The Australian Rangeland Society

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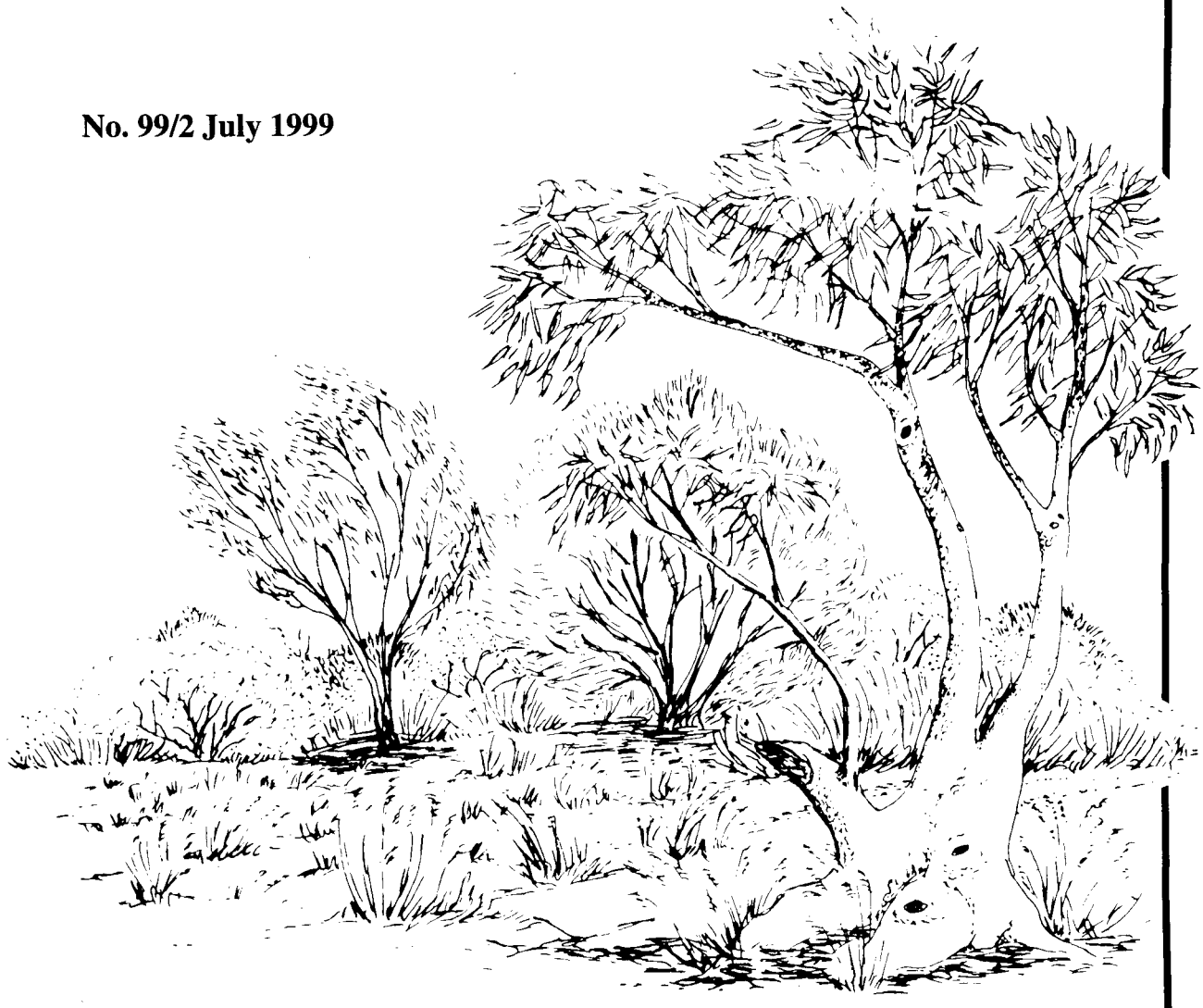
No. 99/2 July 1999



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EDITOR (RMN)
Gary Bastin
CSIRO, PO Box 2111, Alice Springs NT 0871
Phone: 08 8950 7137 Fax: 08 8950 7187
Email: Gary.Bastin@dwe.csiro.au

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

PRESIDENT
Peter Johnston
Sheep and Wool Institute
Queensland Department of Primary Industries
Locked Mail Bag 4, Moorooka QLD 4105
Phone: 07 3362 9577, Fax: 07 3362 9429
E-mail: johnstpw@dpi.qld.gov.au

VICE PRESIDENT
Fleur Tiver
School of Environmental Management
The University of SA, The Levels SA 5095
Phone: 08 8302 5137; Fax: 08 8302 5082
Email: fleur.tiver@unisa.edu.au

IMMEDIATE PAST PRESIDENT
Ron Hacker
NSW Agriculture
Trangie Agricultural Research Centre, PMB 19
Trangie NSW 2823
Phone: 02 6888 7404, Fax: 02 6888 7201
E-mail: ron.hacker@smtpgwy.agric.nsw.gov.au

SECRETARY
Eda Addicott
Queensland Herbarium
POBox 1054
Mareeba QLD 4880
Phone: 07 4092 8526, Fax: 07 4092 3593
E-mail: Addicoe@dpi.qld.gov.au

TREASURER
Manda Page
Department of Natural & Rural Systems Management
University of Queensland
Gatton College QLD 4345
Phone: 07 5460 1182, Fax: 07 5460 1324
E-mail: mpage@jedi.uqg.uq.edu.au Manda Page

SUBSCRIPTION SECRETARY
Bruce Alchin
Department of Natural & Rural Systems Management
University of Queensland
Gatton College QLD 4345
Phone: 07 5460 1182, Fax: 07 5460 1324
E-mail: b.alchin@mailbox.uq.edu.au

SUBSCRIPTION MANAGER
Rob Richards
Department of Land and Water Conservation
PO Box 235
Condobolin NSW 2877
Phone: 02 6895 2033, Fax: 02 6895 3406
E-mail: dlwcondo@lisp.com.au

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FROM THE EDITOR

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

Just a quick introduction to this issue of the newsletter from me. At this time of the year, I am probably in a similar position to many other members – busily preparing for the IRC whilst also trying to meet other pressing work commitments.

This issue has two main articles. The first is a report on the major biological features of the Lake Gairdner National Park in South Australia by Carolyn Ireland and Brendan Lay. These two were greatly enthused by their work in this area as witness their concluding sentence "The authors consider that their work on the park has been a special privilege and a highlight of their careers". You should find their story both interesting and educational. In the second article, my colleagues and I describe the use of aerial videography as a remote-sensing tool for verifying satellite data and for supplementing ground-based measurement of rangeland vegetation and soils.

Other articles report on recent activities and meetings in the rangelands. There is also a section at the end with reports from the recent annual general meeting. Finally, please remember that the next issue commemorates the 25th anniversary of our Society. It is being guest-edited by John Morrisey. If you have something that you would like to contribute to this issue, then please send it to John – see John's article below.

RANGE MANAGEMENT NEWSLETTER – NOVEMBER 1999
Contributions Wanted

John Morrisey, 26 Elizabeth St, Cottesloe WA 6011

The next issue of the newsletter will be dedicated to a celebration of the first 25 years of the Australian Rangeland Society. A group of the society's stalwarts from WA will oversee the preparation of the newsletter and they have identified characteristics of the society and its members that should be featured in the newsletter.

The WA team recognised that most society members are located in small, widely scattered groups and that the national conferences, the *Rangeland Journal* and the newsletter are the key elements that define the character of the society and attract the widely dispersed membership. Unlike many other professional associations, the society's membership is not distinguished by a single core discipline. Rather, the environment in which members live in and/or work is the most strongly shared characteristic. Society members are engaged in widely diverse tasks. Similarly, social change has led to increased diversity in the tasks undertaken during a career.

Given the above context, the newsletter will seek to celebrate the conference, journal and newsletter highlights that have shaped the society since it was launched in 1974.

Articles describing the "defining moments / contributions" will be welcomed. Similarly, stories demonstrating the diversity of the tasks and activities undertaken by members, and how that has changed since the society formed, would be welcome for the next issue of the newsletter. I will edit the next newsletter and can be contacted by phone on 08 9284 7948. My email address is jmorisey@cygnus.uwa.edu.au

THE ISLANDS OF LAKE GAIRDNER NATIONAL PARK IN ARID SOUTH AUSTRALIA
An Initial Appraisal of Biodiversity and Land Condition

Carolyn Ireland, Ireland Resource Management Pty. Ltd., 13 Woodland Close, Aldgate SA 5154
Brendan Lay, Department for Environment, Heritage and Aboriginal Affairs, GPO Box 1047, Adelaide SA 5001

A program for monitoring and assessing land condition that closely mirrors the existing system for pastoral leasehold land in South Australia has been initiated in three major National Parks in the State - the Flinders Ranges, the Gammon Ranges. and Lake Gairdner (Ireland, 1999). The Flinders Ranges and Gammon Ranges National Parks were previously pastoral leases and have had a long history of overgrazing such that much of the land has been highly modified from its original condition. Lake Gairdner National Park (LGNP), on the other hand, consists of 5,500 sq. km of salt lakes within which are numerous islands. This unique area, which has never been under Pastoral Lease, qualifies as wilderness of the highest quality under the criteria of the National Wilderness Inventory.

The main objectives agreed for this initial appraisal of biodiversity and land condition on LGNP were:

1. To undertake an inventory of biodiversity on the islands of LGNP, including vegetation and wildlife.

2. To formalise a system of monitoring (photopoint) sites by selecting sites deemed suitable for long term vegetation change or trend assessment.

3. To evaluate and document existing land management problems and threats to the integrity of the natural ecosystems of the park.

4. Where applicable, to suggest some strategies for addressing or mitigating these problems or threats.

The Study Area

Lake Gairdner National Park is located approximately 150 km north west of Port Augusta in South Australia (Figure 1). It lies within latitudes 31°00' S and 32°30' S and longitudes 134°30' E and 136° 15' E.

The park is surrounded by pastoral leasehold land; direct access to the lakes is only possible on station tracks. Visitors to the park gain access through Mount Ive Station on the southern shore of the lake. Many visitors are members of the land speed racing fraternity seeking alternative venues to Lake Bonneville in the USA.

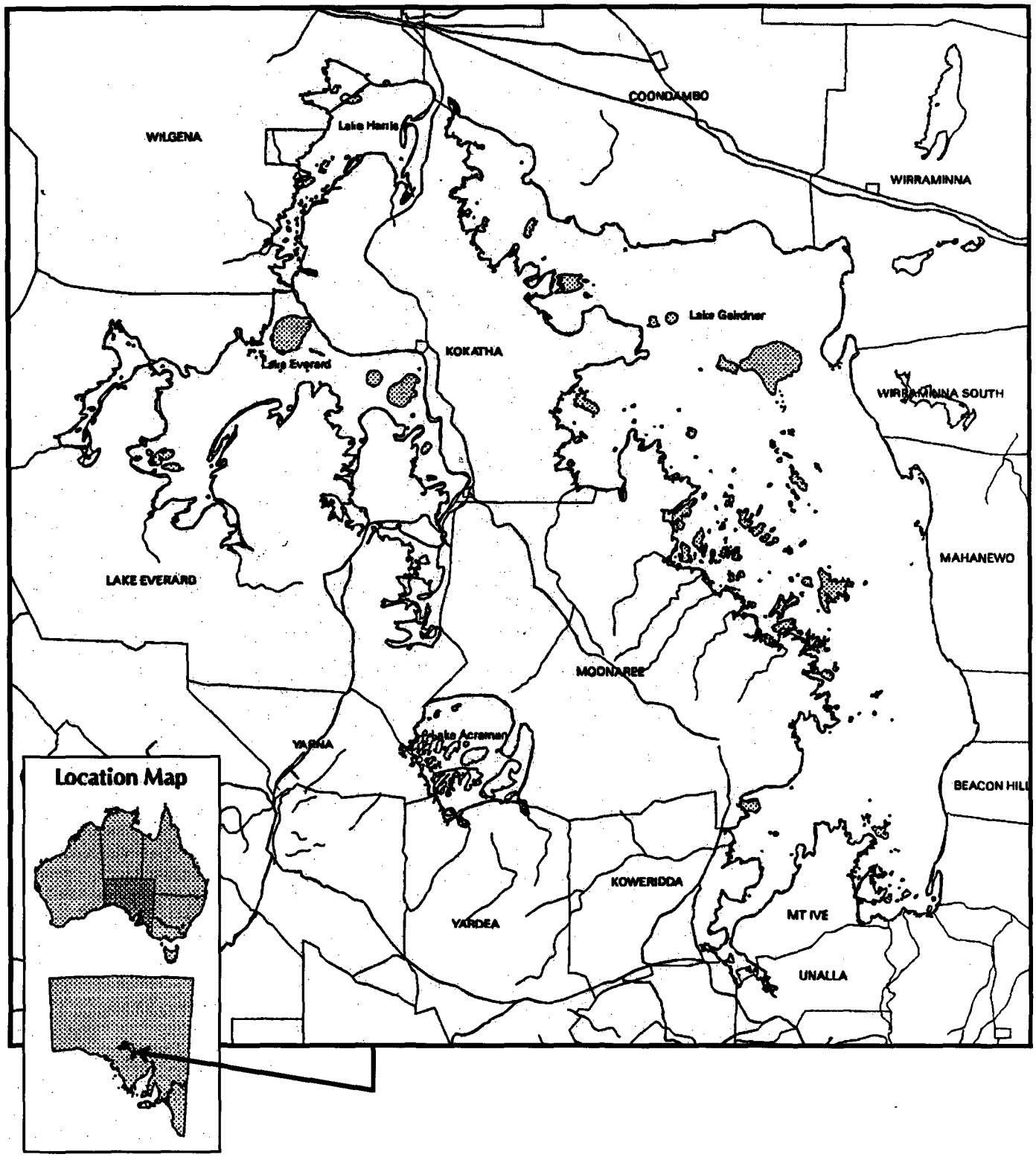

Figure 1. Location of Lake Gairdner National Park.

