initiated with the Society for Range Management (SRM) to explore the possibility of reciprocal membership rights. These negotiations are still being actively pursued.

Council has continued to develop a number of administrative procedures to facilitate the operations of the Society. The most significant of these was the decision to keep the membership records at a static address for the foreseeable future.

Council received two applications for travel grants in 1997-1998. One grant was offered and did not exceed the amount of available funds.

Council has continued to be represented by the immediate Past President on the Organising Committee of the VI International Rangeland Congress. The Congress is now incorporated and the Society's claim as the major beneficiary in the distribution of any surplus assets generated by the Congress is established in the rules of the incorporated body.

#### Likely Developments and Results

Some developments currently in train include:

- Negotiation with the Society for Range Management regarding possible reciprocal membership rights.
- Relocation of the Registered Office.
- Development of a web site for the Society.
- Membership survey to determine the needs and wants of Society members.

## TREASURER'S REPORT

*Manda Page, Director, Australian Rangeland Society, Department of Natural & Resource Systems Management, University of Queensland, Gatton College QLD 4345*

It is with great relief that I present this report for my first year as the Society's Treasurer. Throughout the last year I have been on a steep (extremely steep) learning curve in relation to being an honorary treasurer and director for the Australian Rangeland Society. I have found the job to be interesting, challenging and at times quite time consuming.

The financial position of the Society continues to be sound. Membership fees for the Society have increased slightly to cover costs, however the cost is still relatively low compared to most professional associations. We are still able to produce a very high quality Journal, an equally high quality Newsletter, and maintain a substantial travel and scholarship grant program, all without eroding our reserves.

I would like to bring the draft financial statements (to 31st December 1997) to the attention of members. The final audited accounts will be presented in the next Newsletter. It is not anticipated that there will be any differences between the draft and audited accounts. Unfortunately it was not possible for the full audit to be completed before the Annual General Meeting.

I would like to acknowledge the work of the auditors of Michael Boyce and Co, in particular the work of Patsy Cross, who have produced a clear and concise record of the Society's financial affairs.

I would like to propose that we close the past conference accounts (from Port Augusta, 1996 and Katherine, 1994). Having a variety of accounts spread all over the country makes it difficult to complete an audit in a short period, costs the open accounts \$35.00 for audit certificates each year and costs extra time by the auditors to chase and audit these accounts.

Changes that have occurred during the last year that relate to the finances of the Society include:

- Subscriptions Secretary retained and payed an honorarium of \$2,000/year.
- We passed a motion and put in place a policy that all honoraria (Alan Wilson, Gary Bastin, Malcolm Howes and now Rob Richards) receive an increase in their payment of 10% as of 1-1-98 and that payments increase each year indexed on the CPI.
- The Australian Rangeland Society has been registered with the UK Board of Inland Revenue which enables members to claim their annual membership subscription as a deduction on their income tax.
- We closed various investments and consolidated all our investments into a series of term deposits with the NAB.
- We have also been trying (for some time now) to change the registered office of the Society. Research indicated that there was no legal impediments of changing office (according to the Australian Securities Commission) and that the Australian Institute of Agricultural Science and Technology is willing to become our registered office. We are now just waiting on the paperwork to go through.

## SUBSCRIPTION SECRETARY'S REPORT

*Bruce Alchin, Department of Natural & Rural Systems Management, University of Queensland, Gatton College QLD 4345*

The number of members of the Society appears to be reasonably static, resulting mainly from a balance of members joining and members not rejoining. It is apparent that if we could retain most members over the long term, the Society would continue to increase in numbers. In light of the problems that comparable organisations to the ARS are facing, this is probably not too unhealthy a position. However, I do not think that we should be complacent, nor seek to grow just for the sake of it.

The Society's viability (in terms of achieving its purpose as the main forum for rangeland management issues) will continue to be maintained by securing the long term interest of its existing members and attracting new members.

There are several areas we can examine to achieve on-going membership growth:

**IRC:** The IRC will provide an excellent springboard to attract national (and international) interest in the Society. Whilst the main focus is on the IRC *per se*, we should still take every opportunity to promote the Society.