Lake Gairdner National Park is situated in an arid area with low erratic rainfalls averaging 200-250 mm per year, and annual evaporation of about 3000 mm. The park conserves the third largest of the salina lake systems that are so typical of the arid landscapes of central and Western Australia. The boundary of the reserve follows the edge of the three lakes that comprise the park – Lakes Gairdner, Harris and Everard. There are some 315 islands, varying in size from rocky outcrops less than 50 m across to large, densely vegetated land masses of up to 4,500 ha. Their total area is about 270 sq. km or less than 5% of the total area of the park.

The explorers Stephen Hack and Major P.E. Warburton both investigated the shores of Lake Gairdner in the late 1850s. Neither ventured onto the lake surface but both described the sight in various reports to Parliament. Governor MacDonnell (Dispatch of Governor MacDonnell, 1857) of South Australia wrote to the Colonial Office in England:

"...the Great Salt Lake, which apparently is of considerable extent – more than 100 miles long – and probably connected at the North East with Lake Torrens. Its size and remarkable cliffs projecting into a vast expanse of dazzling salt here and

there studded with islands make it one of the most striking objects hitherto met with in Australian scenery. I have taken the liberty of naming it Lake Gairdner..."

Within the bed of the southern and western portions of Lake Gairdner are numerous islands usually comprising a core of Gawler Range Volcanics (fine grained rhyolites and dacites) with or without a cover of aeolian sand (Photo 1). By contrast, the islands in the northern part of Lake Gairdner and in Lakes Harris and Everard are composed of more recent sediments with extensive sand cover derived from the Great Victoria Desert, which lies to the west of the park.

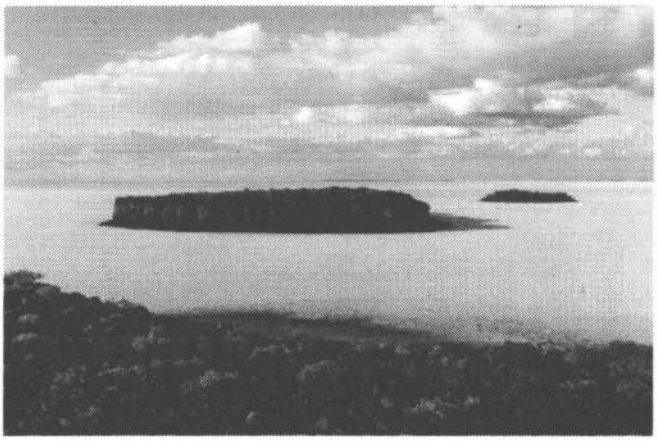

Photo 1. Rocky islands of volcanic origin in southern Lake Gairdner. The cliffs are two to three metres high.

The lake bed deposits are variable sequences of saline and gypsiferous mud, clay and silt with some aeolian sands. When dry, the western and southern portions of Lake Gairdner are almost completely covered by a crust of white halite up to about 30 cm thick. The northern section of the lake and both Lakes Harris and Everard are composed mainly of gypsiferous muds with thin, discontinuous patches of halite.

The bed of the major lake (Gairdner) varies from 110 m above sea level at the southern end to 125 m above sea level in the north. Deflation of lake bed materials such as clay and gypsum result in the characteristic lunettes which edge the lakes downwind (east) of the prevailing winds. The lakes are normally dry but sporadically fill with water (sometimes up to a metre in depth), most often as a result of occasional heavy rains of monsoonal origin. During these times, large shallow sheets of water move back and forth across the lakes driven by the prevailing winds. Photo 2 shows the leading edge of such a body of water moving at approximately one kilometre per hour across the surface of Lake Gairdner in March 1998. During the summer months, the lakes may dry completely. The water table is always very close to the surface, and there are often fresh, brackish or saline springs along the margins of the lake and shores of the islands. Occasionally, springs are observed where saline groundwater discharges to the lake surface forming a low gypseous mound.

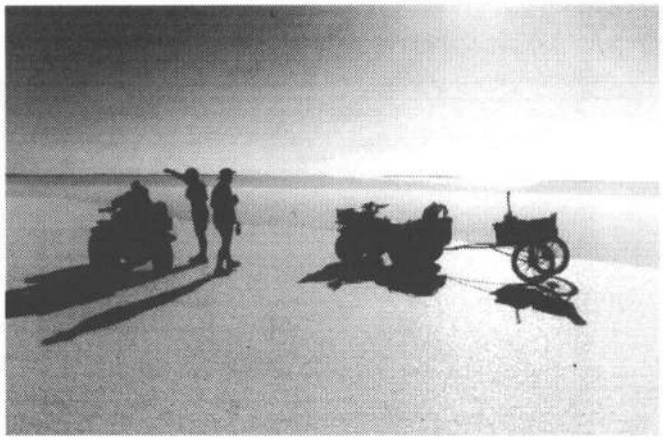

Photo 2. Water moving across the bed of Lake Gairdner. The photo also shows the all-terrain vehicles and light trailer used for accessing the islands.

An Initial Appraisal of the Flora, Fauna and Wilderness Attributes of the Park

Flora

Extreme fluctuations in past climates have given rise to a distribution of native trees and other flora in South Australia that does not follow patterns that are simply explained by modern soil and rainfall associations (Boardman, 1986). This is particularly the case with fossil drainage features such as large inland salt-lake complexes.

In spite of the impact of these historical changes on the vegetation of arid South Australia, the islands of the park contain a remarkable diversity of plant communities which include all the major elements represented on surrounding pastoral land. The colonisation of these islands by so many diverse plant species must have been remarkably rapid given the great distances between some of the islands and the mainland. The Gawler Ranges, within which the national park is partly situated, are considered to lie within the top 22 refugia in the arid and semi-arid lands of Australia (Morton *et al.*, 1995). The ranges are also significant as a transitional area between the more mesic flora and fauna of the Eyre Peninsula and the arid biota further north.

At least 265 plant species were recorded during four separate field trips to Lake Gairdner National Park. Of these, 19 have never been recorded before for the Gairdner-Torrens (GT) Region (Jessop, 1993). This region is located north of 32° S of latitude. Whilst none of the 265 species were nationally significant (Briggs and Leigh, 1995), some do have particular conservation significance, either for South Australia as a whole or regionally (Lang and Kraehenbuehl, 1997). These include sandalwood (*Santalum spicatum*) which is listed as 'Uncertain' both for the State and regionally. The abundance of this species on the islands testifies to the fact that these areas were not accessible to the sandalwood cutters in the 1930s (Lay *et al.*, in press).

Other plant species found that were of interest included:

- *Acacia tarculensis* (steel bush or Tarcoola wattle); this species is endemic to South Australia and of particular interest in the Gawler Ranges. It was relatively common on the islands of the park.
- *Darwinia salina* and *Dodonaea intricata* (Gawler Ranges hopbush); both species were common on some of the more rocky southern islands of Lake Gairdner.
- *Myoporum brevipes*, uncommon elsewhere, was abundant on sandy shorelines of many of the islands.
- Many perennial species were regenerating freely.

Few alien weed species were found in the Park.

One interesting feature of the flora observed was that islands in close proximity which were apparently similar or identical in physical characteristics were often dominated by quite different vegetation communities, and often by one or two dominant species. A possible explanation for this phenomenon is the short period of time that has been available for plants to colonise the islands, and the long distances involved (described in the section above). Once a plant reached an island, most probably transported by birds or animals as seeds, it would have had ample time to fill all the niches available to it in the absence of competition. It would have been very difficult for plant species arriving at a later date to gain a foothold. The process of colonisation may essentially be unfinished and it will take much longer for all plant species to spread out across the islands and for the curious dominance of some plant species to become less evident.

Birds

Fifty native bird species were recorded on field trips in 1997 and 1998; observations matched similar habitats on the mainland (Chris Baxter, *pers. comm.*). One bird species occurring on the islands of the Park - the Major Mitchell's cockatoo (*Cacatua leadbeateri*) is regarded as vulnerable at the State level. The night parrot (*Geopsittacus occidentalis*), rated as 'Nationally Endangered', was sighted late last century near Murnea Rockhole less than one kilometre from the western shore of Lake Gairdner. Close to the extreme southern shore of the lake, the variously rare or vulnerable Gawler Ranges subspecies of the thick-billed grasswren (*Amytornis textilis myall*), the redthroat (*Pyrrholaemus brunneus*), the fieldwren (*Sericornis campestris*) and the slender-billed thornbill (*Acanthiza iredalei*) have been sighted on the mainland; these species may also occur on the southern islands of Lake Gairdner. Over 20 bird species reach their northern-most limit and eight species their southern-most limit in the vicinity of the Park (Penny Paton, *pers. comm.*).

Other Fauna

None of the animal species seen in the park are listed as threatened fauna (Harald Ehmann, *pers. comm.*). Native mammals commonly recorded were the red kangaroo (*Macropus rufus*), western grey kangaroo (*M. fuliginosus*) and common wallaroo (*M. robustus*). The small-mammal and reptile fauna of the islands was considered depauperate (Ehmann, 1998; Tonia Brown, *pers. comm.*). This may be a function of ineffective dispersal agents, e.g. the minimal potential for rafting from the adjacent mainland (Ehmann, 1998).

It was disappointing to observe the prevalence of feral animal activity on even the most remote islands visited. There has been an apparent total penetration by introduced mammals (house mouse, fox, goat and camel) onto all of the islands of the park, in some cases over at least ten kilometres of salt and mud. From observations of tracks on the lake surface and from direct observations, kangaroos, emus and camels move quite freely across the salt surface and no doubt prefer the islands of the park where no shooting or other disturbance occurs. It is likely that relatively high densities of these animals may account in part for the present depauperate native vertebrate fauna (Ehmann, 1998).

Wilderness attributes

The lakes form a large area of high-value wilderness in its natural condition. The natural processes associated with salina landforms remain intact. Lake Gairdner, with an area of 4,800 sq. km, is the third largest salt lake in Australia after Lakes Eyre (9,300 sq. km) and Torrens (5,800 sq. km). Based on the criteria proposed by the National Wilderness Inventory (Lesslie and Maslen, 1995), the entire area occupied by LGNP scores very highly as wilderness of the highest quality. It has the highest value for both Biophysical Naturalness (the degree to which the site is free from biophysical disturbances caused by the influence of modern technological society) and Wilderness Quality (estimates produced by combining wilderness indicator measurements). Certainly no traces of European visitation were seen on any "offshore" islands, due presumably to the difficulty of access.

Lake Gairdner is regarded as a good example of its type because it includes the whole range of geological variation associated with large salina complexes. Together, the lakes of the park characterise most of the landforms associated with Australia's larger salt lakes. These include shoreline features such as lunettes, variations in lakebed surfaces, sand accretions, dunefields and residual features such as island outcrops of mainland rocks. Although small in total area (270 sq. km), the number and diversity of islands represented in the LGNP is unique. The park presents a spectacular and varied landscape of dry mulga covered hills, stony plains, lunette dunes, islands and the brilliant white salt surface. These islands contain at least 265 plant species and 50 bird species in many diverse communities. The Gawler Ranges were considered by Morton *et al.* (1995) to be one of the prime foci of biological diversity in South Australia.

Land Condition and Land Management Considerations

Although it is surrounded by pastoral leasehold land, most of the park has not experienced stock grazing. There was, however, a disappointing prevalence of other introduced animals. The abundance of these animals corresponded fairly well with grazing impacts on susceptible vegetation types (Lay *et al.*, in press). On some islands there were signs of good regeneration of native tree and shrub species largely due, it is suspected, to the recent absence of rabbits killed by calicivirus. Introduced weeds were uncommon, with the exception of Ward's weed (*Carrichtera annua*) on the volcanic soil types.

Protection of wilderness attributes

Two of the more spectacular areas of the park are described as follows:

- The lake has special landscape appeal, particularly where Lake Gairdner nestles into the Gawler Ranges. This area, located in the south-eastern arm of the lake, presents a spectacular landscape of dry mulga-covered hills, stony plains, lunette dunes, islands and the thick salt surface of Lake Gairdner itself. This area, one of the most spectacular landscapes within the park, occurs within the Controlled Vehicle Access Zone.
- The Moonaree archipelago, located in the middle section of Lake Gairdner, is a vast expanse of brilliantly white salt crust studded with a colourful and fascinating array of islands.

It is essential that these wilderness attributes, particularly in the two sections of the park described above, be protected (e.g. as in Landscape Protection Zones proposed in the Draft Management Plan) so that the park can maintain its unique values. However, any future indiscriminate access to any part of the park will threaten these attributes and values. Apart from park managers, or for approved scientific or research purposes, motorised access should be precluded from the proposed landscape protection zones of the park. Any such vehicles in the above categories should refrain from driving overland on any island.

Total grazing pressure and pest animal species

As has previously been explained, it was disappointing to observe the prevalence of feral animal activity on even the most remote islands visited. Unless the level of feral animals in the park can be reduced, then the park will probably never be as pristine as it could be. A campaign of eradication is recommended. However, we recognise that levels of funding for this purpose are never likely to be sufficient to eliminate all species.

It has been suggested that some of the more remote islands of the park may be useful as release sites for small native mammals. It is strongly recommended that no releases of this type take place unless foxes and cats are first eradicated.

Soil erosion

Little significant soil erosion was encountered on any of the non-sandy islands visited. However on two larger islands comprised of aeolian sand sheets, massive recent instability, drift and deflation was occurring. Significant blow-outs had also occurred on one other island.

Alien weeds or pest plants

Few plants of this nature were encountered on any of the 17% of islands visited. Bitter melons (*Citrullus lanatus*) and Ward's weed were, however, present on some islands.

Vegetation degradation

Degradation or vegetation change was hard to assess as this was the first appraisal of the park. Suffice to say that the land condition was at least as good as that on surrounding pastoral leases. Interestingly, it was not considered by any of the scientists involved to be in better condition. Much of this is thought to be due to the high levels of native and feral herbivores encountered on the park. Regeneration of many perennial species was occurring, due mostly we believe, to the recent demise of rabbits.

Fire

Very few signs of fire were noted in the park apart from small areas burnt apparently by lightning strikes. We concluded that fire does not play a large part in the park's ecology.

Rare and endangered plants and animals

None were encountered during the initial appraisal. As stated earlier, several plants and animals of interest (particularly birds) were observed.

Roads, tracks and Public Access Routes

There are no roads or tracks in the park. Currently the only recognised access track in the vicinity of LGNP is that which traverses the northern block of Mount Ive Station and provides access for motor sport enthusiasts and ecotourism on the south western arm of the lake. The danger remains, however, that uncontrolled access to the surface of the lake may create tracks in sensitive wilderness areas.

Under Section 45 of the Pastoral Land Management and Conservation Act (SA Government Parliament, 1989), provisions are made to dedicate public access routes (PARs) over pastoral leasehold land. It is recommended, however, that a great deal more thought be given to the future dedication of PARs in the Landscape Protection Zone. In any event, apart from park managers, or for approved scientific or research purposes, motorised access should be precluded from the proposed Landscape Protection Zone of the park.

Conclusion

Traditionally, most effort by national park and reserve managers in rangeland areas of South Australia has been directed to the management of visitor services and infrastructure. Even where managers were aware of past and present impacts of non-native plants and animals, there have not been the resources available to address these adequately. Nor, until recently, have we had the information available to quantify their impacts on the biological and physical resources of the land. For too long we have simply accepted the fact that degraded portions of these parks are not likely to contribute to our biodiversity conservation goals. However, in recent years, there has been an increasing emphasis on the need for park managers to audit their performance, not just to improve management of visitor facilities, but also to evaluate how effectively the biodiversity

conservation values of these lands are being conserved or enhanced (Lay *et al.*, in press).

To assist with this process at Lake Gairdner, we have set up 50 photopoints on 31 islands (10% of all islands) in as many diverse vegetation types as it was practicable to find on the park. This documentation, which includes species lists and abundance, is viewed as one of the most important components of the initial appraisal of biodiversity and land condition for the park. It also provides a basis for long-term monitoring of the condition of the park.

The land condition of LGNP has, predictably, been assessed as considerably better than that of the Flinders Ranges and Gammon Ranges National Parks, where long periods of historic total grazing pressure have prevailed. However, vegetation degradation, soil erosion problems and concentrations of feral animals, although not as severe, were evident - even on the most remote islands.

The park's main values are its scenery, its aesthetic attributes and its wilderness experiences. It has a special landscape appeal combined with a high degree of integrity and few visual signs of human impact. The authors consider that their work on the park has been a special privilege and a highlight of their careers!

Acknowledgements

Funding for the project was made available by the National Estate Grants Program and the South Australian Department for Environment, Heritage and Aboriginal Affairs (DEHAA). Colleagues Chris Baxter, Merri Tothill, Harold Ehmann, Chris Turner, Frank Kutsche and Tonia Brown provided valuable field support.

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SCIENCE AWARENESS: WHY IS IT SO? Media release from FASTS

Toss Gascoigne, Executive Director, Federation of Australian Scientific and Technological Societies, PO Box 218, Deakin West ACT 2600

Australia's peak council for working scientists and technologists has urged the science community to speak out strongly in a review of a national program for science awareness. Professor Peter Cullen, President of FASTS, said the review should be seen as an opportunity to set new objectives and a new direction for the program, and to reverse savage cuts announced in the last Budget.

The Commonwealth Department of Industry, Science and Resources currently spends $2.6 million each year on initiatives like the Australia Prize, National Science Week, and the Science Olympiads. "These are all worthy ideas," Professor Cullen said. "But the objectives of the Program have not always been clear. We need to identify exactly what we want to achieve from this Program, and the best way to achieve these objectives.

"How much science do people need to know? What is the best way to get these ideas across? Where should we spend the money, and how much do we need to spend? It's a crucial issue, one we need to get right."

The review has been asked to identify what the science and technology awareness needs are in Australia, the extent to which these are being addressed by existing initiatives, and propose any changes to STAP that may be necessary to take account of current awareness needs and to improve outcomes.

Professor Cullen said FASTS approved of the broad terms of reference for the inquiry. "It's a great opportunity to have a complete rethink about what we are trying to achieve and the way we are going about it," he said.

VIDEO - I SEE!
Measuring Rangeland Vegetation With Aerial Videography

Gary Bastin, Vanessa Chewings and Graham Pearce
CSIRO Wildlife and Ecology, PO Box 2111, Alice Springs NT 0871
Geoff Pickup, CSIRO Land and Water, PO Box 1666, Canberra ACT 2601

Introduction

Rangeland landscapes are renowned for their spatial variability. This means that it is often difficult to measure vegetation adequately with ground-based methods unless landscapes are carefully stratified, sites sensibly selected and then adequately sampled. There is a continual trade-off between the time that can be spent measuring a site and the extent to which such sample measurements truly represent the site and general area. In most cases, not enough ground-based measurements can be made to be fully representative of larger areas.

At the other end of the scale, satellite data can provide "global" information about some attributes of the soil and vegetation. These data are commonly processed to an index of plant cover, allowing the vegetation to be monitored over very large areas (e.g. Pickup, *et al.*, 1993; SCARM, 1998). Some indices such as the widely used normalised difference vegetation index (NDVI) can provide information about plant health when the vegetation is actively growing, or drought conditions when it is not (Cridland *et al.*, 1994). Commonly available satellite data vary in spatial resolution from 10 m for SPOT panchromatic imagery to 1.1 km for NOAA AVHRR. This means that unless particular species have distinctive spectral signatures, it is generally not possible to describe or measure vegetation at the species level. Hyperspectral satellites may allow this in the future but hyperspectral data are currently only available from aircraft flying special instruments such as the HYMAP or CASI scanners.

Air photography has been widely used for a long time to provide information at a scale intermediate between that of ground-based data and the landscape to regional scale view available from satellites. Airborne videography goes one step further than air photography in that the data are digital and thus can be processed by computer. As with air photography, spatial resolution is controlled by lens characteristics and flying height, allowing images to be acquired with pixel sizes typically in the range of 10 cm to 2 m. At the smaller end, it is possible to identify perennial grass tussocks while the coverage provided by larger pixels allows such things as tree cover, erosion features and fire effects to be investigated. Where camera systems allow different filters to be fitted, it is possible to acquire data that correspond with those collected by satellites, making aerial videography a potentially powerful tool for verifying satellite data. When imagery is viewed in true colour (i.e. the blue, green and red bands), then aerial videography is almost a case of "what you see is what you get".

Aerial videography has been used by a number of agencies for assessing rangeland vegetation and soils (e.g. Everitt *et al.*, 1996; Phinn *et al.*, 1996; Grierson *et al.*, 1998; Pickup *et al.*, in press). In Australia, video data have also been used for modelling forest habitat for wildlife management (Coops and Catling, 1997), assessing water quality in inland rivers (Lamb and O'Donnell, 1996), and for some novel teaching exercises (Frazier and Bentley, 1999). In this last example, students gained experience with remote sensing, GIS and GPS technologies when they surveyed a stylised map of Australia into a paddock of flowering Patterson's Curse (*Echium plantagineum*), then mowed the "coastline" and imaged their handiwork with aerial videography.

Our CSIRO System

Components

Our system, based in Alice Springs, is a Specterra Systems digital multi-spectral video (DMSV). It has four charge-coupled-device cameras similar to the security cameras used in shops. Each camera has a 12 mm lens fitted with filters centred on one of four wavelengths; 450 nm wavelength ("blue"), 550 nm ("green"), 650 nm ("red") or 770 nm ("near infrared"). The cameras are held in a frame mounted above a 200 mm square hole in the aircraft floor. Images are "grabbed" directly to a RAM buffer in an industrial-standard personal computer and then copied to the hard disk when the buffer is full. Power is supplied through two 12-volt batteries and an inverter. Image locations are recorded with a differential GPS. The system is flown in a Cessna 206 with the various components mounted in a cradle (Figure 1) anchored to the aircraft seat rails.

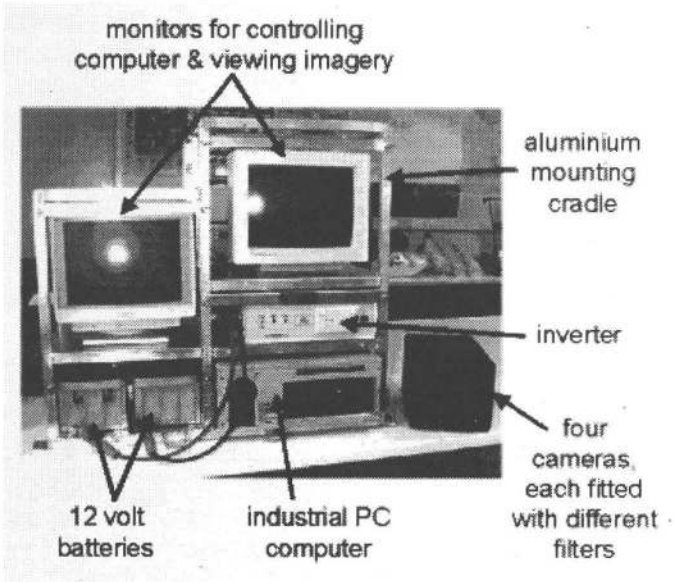

Figure 1. Components of CSIRO's digital multi-spectral video system. The mounting cradle, shown here sitting on a laboratory benchtop, clamps to the chair rails of a Cessna 206. The cameras point down through a 200 mm square hole in the aircraft floor.

Operation

We generally acquire images with pixel sizes ranging between 20 cm and 1 m. However, we occasionally fly at the 3150 m ceiling altitude (above sea level) permitted for non-pressurised aircraft which enables us to acquire imagery with a pixel size approaching 2 m. A maximum of 36 images can be grabbed before copying to the hard disk which, with 20% overlap between frames, provides aerial coverage between 50 and 4900 ha (Table 1). As an example, we might capture a "grazing gradient" by flying a defined transect from a watering point to an end point which is determined according to pixel size.