**Survey of members:** It is anticipated that the proposed survey of members will provide some insight to maintain existing membership. In particular, what do members want for their subscription?

**Direct approach to rangeland stakeholders:** There are a range of groups which may be more interested in corporate and individual membership and participation if they were more familiar with the role and function of the Society. Examples of the groups are:

*Tertiary Institutions:* Rob Richards has provided a list of Tertiary Institution Libraries who may wish to subscribe. (Bruce Alchin is to follow through with direct contact). It may be useful to ensure a general overview of the Society is included in each journal and newsletter to promote it with students and staff.

*Producer Organisations:* Awareness of producers through their organisations may be of value. For example, by direct contact and displays at producer conferences.

*Other Organisations:* Other organisations involved in issues related to conservation, Aboriginal interests, tourism, mining, institutional finance, etc may be worth following up.

*Longer term:* Media such as a display board and an educational video sponsored by the Society could be considered.

It is important that the Society maintains its profile and ensures that it adapts to attracting membership - particularly to ensure a greater balance of all the stakeholders in rangeland management.

## SUBSCRIPTION MANAGER'S REPORT

Rob Richards, Dept. Land and Water Conservation, PO Box 235, Condoblin NSW 2877

The last year has seen the welcoming of 33 new members to the Society. This figure is slightly down from an average of 40 in the previous three years.

The table below gives a breakdown of the current membership as of 22 May 1998.

Member Type				
1998	Journal and N'letter	Journal only	N'letter only	TOTAL
Individual	253		54	307
Company	35	3		38
Library	23	33	4	60
TOTAL	311	36	58	405

A true reflection of the total number of members of the Society is given by the total number of members at the end of the calendar year. This is because many members still do not renew their membership until quite late in the year. I enjoy the creativity of people's excuses but it is very time consuming sending out back issues to these people. The number of members at December 31 1997 was 538, which is also down on previous years.

As most of you are aware, the membership rates were increased this year in order to cover increasing production costs. The Individual Full Membership rose from \$55 to \$60.

Despite sending a reminder slip with the April newsletter, many members are late to renew. Investigation of a new reminder system is needed.

This year a new ARS laptop, software, and printer were purchased by the Society. A new faster version of MS-ACCESS for Office 98 is a great asset for the Society in streamlining the renewal and database administration.

New stationary was printed this year along with plans to re-print the ARS colour brochure.

It has been a difficult twelve months for the Queensland Council given the short time frame for preparation of the Biennial Conference at Gatton and the resignation of the President as the Council was finding its feet. I congratulate and thank all members of the Queensland Council for a job well done and their support throughout the last year. My thanks go also to Gary Bastin and Malcolm Howes for their assistance.

## REPORT OF THE PUBLICATIONS COMMITTEE

Leigh Hunt, Agriculture WA, PO Box 417, Kalgoorlie WA 6430

The Publications Committee met once in the last 12 months, during the conference at Gatton in December. While a number of committee members were unable to attend, the meeting included Eugene Moll in his position as ARS President and several associate editors, making it a worthwhile and constructive meeting. However, as usual, most committee business occurs outside of meetings, either by email, fax, phone or letter.

The Society's two publications, *The Rangeland Journal* and the *Range Management Newsletter*, have continued to maintain their high standards during the last year. During this period the business of the Publications Committee has essentially involved continuing with the initiatives we have begun over the last few years. These have been directed at increasing the profile of *The Rangeland Journal*, in order to attract more subscribers and more potential contributors to the Journal. We regard this as necessary to ensure the long-term viability of the Journal, since the flow of incoming papers is often erratic. Only time will tell whether we have been successful.

One initiative has been to internationalise the Journal. To help achieve this we have appointed three international associate editors, who join the five incumbent Australian associate editors. These new editors are all distinguished rangeland scientists and we are fortunate that they have agreed to become Associate Editors. They are Dr Ockie Bosch (Landcare Research, New Zealand), Dr Brien Norton (Utah State University, USA) and Prof. Len t'Mannetje (Wageningen Agricultural University, The Netherlands). I would like to welcome them on board. The appointment of these people will increase the international flavour of the journal and should also help to attract more overseas papers.