Table 1. Spatial characteristics of video imagery are determined by pixel size.

Pixel Size	flying height (m above ground level)	frame coverage m	transect for 36 frames with 20% overlap	
			length	area
20 cm	284	148 by 115	4.26 km	50 ha
50 cm	710	370 by 288	10.36 km	305 ha
1 m	1420	740 by 576	21.31 km	1225 ha
2 m	2840	1480 by 1152	42.62 km	4900 ha

Navigation

The video system can either be flown to sample different landscapes or vegetation types at loosely specified locations or it can be used to precisely overfly designated areas that are to be sampled on the ground. In the former case, we use the logged differential GPS positions to tell us where we have been. More precise navigation is highly dependent on the skill of the pilot. Early attempts to overfly precise locations (e.g. areas already sampled on the ground) using visual and compass navigation were generally frustrating, often requiring several passes to capture the required area. This quickly taught us that it was far preferable to acquire the imagery first and then sample on the ground. Now that pilots are becoming increasingly familiar with the use of GPS for precise navigation, we are able to accurately fly designated areas by defining entry and exit waypoints for each transect. This means that it is now feasible to fly adjoining transects and join imagery along, and between, transects to obtain complete-area coverage of, for example, small rangeland paddocks.

Despite the increased ability of pilots to use GPS as a navigational aid, flying video transects can still be an arduous and tiring job for the pilot, and uncomfortable for the video operator. This is particularly so when operating at low flying heights on hot and/or windy days when there is a lot of turbulence. We need clear sunny days and moderately high sun angles (less than 45° zenith) for good illumination and sharp imagery. A good day is when we can fly upwards of 12 precisely defined transects in a general area of 100 km square in about four hours. A bad day is when the equipment is not working properly, there is low light because of general cloud cover or some transects have to be repeatedly flown in the hope that shadows cast by broken cloud cover will move away from the transect area.

Correcting video imagery

Spatial and spectral distortions in the raw imagery need to be removed before the data can be used. Spatial distortion mainly occurs through pixel misalignment due to the way in which the cameras are operated while spectral distortion arises because of differential illumination across each image. The correction procedures are largely automated allowing us to produce "clean" imagery within a few days of flying.

The correction procedures are described in some detail in an appendix at the end of this article.

Image Analysis and Interpretation

We have mainly used aerial videography to verify the results obtained from analysing satellite data, e.g. grazing gradients such as those described by Pickup and Chewings (1994) and Bastin *et al.* (1993). In the process, we have developed a couple of new vegetation indices and a sequential classification procedure that allow transects of video imagery to be rapidly differentiated into cover types. We have compared these cover classes with indices of cover derived from satellite imagery. Before doing this, however, we needed to be sure that the video-derived cover estimates compared favourably with the results obtained using ground-based cover measurement.

Vegetation indices

Examining the spectral values of small, relatively homogenous areas of soil and vegetation in video images acquired for a number of landscape types in central Australia showed that the PD54 index (Pickup *et al.*, 1993) was the most versatile method for estimating vegetation cover from remotely sensed data in this region. This index is based on the red and green wavelength bands: in this dataspace, bare soils of varying colour plot at the top of the two-band cross plot while vegetated targets of increasing cover plot progressively closer to the origin. Cover levels are determined by calculating the perpendicular distance of pixel values in the green and red bands from the "soil line" and scaling this distance relative to the distance to the point of maximum cover.

Further investigation of the video-derived spectral values showed that plant litter could be identified in high-resolution imagery by summing green and red pixel values and graphing these values against values for the blue band. This litter index, which we call PDRGB (Pickup *et al.*, in press), is another perpendicular vegetation index and is calculated in a similar way to PD54.

In extending our satellite-based grazing gradient methods to the Mitchell (*Astrebla* spp.) grasslands of the Barkly Tablelands, we found that existing indices did not reliably estimate vegetation cover. In this region, there is little spectral contrast between dry vegetation and the grey soil background. Radiometer data suggested that yet another perpendicular vegetation index, this time based on the blue and green wavelengths, should provide suitable discrimination of cover levels (Bastin *et al.*, 1999). By comparing the results obtained from analysing video imagery with ground data on the one hand, and with satellite imagery on the other (in a similar way to that described in the following sections), we were able to

demonstrate that this (PD12) index was suitable for monitoring vegetation cover on the Barkly Tablelands.

Discriminating feature types

The ability to visually recognise objects of pixel to multi-pixel size such as perennial grasses, chenopod shrubs and trees, often in true colour, makes video data easier to classify than satellite images. However, variation in the colour of features across an image and residual brightness variation, despite correction for differences in viewing and illumination angles, lens effects etc, means that conventional supervised classification approaches based on small, relatively uniform training areas are difficult to apply.

We have overcome these difficulties by using a sequential classification approach which is based on simple spectral themes and transforming data to indices which discriminate features of interest. An example of how this might operate for a sequence of adjoining images is illustrated in Figure 2 (next page). Once identified, the features are progressively masked, allowing less apparent features or cover types to be discriminated. Once all features are identified, the image is classified with a hierarchical set of categories to produce the required output.

Comparison with ground data

We tested the accuracy of the sequential classification procedure by comparing the proportional area of feature types with those obtained from ground measurement. In the example shown here (Figure 3), the site was measured by estimating the proportional area of each component within 250 one metre square quadrats accross the site.

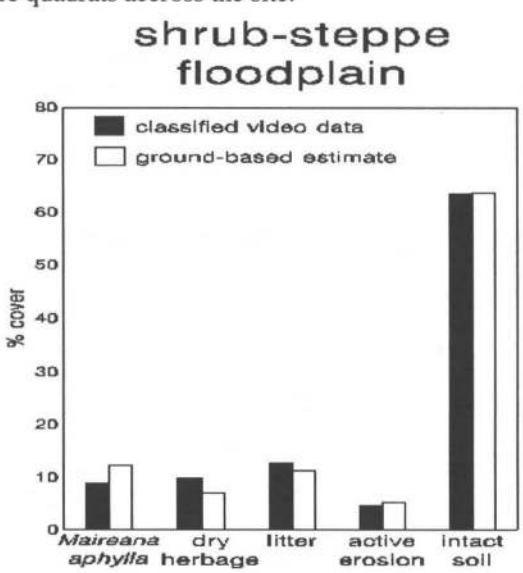

Figure 3. Comparison of percentage cover of feature types obtained from classifying video data and ground measurement, for two sites.

In both examples, there was good agreement between the ground-based estimates of those soil and vegetation features that could be distinguished in the video imagery, and the classified data. We also found, for other examples, that the differences between results obtained from these two methods were often less than the range of operator variability obtained by skilled observers concurrently measuring the same site (Pickup *et al.*, 1995b; in press). Indeed, in some cases, the airborne video data identified errors made by the ground observers when recording their information. This means that in many situations, classified video imagery can reliably be used to measure vegetation cover.

Comparison with satellite data

We have used transects of video data classified into cover types to verify satellite data at a number of locations (e.g. Bastin *et al.*, 1998; Pickup *et al.*, in press). The satellite data are usually processed to an index of vegetation cover (e.g. the PD54 index, Pickup *et al.*, 1993). In the example shown here (Figure 4), both datasets were rectified to the Australian Map Grid and the video cover classes then resampled to 30 m pixels to match those of the satellite (Landsat TM) data. Cover values were then compared along linear transects of pixels.

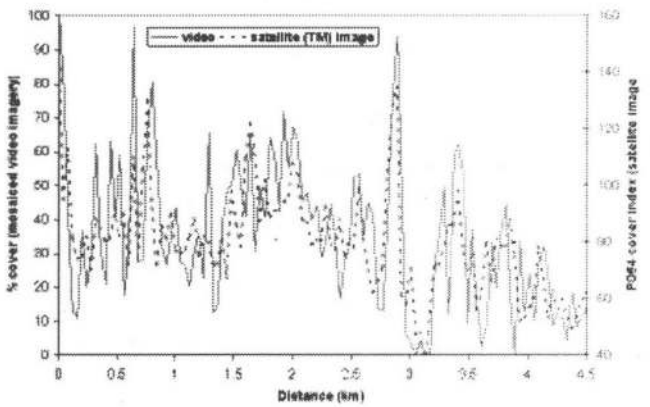

Figure 4. Comparison of cover derived from classified video data and the TM-produced PD54 index for a linear transect of 30 m pixels.

In this example, there was generally close agreement in the pattern of cover change along the transect. Both datasets show the sharp transitions in cover that exist on a strongly patterned landscape as one moves from areas of bare soil to reasonable cover. Differences in the results arose because it was difficult to precisely match the video and satellite pixels so that they covered the same area on the ground. The video data indicated that some areas had very high cover (>80%), levels that are unusual in the arid rangelands. These areas had considerable tree cover and it was difficult to separate all areas of shadow from the dark tree canopies when classifying the 1 m imagery. Although the video-derived estimates of cover may have been inflated in some areas, the ability to rapidly segment video images into different soil and cover components meant that we were able to verify a reasonably large area of satellite data. Such verification would have been difficult using ground-based methods.

Current Applications

We are now using aerial videography, in conjunction with CSIRO colleagues in Townsville and Darwin, to expand the scope of their ground-based measurements. In 1997 we flew a number of experimental paddocks in the Charters Towers area. These paddocks had been intensively sampled on the ground to investigate the effects of different grazing strategies and we wanted to broaden the scope of these measurements. Some areas were infested with rubbervine (*Cryptostegia grandiflora*)

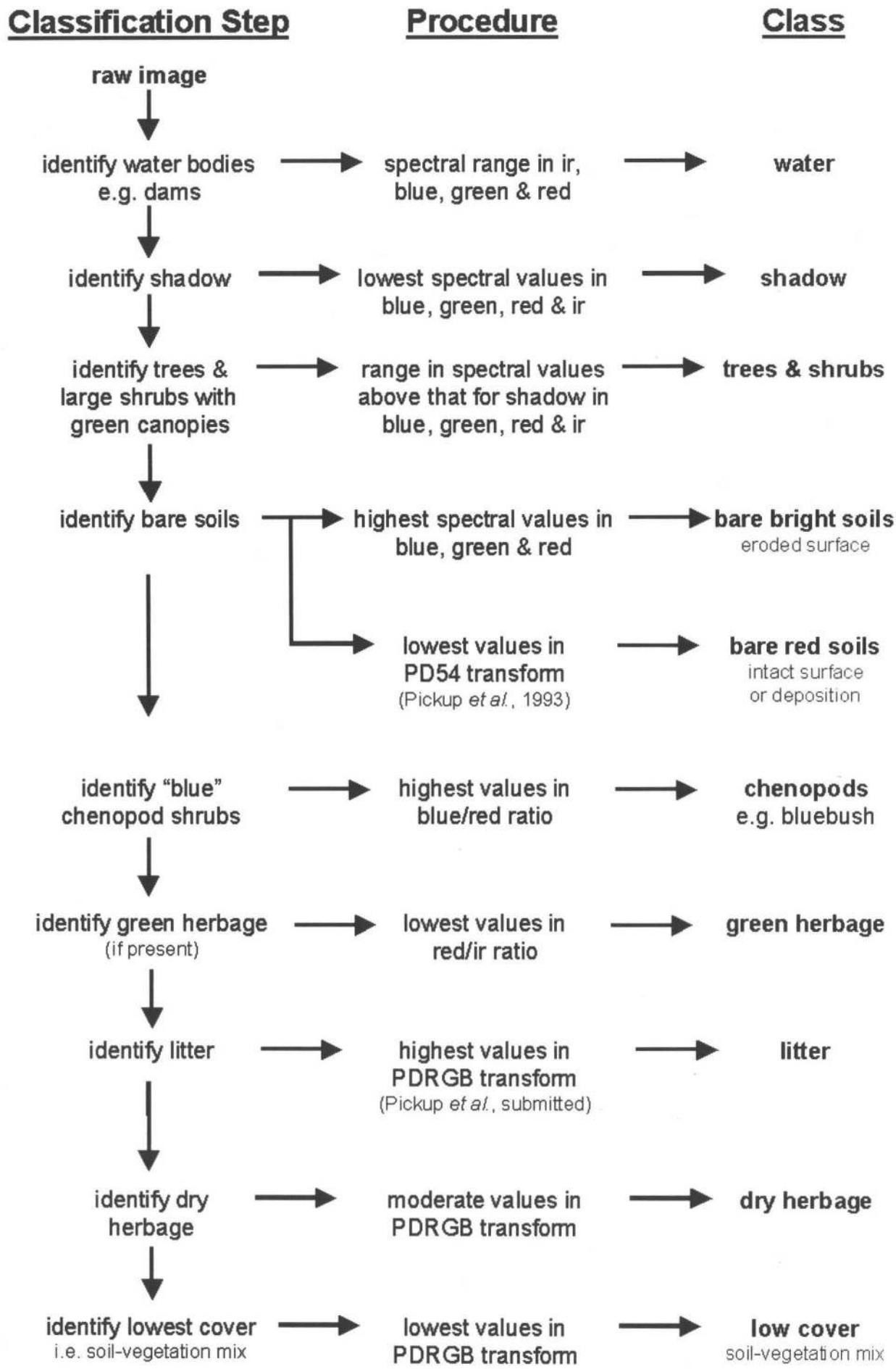

Figure 2. An example of the sequential pathway used to classify transects of video imagery into different feature types.

and we also wanted to investigate if aerial videography was useful for detecting and monitoring such infestations. Some of the results from both studies will be presented via posters at the International Rangelands Congress in July.

We are presently working with the Darwin laboratory to investigate vegetation patchiness as a component of landscape resilience. The Darwin people have shown with ground data how various soil and vegetation attributes change at varying rates with increasing distance from water in the savanna lands of northern Australia (Ludwig *et al.*, 1999). Our immediate goals are to determine:

1. whether videography can provide accurate and more rapid surrogates for ground data in savannas, and
2. if the broader scale information that video can capture is better able to predict some of the landscape relationships important to understanding resilience than is the case with the limited area sampled by ground data.

Postscript on Technology

Our DMSV cameras are now superceded by systems based on a single digital camera or by systems which integrate four digital CCD cameras. Commercial systems based on the latter are extremely expensive. To illustrate the capacity of current digital technology, the Kodak 460 camera has a sensor with an array of 3000 by 2000 pixels, far superior to the 740 pixels by 576 lines of our DMSV system. This allows a larger ground area to be covered with fewer flight lines. Separate filters allow change between capture of true-colour images and colour-infrared, a slight disadvantage on DMSV where we can obtain both true-colour and near infrared imagery at the same time. (Positive Systems is one company providing these systems: for more information, visit their web site at *www.possys.com*)

Unfortunately, there is a downside to this expanding technology. As capacity increases, so does cost (of the order of $A200,000 for us to upgrade to a commercially available system). So for now, we continue to nurse our aging DMSV cameras (purchased in late 1992) through each successive data acquisition mission.

Video - I See

We used the caption "video – I see" to introduce this article because we believe that aerial videography can contribute valuable information for assessing and monitoring rangeland landscapes. However, with a little imagination, one might wonder who is looking at who in this image (Figure 5).

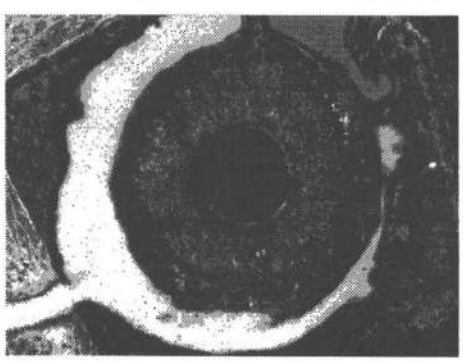

Figure 5. Not the "eye in the sky" but the "eye" on the ground. A video image of a turkeys nest dam surrounded by water in the Victoria River District.

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Appendix

Procedure for correcting video imagery

Operating the DMSV video cameras in interlaced mode provides the best possible spatial resolution. In this mode, a video frame consists of two fields. The odd field is imaged first and consists of lines 1, 3, 5, 7 etc. The even field, consisting of lines 2, 4, 6, 8 etc. is imaged after the scan of the odd field is completed. This means that the odd and even lines in each frame are acquired one-fiftieth of a second apart which, for 20 cm imagery, can displace adjacent lines by four to five pixels in the flight direction at a typical flying speed of 100 knots. Spatial distortion is further accentuated if the aircraft rolls, because lines of pixels are then also displaced at right angles to the flying direction in the image. Aircraft yaw can add further distortion.

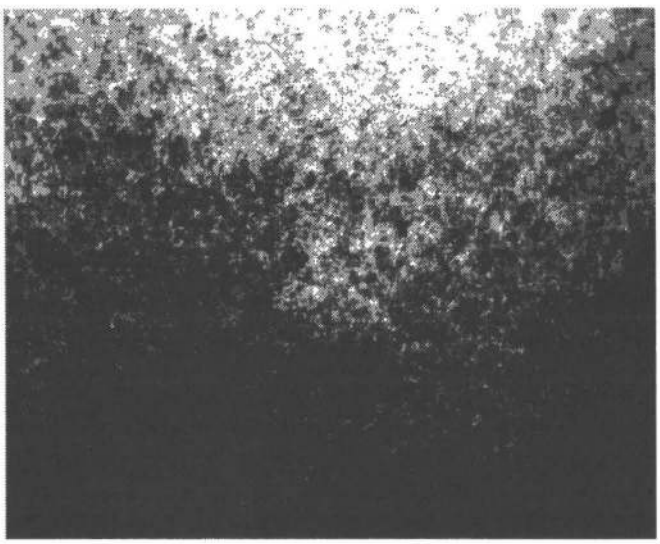


Image A

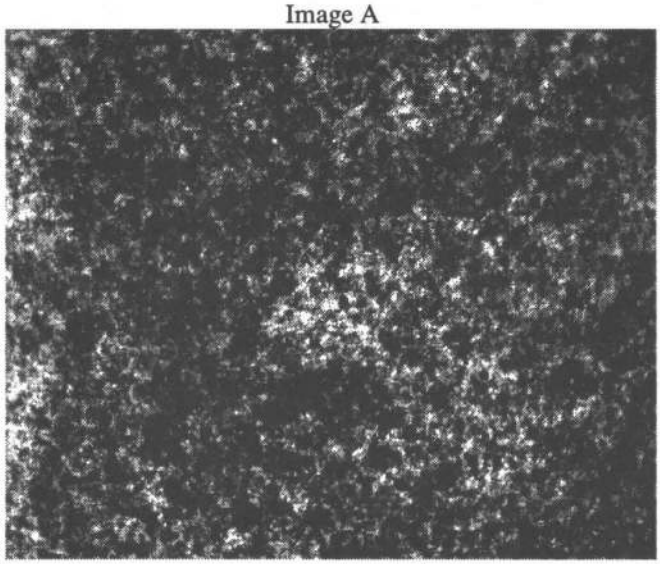
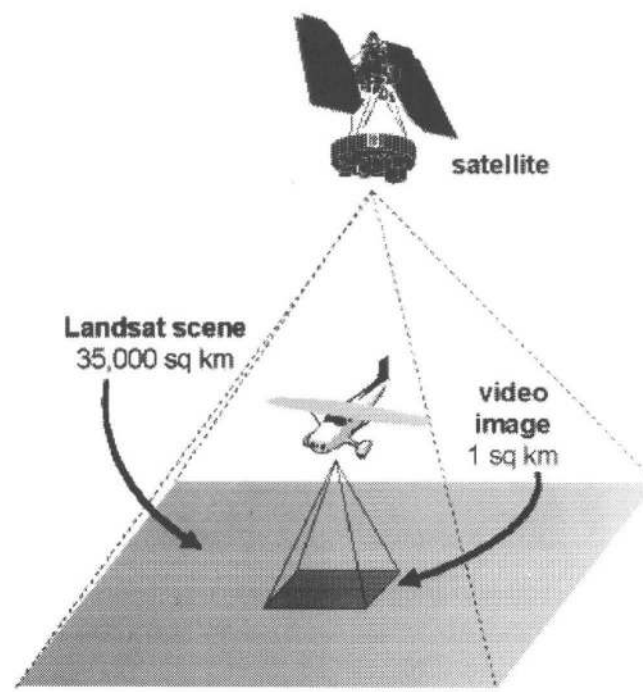


Image B

Figure 6. Mean brightness derived from all images in a flight line: (A) prior to correcting for viewing and illumination geometry and (B) following brightness normalisation. There is a gradient of decreasing brightness away from the top centre of image A which has disappeared in image B. Data in this example are from the camera fitted with a green filter.

We use a largely automated correction procedure based on the cross-correlation structure of the odd and even fields in each video frame to restore pixels and lines to their correct positions (Pickup *et al.*, 1995a and b). Image rectification procedures are then used to correct for slight distortions which may occur because the four cameras are not perfectly aligned. A further rectification model is used to minimise lens distortion, an effect which is most marked at the image edges.

A common problem with air photography and videography is differential illumination across the image. This arises because part of the image is being viewed into the sun and the rest away from it. The effect is most marked where a "hot spot" occurs on the image; i.e. around midday close to the summer solstice when the aircraft shadow is within the camera's field of view. We minimise this problem by using viewing and illumination geometry (Pickup *et al.*, 1995a) and multiple regression techniques (Pickup *et al.*, 1995b) to standardise spectral values across each image. The results of this correction procedure can be seen in Figure 6 where the distinct brightness gradient in the mean image of raw data from a flight transect (image A) largely disappears after applying the spectral correction procedure (image B).



BIOGRAZE PROJECT WORKSHOP IN SOUTH AUSTRALIA
How much is conservation worth to the pastoral industry?

Craig James and Mark Stafford Smith, CSIRO Wildlife & Ecology, PO Box 2111, Alice Springs NT 0871
Rodger Tynan and John Maconochie, Biodiversity Branch, Department for Environment, Heritage & Aboriginal Affairs, GPO Box 1047, Adelaide SA 5001
Jill Landsberg, CSIRO Wildlife & Ecology, GPO Box 284, Canberra ACT 2601

The *Biograze* project grew out of the results of surveys to determine how plant and animal species were affected by water points and the grazing that surrounds them. That work was conducted by a group from CSIRO with substantial help from staff in state land management agencies at sites across the country. The reasons for beginning that work, and the methods used, were outlined in an article presented in this newsletter in July 1995 (*RMN* 95/2), and a summary of the results appeared in the Conference Papers of the 9th Biennial ARS Conference, Port Augusta in 1996. Briefly, those results suggested that different species have different responses to a grazing gradient from water. Across a wide variety of types of responses, we classified species into three main groups:

- the "*Increasers*" that were most abundant close to a waterpoint and became less common the further you moved from a waterpoint (Figure 1);
- the "*Neutral*" group that showed no obvious trend in abundance away from waterpoints; and
- "*Decreasers*" that were most abundant at the site furthest from the waterpoint and became less common the closer you moved to a waterpoint.

The Neutral species made up about 50% of the species we detected during the surveys, and the Increaser and Decreaser groups about 25% each of species (these figures varied a bit depending on the plant or animal group and the particular location). It is important to note that some Decreaser species occurred only at the water-remote sites where there was little grazing pressure.

The number of waterpoints in pastoral areas is increasing. This is recommended best-practice for reducing soil erosion, maintaining forage for sheep and cattle, and for maximising livestock production efficiency. But the consequence of this recommendation is that across large areas, the land area that is very lightly, or not, grazed is decreasing (Figure 2). This may be a problem for those species that are sensitive to grazing, and may eventually lead to their local extinction.

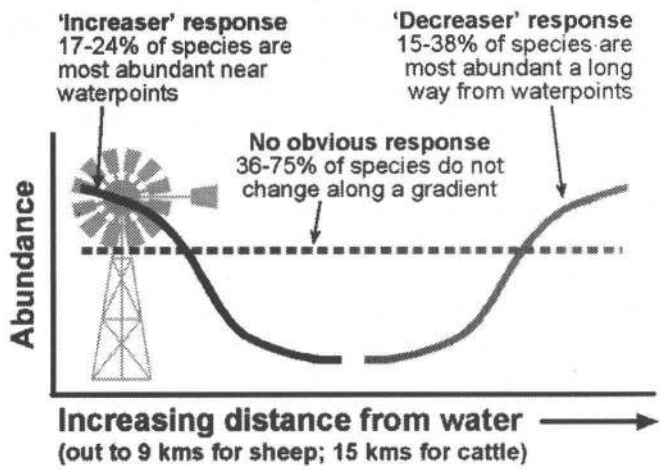


Figure 1. Stylised trends in the abundance of "increaser", "decreaser" and "neutral" species with increasing distance from water.