During the year an approach was made to the publisher of *Current Contents*, requesting them to list *The Rangeland Journal*. Having the journal included in this scientific citation/abstracting publication will also increase the exposure of the journal. At this stage I am unable to report on the outcome of this approach as the Journal is still under assessment by *Current Contents*. I am grateful to Publications Committee members Ken Hodgkinson and Allan Wilson for preparing the submission to *Current Contents*.

Another initiative has been the development of a joint electronic bibliographic database with the Society for Range Management (SRM). In the annual report last year I mentioned that we had finalised an agreement with SRM for the production and marketing of the database. Now I am able to report that substantial progress has been made in the development of the database and SRM expects to have it available for purchase next month. We will advertise the database in the *Range Management Newsletter* once its availability and price have been confirmed. The database will contain all the bibliographic

information for all issues of *The Australian Rangeland Journal* and *The Rangeland Journal* and *The Journal Of Range Management*, and so should be a valuable resource to people working in rangelands. While on the subject of the database, I would like to thank Gary Bastin for the large amount of work he put in to preparing the records from the Australian journals so they could be included in the database. This was certainly not a straightforward task since the majority of the records were not in electronic form – so they needed scanning and correcting and then formatting to make them compatible with the database software.

The successful series of special issues of the journal that we have published over the last six years is set to continue. Preparations are well in hand for a special issue on 'Water in Rangelands', which is due to be published in December this year. Our previous special issues have been well received and have been acknowledged as excellent collections of the latest thinking and knowledge on the particular subject in question. I am confident the next one will be no different. It will include papers on a wide range of 'water' topics, including landscape hydrology, stream flow, rainfall variability, landscape processes and underground water resources, and the interaction between these factors and land use, management, pastoral production and biodiversity. Instead of having a guest editor as we have in the past for special issues, our usual Journal editor Allan Wilson is handling the editorial work for this issue.

Something else that is new for the Society is to have some of its published material on the World Wide Web. Gordon King (International Rangeland Congress Business Manager) has been instrumental in placing the journal titles and authors and extracts from the newsletter on the IRC web site, thus promoting the Society and its publications. This form of publishing is certainly becoming more commonplace and popular, and while we are not planning to start electronic publishing of the entire journal and newsletter in the immediate future, it is certainly a development that we need to monitor and keep in mind.

Much of the success of the journal over recent years must be attributed to its editor, Allan Wilson. However, it is with regret that I report that Allan has decided this will be his last year as editor and it is time to give someone else a go at the job. Allan's contribution will be sorely missed. Apart from playing an important role in the development of the journal and improving its overall standard as a scientific publication, Allan has also made a substantial intellectual contribution in other ways. He has acted as a referee, has sought out papers for the journal and has identified important issues that warrant coverage in the special issues (and authors to address these issues). This has been possible because of Allan's great expertise in rangelands, his excellent international network of contacts and his critical thinking abilities. So, thank you Allan for the great contribution you have made. I am sure you will continue to be active in rangelands and look forward to your continuing contribution as a member of the Society. In the meantime, the committee is making arrangements to find a replacement for Allan.

Fortunately I can report that our newsletter editor, Gary Bastin, is not planning to retire from the position in the immediate future. Gary has continued to produce an interesting and varied newsletter with apparent ease (although I know it is not easy and involves a great deal of work) and I commended him for the job he does. As probably the most visible sign of the Society for a lot of our membership, particularly the pastoralist members, Gary's efforts as newsletter editor contribute substantially to the well-being of the Society. I believe that the newsletter is universally regarded as being a high quality and valuable benefit of being a member of the Society.

In closing this report I would like to thank the many other people that have contributed considerable amounts of time and effort to the Society's publications over the last year: these include our Production Manager, Malcolm Howes, our associate editors, the Journal referees and members of the Publications Committee. I believe the Society membership is well-served by those directly responsible for the production of the journal and newsletter. However, we rarely receive feedback from members about the publications, so I would encourage you to provide us with any comments you may have on any aspects of the newsletter and journal, to ensure we produce what you want.

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