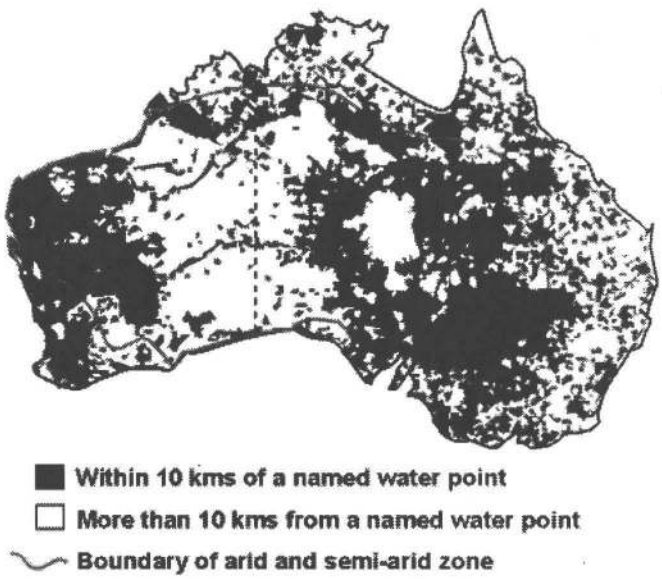


Figure 2. Areas within 10 km of named water points on the Australian series of 1:250,000 and 1:100,000 topographic maps.

The *Biograze* project is being conducted by staff from the Biodiversity Branch of the SA Department for Environment, Heritage and Aboriginal Affairs, Parks and Wildlife Commission of the Northern Territory and CSIRO Wildlife and Ecology, to find out if the suspected regional pattern of decline is occurring, and if so, what steps can be taken to prevent the further decline of species. In the project researchers working with land managers aim to develop some hypothetical scenarios of how nature conservation and pastoralism could be integrated in a regional land-use plan that minimises economic disruption to pastoral enterprises. The team aims to analyse these hypothetical scenarios, to determine the once-off and ongoing economic costs that would arise if they were implemented. The intention is to give an indication of the level of support that would be required to set-up and maintain conservation areas within pastoral enterprises, and the financial incentives that might be appropriate to make the burden of costs equitable, and the planning attractive to producers.
The results of the biological survey, and ideas for the planning and economics phases of the project, were discussed at a

public meeting in Glendambo, South Australia, recently. The *Biograze* project is predicated on the belief that effective conservation of biological values in the vast rangelands will be much more effective than reserves alone. Off-reserve conservation obviously requires planning and therefore needs land manager input. The success of the project requires that biological information be interwoven with the economic reality of running a pastoral station. Hence, concerns, criticism and praise of aspects of the project from pastoralists and other land managers are all important. The meeting in SA in early June was to ask the opinion of land managers (pastoralists mostly) about our ideas for the next phases.

Over 30 pastoralists and family members attended the meeting in South Australia. This is in excess of half the pastoralists in the local Soil Board region and probably everyone was surprised by this extremely good roll-up. The two hour workshop consisted of three short presentations on (i) conservation as a backdrop to the pastoral industry and results of our recent survey, (ii) regional planning ideas, and (iii) economic considerations, each followed by lengthy question, answer and debate of the issues raised.

After the first presentation, there were questions about the role of conservation in the future of pastoral land-use, "clean-green" images as a significant marketing opportunity, and why some species might be affected by water points and grazing and not others. Some of the questions about native species and grazing could be answered, but there were a number of questions that cannot be answered at the moment. For example, will the species that appear to be sensitive to grazing come back if stocking rates are lowered? What effect does spelling a paddock have? How do swings from drought to wet times affect the species that seem to be sensitive? These questions and others like them can be answered given sufficient time – ecological processes are slow in the rangelands and our ability to collect sufficient information is correspondingly slow. But can we afford to ignore the indications already available, for a decade or more, while more details are discovered, when others are judging the industry on much shorter time frames?

The second presentation on ideas for a regional plan interweaving conservation and pastoralism highlighted the large number of questions about regional conservation planning that cannot yet be rigorously answered. We do not know yet how much land needs to be left across a region for those species that need minimal disturbance, how big or how far apart the patches of land they require should be, and whether or not the patches need to be fenced. Some indication of the answers to these questions can be gained from work in other environments (such as forests, where a lot more work has been done) and from discussions with landholders. We probably know enough to work out some hypothetical regional plans, and see how much they might cost. Obviously, any implementation of a real plan must not proceed without extensive consultation and agreement among land managers that might be affected.

The third presentation gave some very rough estimates of costs that might be associated with setting up a hypothetical regional conservation scheme. Who would pay these sorts of costs? Not surprisingly, there were lots of questions about these issues. Only a percentage of species appear to be adversely affected by pastoralism. If these species require special planning, beyond normal management by pastoralists, then it is fair that a proportion of the cost should be born by society, and a proportion of the costs born by landusers. Our preliminary estimates suggest that these costs may be modest in this intitial study region.

If the ideas being developed in *Biograze* are proven effective in helping retain native plants and animals without compromising economic viability, then opportunities for "green" marketing images would emerge. The green market image will become increasingly significant as international markets judge our performance against treaties signed by Australia to conserve native species. Initially there could be advantages to having accredited "green" products. There will be disadvantages if overseas markets boycott products that do not come from ecologically sustainable enterprises. Some boycotts are beginning to develop with forest products. While producing "clean" products from rangelands is relatively easy because there are fewer chemical contaminants used in rangeland production systems, demonstrating to conservation organizations that rangeland pastoralism is "green" will be much harder. The *Biograze* project will provide essential pieces of a framework for developing an ecologically *and* economically sustainable pastoral industry.

RANGELANDS MONITORING THEME National Land and Water Resources Audit

Ian Watson, Agriculture Western Australia, PO Box 483, Northam WA 6401

Background

Rangeland Monitoring is one of seven themes within the National Land and Water Resources Audit (NLWRA), part of the Natural Heritage Trust. A National Rangeland Monitoring Coordinating Committee (NRMCC) has been formed to oversee the implementation of the workplan, which is well underway. All work should be finished and final reports prepared by the end of 2000 or early 2001. However, an important task for the Committee is to leave in place an enduring framework beyond the life of the Audit.

The workplan has a number of projects which together define the components of a national monitoring and reporting framework for rangelands. It is based on the premise that the maintenance of ecosystem function provides a fundamental backdrop to the continued use of Australia's rangelands in

biophysical, social, economic and institutional terms. The information generated by the Audit is designed to be used at the regional to state scale rather than for the management of individual properties or specific areas. However, many of the products generated will be freely available to the public via the Internet.

Further background to the Audit was published on Page 16 of the November 1998 (98/3) edition of the *Range Management Newsletter*. This article provides a brief update on progress.

Projects of the Rangeland Monitoring Workplan

The workplan comprises five projects, made up of a number of discrete activities

***Project 1**: Assessment of change in ecosystem function, trends in intensity of use and history of climate and fire which impact on the ecosystem.*

Implementation Project
A collaborative project based in Darwin is using satellite (Landsat) data to map changes in cover over time within the tropical savannas using a technique developed by CSIRO Mathematical and Information Sciences. Assessments of landscape function are also being made at ground based sites. This work builds on complementary projects in Western Australia and the Northern Territory. Test areas for the Implementation Project include the East Kimberley, the Victoria River District, the Sturt Plateau and the Burdekin catchment. The Implementation Project will also make available maps of fire extent. Collaborators are from the NLWRA, Tropical Savannas CRC, NT Dept of Lands Planning and Environment, Queensland Dept of Primary Industries and Agriculture Western Australia.

Project 1.1 - Regional indices of change in ecosystem function using rangeland monitoring site data
David Tongway (CSIRO Wildlife and Ecology) is reviewing the types of data collected by existing state/NT rangeland monitoring systems (as well as their underlying conceptual basis) to determine how well they can be interpreted in an ecosystem function context. For example, can estimates of perennial grass frequency also be used as surrogates for indicators of landscape function, such as fetch length? David will also consider how thresholds of change can be identified from existing data as well as providing advice on how existing systems might provide useful information at a regional scale.

Project 1.2 - Assessments of change in ecosystem function using Landsat imagery in South Australia
Grazing gradient techniques developed by CSIRO Wildlife and Ecology in Alice Springs are being used to detect vegetation cover changes in the Marla-Oodnadatta District in northern South Australia by the South Australian Dept for Environment, Heritage and Aboriginal Affairs. This project is well underway and builds on existing DEHAA work in South Australia. It will be finished by the end of 1999.

Projects 1.3 and 1.4 - Indices of change in ecosystem function and seasonal context information using NOAA satellite data
NDVI data are used to provide estimates of vegetation "greenness". The Environmental Resources Information Network and Satellite Remote Sensing Services have been contracted to provide an archive of NDVI data processed to agreed national standards. A range of information products derived from these data will be available for public viewing and downloading via the Internet. Products will include broad scale assessments of landscape function, images showing those areas that have received much below or much above average rainfall and seasonal histories. Draft and interim products will be produced throughout the middle of 1999, with final reporting towards the end of 2000.

Project 1.5 - Changes in intensity of land use since 1957
This project will highlight the changing grazing pressures on Australia's rangelands over the last 40 years. The Qld Dept of Natural Resources have begun the task of comparing (by simulation) total grazing pressure on the rangelands with estimates of safe grazing capacity at the scale of Local Government Areas. This work uses the spatial modelling framework developed as part of the National Drought Alert project.

***Project 2:** Trends in economic, social and institutional factors that influence land use and management in rangelands.*

Project 2.1 - Identification of key attributes that depict socio-economic and institutional factors affecting the management of rangelands
The Centre for International Economics (in collaboration with other groups such as the Bureau of Resource Sciences, CSIRO Wildlife and Ecology and the Key Centre for Social Applications of GIS) have begun developing and testing a range of indicators that can be used to provide a snapshot of current economic, social and cultural conditions in the rangelands. These indicators will then be used within a case study framework aimed at allowing better informed decisions on the use and management of these lands. Further output of this initial work will be identification of data sources and a recommendation on a host organisation to collect and collate data for a nation-wide assessment.

Project 2.2 - Collecting, collating and summarising data for socio-economic and institutional attributes across Australia.
The host organisation identified by Project 2.1 will assemble trend data on identified indices and develop routines to produce summaries according to the agreed framework.

Project 2.3 - Change in land use since 1957
Maps will be prepared showing change in land use, land tenure and land ownership across the rangelands over the last 40 years. The contract has been let to the Qld Dept of Natural Resources and the collation of much of the raw data has already begun, using archival records from state/NT agencies involved in land administration.

Project 3: *Develop an adaptive framework for monitoring biodiversity in rangelands*

This contract has not yet been let. The project will develop an analytical framework for monitoring biodiversity in rangelands that will be linked to our current understanding of the importance of landscape functioning. It will also detail the steps necessary to integrate the framework within the monitoring and reporting system developed by the Audit. After demonstrating the proposed approach in several regions, it will recommend how best to incorporate biodiversity monitoring into existing rangeland monitoring activities of the states and NT.

Project 4: *Packaging and presentation of information for value judgements by decision makers*

This project will provide information outputs from Projects 1, 2 and 3 in various forms tailored for better decision making. There will be heavy reliance on web (Internet) based technologies for this information transfer. The project will not begin formally until early 2000.

Project 5: *Workplan management, reporting, project assessment and improvement.*

This project includes the work of the NRMCC coordinator (Ian Watson), review of the information products developed in the workplan and preparation and testing of the web site. An important component of the project is the setting up of an enduring framework for monitoring and reporting on Australia's rangelands beyond the life of the Audit.

The National Rangeland Monitoring Coordinating Committee (NRMCC)

The NRMCC has the task of overseeing the implementation of the workplan. It is made up of representatives of state, territory, Commonwealth and national bodies. Membership comprises:

- Rod Applegate (Chair), Department of Lands, Planning and Environment, Northern Territory;
- Sally Skyring, Indigenous Land Corporation;
- Eric Anderson, Queensland Beef Industry Institute, Queensland Department of Primary Industries;
- Anwen Lovett, National Farmers Federation;
- Paul Novelly, Agriculture Western Australia and Tropical Savannas CRC;
- Lionel Wood, Agriculture, Fisheries and Forestry Australia;
- Susan Wright, Environment Australia;
- Ken Hodgkinson, CSIRO Wildlife and Ecology;
- Daryl Green, NSW Department of Land and Water Conservation;
- Brendan Lay, Department for Environment, Heritage and Aboriginal Affairs; South Australia;
- Colin Creighton, National Land Water Resources Audit.

Further Information

The Audit already has a web site providing comprehensive information on the Audit in general and the Rangeland Monitoring Theme in particular. (http://www.nlwra.gov.au)

Those wanting more information on the Audit's activities can visit the web site, contact members of the NRMCC or contact either of the following;

Ian Watson
Coordinator - Rangeland Theme, Agriculture Western Australia, PO Box 483, NORTHAM WA 6401
Ph: 08 9690 2128
Fax: 08 9622 1902
Mob: 0408 337 702
Email: iwatson@agric.wa.gov.au

Rochelle Lawson
Project Officer, NLWRA, Level 2, Unisys Building, 91 Northbourne Ave, GPO Box 2182, CANBERRA ACT 2601
Ph: 02 6257 3109
Fax: 02 6257 9518
Mob: 0408 604 845
Email: rochelle.lawson@nlwra.gov.au

ANNUAL CONFERENCE OF THE AUSTRALASIAN WILDLIFE MANAGEMENT SOCIETY

Arthur Georges, AWMS President

The new ARC Key Centre for Tropical Wildlife Management will be hosting the annual conference of the Australasian Wildlife Management Society in Darwin between 30-November and 3-December, 1999.

The conference is open to all interested in scientific wildlife management.

Postgraduate students are encouraged to attend and present their research findings, either in a spoken paper or as a poster. A limited number of travel awards are available from the organisers.

If you are interested in attending this conference, we ask that you complete a preliminary expression of interest that will assist in our planning of symposia. Details can be obtained by emailing director@aerg.canberra.edu.au with the subject heading "AWMS Flier" (omit quotes). A form will be sent to you automatically, so do not include any message.

CENTRE FOR THE MANAGEMENT OF ARID ENVIRONMENTS

Adrian Williams, Curtin University of Technology, PMB 22, Kalgoorlie WA 6430

(Ed. The following information has been extracted from the first newsletter of the Centre for the Management of Arid Environments (CMAE) which is being established at Kalgoorlie. Adrian advises that it is proposed that this newsletter will be published every three months. Further information about both the centre and the newsletter can be obtained from Adrian (Tel: 08 9088 6715, Fax: 08 9088 6832 or email: williama@kalg.curtin.edu.au)

The Department of Commerce and Trade of the WA Government have committed $900,000 over three years from its Centres of Excellence program for the formation of the Centre for the Management of Arid Environments (CMAE). CMAE will be the first regional Centre of Excellence in WA, located at Curtin University of Technology in Kalgoorlie.

Agriculture WA is planning to become a partner by moving its Goldfields/Nullarbor office to the new Centre.

The arid and semi-arid regions of Western Australia comprise 80% of the land area of the State. Economic activities in these regions are based on a rich mining sector, pastoralism and tourism. Other major interests in these regions are aboriginal heritage and aboriginal economic development, and resource conservation. These regions are the 'power house' of the State's economy. Yet only some 15% of the State's population live in these areas. This is in part due to the lack of new, sustainable land use options.

The pastoral industry has suffered from depressed commodity prices through much of this decade. Research, teaching and training in topics of diversified land use, land rehabilitation, and resource conservation are urgently needed. A proposal to provide such facilities has received strong backing from the mining, pastoral, aboriginal and government sectors in the Goldfields.

The benefits to the State include a diversified, well managed, profitable, sustainable rural sector in the arid and semi-arid regions, improvements in aboriginal living conditions and economic development, and improved conservation of the State's land and water resources.

The land resources of Australia's arid areas are amongst the most intact, and most bio-diverse in the world. This is creating a lot of interest amongst researchers and technologists in other arid countries. Western Australia welcomes the opportunity to become a major area for international collaboration in research and teaching of topics concerning arid land management. This would result in the sharing of research costs and research results, and would increase the State's research capability. In addition, international collaboration in technology transfer of arid land management systems and techniques will produce a range of benefits to all involved.

Current Position

The Centre for the Management of Arid Environments will be fully operational by the end of 1999.

Below are brief descriptions of projects involving Curtin University that are already in place in this region, and which will in future be partnered by the CMAE.

Developing Environmental Rehabilitation and Arid Farming Systems (DERAFS)

Long term objective:

To develop farming and land rehabilitation systems that will be appropriate in harsh, arid, sometimes saline soil environments.

Short term research objectives:

1. To develop an understanding of the distribution of salt in the soil, plant and leachate water during the growth of selected chenopods.
2. To investigate the beneficial effects that salt tolerant plants can confer on less salt tolerant plants growing in close proximity in saline environments.
3. To further develop solar still technology for the desalination of water.

The proponents:

The proponents of this research are the Japanese group led by Professor Satoshi Matsumoto of the Soil Science Laboratory, Division of Agriculture and Life Sciences, the University of Tokyo, and the Australian group led by members of Curtin University of Technology in Kalgoorlie. A number of Japanese and Australian industrial interests are also closely associated with this research.

Kundana Gold Pty Ltd has generously provided a ten hectare research site at Kundana Mine. The site is reticulated and drained. The soil on the site is slightly to moderately saline. Two solar water desalinators and a solar powered pumping system are present on the Kundana site. Kalgoorlie Consolidated Gold Mines have kindly made available an area and resources of their Tree Nursery. It is here that pot trials have been performed and seedlings raised. Trials to date have identified that soil additives can increase the growth and survival of selected native species (*Atriplex vesicaria, Frankenia spp,* and *Maireana brevifolia*).

In vegetable trials onion plants were observed to grow particularly well when located close to plants of *Atriplex lindleyii,* a native 'weed' on the site. Soil sampling confirmed that soil salinity was reduced close to the *Atriplex* plants. This has prompted pot trials to ascertain the pathways and quantities of salt movement from the soil via plants and leaching.

Improvement in the efficiency of the existing solar water desalinators by adding a secondary, 'cold' chamber is being investigated.

Coolgardie Wastewater Treatment Research

Most sewage treatment in the Goldfields relies on the oxidation of effluent in shallow ponds. This 'cleaning process' can take several weeks. In that time large quantities of water evaporate, particularly in summer. This reduces the amount of treated effluent water available for reuse. The system that is under test will speed up the oxidation process by blowing air through the effluent as it circulates around a series of treatment tanks. The process will be assisted through the use of new carbon fibre technology. It is estimated that the effluent will be cleaned to better than Australian standards in 48 hours. This compares very well with the retention time in existing oxidation ponds which can be up to 60 days.

Developments in Desert Aquaculture

Desert aquaculture has the potential to provide a major diversification option for pastoralists, an income stream and rich protein source for Aboriginal communities, a use for exhausted mine pits, a source of fresh fish to this inland region, and a new focus for tourism. An early estimate of the potential value of the industry in the Laverton area alone was put at $4m.

The Centre for the Management of Arid Environments (CMAE) will have nodes for research and teaching around the region and elsewhere as appropriate. CMAE will be involved in helping the development of inland aquaculture for arid environments. Curtin University and the Goldfields Esperence Development Corporation were instrumental in bringing together Dr Brett O'Brien, a Western Australian aquaculture consultant, and those interested in aquaculture in the Laverton area.

In the short time that Brett O'Brien and the 'aquaculturalists' at the Granny Smith Mine have been working together they have established a considerable aquaculture facility, ideal for research, teaching and demonstration. Placer Dome, Delta Gold and their committed staff are to be congratulated for this achievement.

The first aquaculture training course was held at Laverton Downs and Granny Smith Mine in April this year, and was attended by 14 participants. The Aridland Aquaculture Association (AAA) has become an incorporated body, based at Laverton. Interested individuals and associations from around Australia are welcome to become members. (Contact Ric Gleadell <Ric_Gleadell@placerdome.com>
Phone: 08 90882293 or Fax: 08 90313103 for more details)

Arid Land Silviculture and Carbon Sequestration Research

Three years of preparatory studies of the North East Goldfields environment have led to the development of an ambitious plan to research the growing of trees in this arid environment.

The long term objective is to sequester 100 m t of carbon in the next 20 years, at a cost of less than $100/t. Short term research objectives are:

1. To model ways to improve carbon sequestration in arid areas.
2. To identify the potential of native tree species for enhanced carbon sequestration.
3. To study catchment hydrology, and identify the potential for water harvesting.

Medium term research objectives include:

1. To assess carbon sequestration in broad-scale tree plantings over a 20 year period.
2. To assess the environmental benefits from broad-scale tree planting in arid areas.
3. To assess the economic benefits from broad-scale tree planting in arid areas.
4. To assess the local effect on rainfall and climate caused by the establishment of large blocks of trees.

The project comprises a multi-disciplinary research group representing major Japanese universities and government agencies, Curtin University of Technology, Kalgoorlie Campus, Minesite Rehabilitation Services Pty Ltd, Kalgoorlie and the Hurst family on Sturt Meadows Station, Leonora.

Funding

The Society of Chemical Engineers, Japan, supported the preliminary data collection. L and C Hurst, Minesite Rehabilitation Services and Curtin University of Technology contributed 'in-kind' support.

The Japan Science and Technology Corporation (JST) has made available some $A8m over the next five years for the studies. Further Japanese funding will be available subject to satisfactory progress over the next three years. Funding is being sought from Australian sources.

If tree planting to increase carbon sequestration is to have any effect on atmospheric carbon dioxide levels, then that planting will need to be on a massive scale. Arid lands, which comprise some 40% of the global landmass, would provide the area required if the technology could be developed to ensure acceptable tree establishment and growth rates.

There is some evidence, too, that tree planting will increase mean annual rainfall. At the Kalgoorlie Water Resources Conference in 1996, Dr Richard Smith of the Dept of Land Administration said that over the last 100 years the mean annual rainfall of the Wheatbelt had decreased by 4%, and that

of the Goldfields had increased by 5%. The fact that this has been a period of tree clearing in the Wheatbelt, and a period of tree re-growth (following the days of the 'Woodlines') in the Goldfields is probably related.

Future trading of carbon credits could make tree planting on degraded areas the first economical means to rehabilitate rangelands. Developing an economic rehabilitation option will greatly assist land users in the rangelands to rehabilitate any degraded or mined land that falls under their control.

In the research site on Sturt Meadows Station, tree seedlings will be planted this winter on a fenced, degraded area of 25 hectares. The tree species to be planted are native to the region and include:

Acacia aneura	mulga
Acacia pruinocarpa	gidgee
Casuarina obesa	casuarina, desert sheoak
Eucalyptus camaldulensis	river red gum
Eucalyptus gongylocarpa	marble gum
Eucalyptus lesouefii	Goldfield's blackbutt

Earth embankments have been built to control, measure, and harvest run-off water. The trees will be planted in holes that have been drilled and blasted to facilitate infiltration and root penetration. Supplementary irrigation will be available if needed in particularly dry times.

Useful 'spin-off' data will come from these trials. For example, measurement of rainfall, evaporation, water infiltration and run-off will provide data for a water balance model for rangelands in this region.

NEW MEMBERS

Deborah Jane Telfer
PO Box 177
Tindal NT 0853

Clive Barker
26 Lower Coast Road
Stanwell Park NSW 2058

Taoufik Ksiksi
PO Box 1539
Charters Towers QLD 4820

Stephen Peter Clipperton
PO Box 631
Dubbo NSW 2830

Dianne Calvert (Librarian)
Environment Australia Library
GPO Box 787
Canberra City ACT 2601

A ROYAL RANGELANDS EXPERIENCE

Rob Richards, Department of Land & Water Conservation, PO Box 235, Condobolin NSW 2877

For the third consecutive year, an "outback rangelands theatre" was set up at the Sydney Royal Easter Show. This year we had a prime position being located in "the dome" which is the centre piece of the new Homebush Bay showgrounds.

In similar style to previous years, visitors to the theatre were treated to ten minutes of pure outback pleasure. A set consisting of a red sand dune covered in spectacular wildflowers (*Rhodanthe floribunda*, *Craspedia sp* and *Helichrysum sp*) with small native mice, an echidna, mallee fowl, shingleback and frill neck lizard, and various native birds made up the set to surround the visitors. A ten minute slide show had a background theme of the seasons of western NSW while looking at landscapes, wildlife, grazing, station life, schooling and cultural features of the west.

The theatre attracted over 10,000 visitors this year, a similar number to previous exhibits. This is another small step in the long road to raising the awareness of rangelands to our city counterparts. This year represented the final year of a Natural Heritage Trust project to fund the display but rest assured, the Lower Murray Darling and Western Catchment Committees are keen to see the continuation of the project at the show now that we have made our presence felt.

Landholders and agency staff spent time talking to city folk at the stand as many visitors experienced for the first time the sights, sounds and scents of our icon landscape. Many Sydney-ites were excited at the prospect of visiting the vast land beyond the Great Dividing Range – "but has that area been settled yet?"!

PROCEEDINGS OF THE DESERT TECHNOLOGY IV CONFERENCE NOW AVAILABLE

Adrian Williams, Curtin University of Technology, PMB 22, Kalgoorlie WA 6430

The Desert Technology IV Conference was staged in Kalgoorlie in October 1997. This was one in a series of conferences initiated by the Engineering Foundation. The proceedings have been published as a special issue of the *Journal of Arid Land Studies*, and are now available for $35 (which includes postage within Australia).

The proceedings contain all the papers accepted for presentation at the conference, as well as the outcomes of the workshop sessions. Articles are arranged under five major headings:

- The World's Arid Areas – Global and Regional Assessment of Past, Present and Future Land Use
- New Technologies for Sustainable Production in Arid Areas
- New Technologies for the Rehabilitation of Arid Areas
- Challenges for the Future
- Workshop Sessions

The conference attracted delegates and papers from 13 countries. As a direct result of the conference, a number of foreign delegates and agencies have made inquiries regarding opportunities for collaboration with Australia in research and training.

The Proceedings can be obtained by contacting me at the above address or by:
Tel: (08) 9088 6715
Fax: (08) 9088 6832
Email: williama@kalg.curtin.edu.au

Desert Technology V will be held in Reno, Nevada between 3-8 October, 1999. For more information about this next conference in the series please contact the Conference Chairman, Dr James A. Young (Fax: +1 775 784 1712, or e-mail: jayoung@scs.unr.edu). Alternatively, contact the Engineering Foundation (Fax: +1 212 705 7441, or e-mail: engfnd@aol.com).

AUSTRALIAN RANGELAND SOCIETY AWARDS

The Society has two awards to assist members with either:
- studies related to the rangelands, or
- with travel expenses associated with attending a conference (or some other activity).

Applications for each award normally close in November of each year. Any member of the Society interested in either award is invited to apply.

Australian Rangeland Society Travel Grant

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

Australian Rangeland Society Scholarship

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

How to Apply

Members interested in either grant should submit a written outline of their proposed activity. Applications should clearly address how the intended activity (i.e. travel or study) meets the aims of the Society. Applications should be brief (less than 1000 words) and should be submitted to Council before 30th November 1999.

Conditions

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

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

Finally, on completing the travel or study, recipients are required to fully acquit their grant or scholarship. They are also expected to write an article on their activities or experiences for the *Range Management Newsletter*.

Eligibility

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

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

Overseas Travel or Study

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

The Australian Rangeland Society

REPORTS FROM THE 1999 ANNUAL GENERAL MEETING

ACN 008 784 414

DIRECTORS' REPORT

Peter Johnston, President, Australian Rangeland Society, Queensland Department of Primary Industries, Locked Mail Bag 4, Moorooka QLD 4105

(Ed. The following information has been edited from the complete Directors' Report presented at the 1999 AGM.)

In accordance with resolution of the directors, the directors report on the accounts and operations of the company for the year ended 31st December 1998 as follows:

Trading Results

The net loss of the company for the financial year was $20,264 (1997 profit = $3,501).

Review of Operations

The year 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 9 times since the 1997 AGM with a quorum present on all occasions (an additional meeting (146th) will be held prior to the 1999 AGM). A meeting was also convened at the 10th biennial conference in Gatton.

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

Eugene Moll resigned as President of the Society in early 1998. In accordance with the Articles and Memorandum of Association (12c) at the 1998 AGM, Council approved the appointment of the Vice-President Peter Johnston to the position of President for the period leading up to the 1999 AGM.

Membership of the Society remained stable with a total membership (including library subscriptions, corporate memberships etc) of 443 as of 31/12/98.

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. A special edition of the Journal with the theme "Water in Rangelands: from Rainfall to Rivers" was well received. During 1998 Wal Whalley replaced Alan Wilson as editor of the journal. Alan is to be commended for his efforts in publishing the journal. A special edition of the *Range Management Newsletter* will be published in 1999 as part of marking the 25th anniversary of the Society. John Morrissey has accepted the position of guest editor for this edition. An updated index for the journal is to be published in the same format as the journal in 1999. The Society for Range Management (SRM) will publish a joint electronic bibliographic database covering all articles from the *Journal of Range Management* and *The Rangeland Journal*. Gary Bastin is to be commended for his efforts in preparing the index of *The Rangeland Journal* and for its publication and inclusion on the SRM database. *Current Contents* are still monitoring the frequency and quality of the Society's journal before accepting it for inclusion in their publication.

Negotiations with the SRM exploring the possibility of reciprocal membership rights were finalised with subscription notices from both societies to offer reciprocal membership for the year 2000.

Jim Noble replaced Ken Hodgkinson as the Society's representative on the Federation of Australian Scientific and Technological Societies (FASTS). The Society renewed its membership to FASTS.

Council has continued to develop a number of administrative procedures to facilitate the operations of the Society. The registered office of the Society was transferred from Western Australia to The Australian Institute of Agricultural Science and Technology. A new computer was purchased for the subscription manager to facilitate better management of membership data. Membership forms were updated to accept credit card payments. The Articles and Memorandum of Association for the Society were typed with a word processor, updated and printed. Further updates will now be easier with an electronic version of the Articles and Memorandum of Association.

Council received and awarded 3 applications for travel grants in 1998. Each grant was to support participation at the 6th International Rangeland Congress in Townsville to be held in July 1999.

A preliminary web site has been developed for the Society. It currently is linked to the larger 6th International Rangeland

Congress web site. When the congress is over it is proposed to modify this web site for the Society.

Council has continued to be represented by the immediate past President on the Organising Committee of the 6th 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. The $10,000 loan made to the congress was converted to a grant.

Likely Developments and Results

Some developments currently in train include:

- A survey of the Society's membership will be conducted in 1999 by a team of students from the University of Queensland.
- Council for the Society will transfer from Queensland to South Australia at the 1999 AGM as per the Articles and Memorandum of Association (10c).

TREASURER'S REPORT

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

The financial position of the Society continues to be sound with retained profits of $100,829.00. However we did experience a loss of $20,264.00 mostly due to the timing of the honorarium payments, the purchase of a new computer and equipment, and the rising costs of publications..

Financial Statements

I would like to acknowledge the work of the auditors at Michael Boyce and Co., in particular the work of Patsy Cross. The financial statements produced are a clear and concise record of the Society's financial affairs. In the past we have been required to have the financial statement prepared in time for the AGM. We followed this guideline again but found that statements are now required within four months of the end of the financial year (31st Dec) by the Australian Securities and Investments Commission. Thanks to the tireless work of Patsy, this was achieved.

Subscriptions

Moneys in for the calendar year for subscriptions were down from last year from $33,822 to $28,074.

Journal and Newsletter

The Journal expenses increased from $13,468 in 1997 to $20,756 in 1998. The Newsletter expenses also increased from $5,408 in 1997 to $7,877 in 1998. Due to these increases in production costs, it may be necessary for the Council to increase subscription rates in 1999.

Investments

Investments remained stable at $80,778.

Equipment

We purchased a new computer and associated software for the Subscriptions Manager to enable accurate records to be kept regarding subscriptions and members.

Accounts Closed

Several accounts were closed which helped to simplify the Society's accounts. Below is a list of accounts that were closed and the amount of money transferred to the ARS account:

1994 Conference Account (Katherine)	$238.00
1996 Conference Account (Port Augusta)	$9,874.39
1997 Conference Account (Gatton)	$10,218.00

Honoraria

Payments of Honoraria increased as outlined in the 1997 Treasurer's report (indexed at CPI). The payment of Honoraria increased from $3,430 in 1997 to $13,428 in 1999 because two payments were made this year instead of the normal one. The first payment was actually for the 1997 calendar year but was late (i.e. payed in January 1998 instead of December 1997).

THE AUSTRALIAN RANGELAND SOCIETY
ACN 008 784 414
BALANCE SHEET AT 31 DECEMBER 1998

1997			
	SHARE CAPITAL AND RESERVES		
121,093	Retained profits		100,829
$121,093			$100,829
	Represented by:		
	FIXED ASSETS		
884	Plant & equipment (at tax value)		4,218
	CURRENT ASSETS		
3,528	Trading account - NAB, Orange	15,963	
3,232	Trading account - BWA, Journal,	4,277	
2,413	Trading account - WBC, Newsletter	537	
310	Trading account - WBC, 1994 Conference	-	
9,750	Trading account - BSA, 1996 Conference	-	
1,184	Trading account - CBA, Cobar	1,185	
1,450	Trading account - ANZ, Victoria Park	1,359	
3,590	Trading account - WBC, Adelaide	3,558	
17,836	Trading Account - UCU, 1997 Conference	-	
-	Funds in transit	239	
1,070	Sundry Debtors	-	
44,363			27,118
	INVESTMENTS		
86,147	Term Deposit - NAB, Orange		80,778
131,394	TOTAL ASSETS		112,114
	CURRENT LIABILITIES		
10,301	Trade creditors		11,285
$121,093	NET ASSETS		$100,829

THE AUSTRALIAN RANGELAND SOCIETY
ACN 008 784 414
STATEMENT OF PROFIT AND LOSS
FOR THE YEAR ENDED 31 DECEMBER 1998

1997			
	INCOME		
33,822	Subscriptions		28,074
2,633	Interest - NAB, Orange		3,200
5	Interest - ANZ, Western Australia		-
14	Interest - WBC, Adelaide		9
418	Interest - Bank SA, Port Augusta		133
1,476	Interest - National Mutual		-
6	Interest - CBA, Cobar		1
(13,468)	Net profit/(loss) Journal		(20,756)
(5,408)	Net profit/(loss) Newsletter		(7,877)
(849)	Net profit/(loss) Conferences		(897)
18,649			1,887
	EXPENSES		
3,850	Accountancy & Audit	3,962	
113	AGM expenses	115	
606	Bank Charges	495	
589	Depreciation	2,116	
-	Filing fees	95	
3,430	Honoraria	13,428	
779	Printing, stationary & postage	562	
3,500	Scholarships & Grants	-	
1,328	Subscriptions and donations	1,378	
954	Travel & Accommodation	-	
15,149			22,151
3,500	NET PROFIT/(LOSS) FOR THE YEAR		(S20,264)

SUBSCRIPTION MANAGERS REPORT

Rob Richards, Department of Land & Water Conservation, PO Box 235, Condobolin NSW 2877

This is, of course, the last Australian Rangeland Society Annual General Meeting that will be held in the 90's so it is time perhaps to reflect on the last decade of membership to the Society. Figure 1, below, shows that the number of new members joining the Society each year has been declining in the last five years. The 1999 figure is particularly disturbing given the IRC to be held in July this year. Perhaps the spikes of increase are a reflection of the conference location in that year. The 1992 conference was held in Cobar, 1994 in Katherine (a definite favourite), 1996 in Port Augusta and 1997 in Gatton

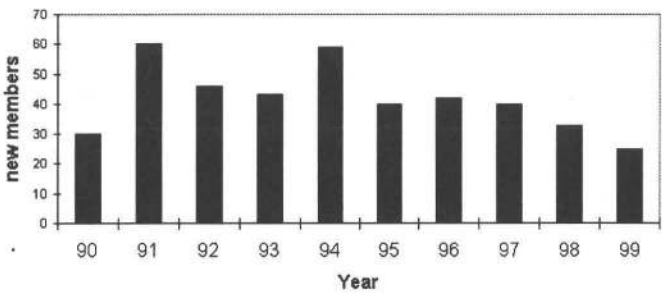


Figure 1. New members to the Society in the 12 months to end of May, 1990-99.

The trend does point to the fact that the Society is struggling to attract new members. The challenge for the incoming SA Council is to determine why and to establish incentives for new members.

If we look at the overall membership in the last decade (Figure 2), the picture is not really any more promising. There has been a small, but steady, decline in membership since the early 90's. The rise in 1999 is no doubt a result of the IRC. The average membership for the last ten years is 518 (at the end of May) with the current 1999 membership at 522. The reason there is an apparent anomaly between the decline in new members and the current rise in membership is because many previous members have renewed their membership after it had lapsed. It is disappointing to note that despite a "reminder" notice being sent out with the April *RMN*, it has had no effect on getting members to renew their membership early.

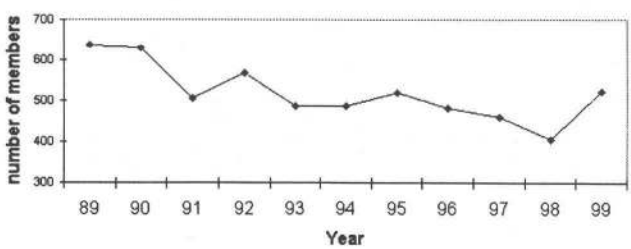


Figure 2. Membership as of end of May for 1989-99.

Again, the challenge for the incoming council is to try and hang on to the members that have rejoined for 1999. From a casual observation, I feel that it is the landholder membership that has declined most in the previous five years.

Membership rates remained the same in 1999 as for 1998. Considering $60 for full membership would not pay most people's mobile phone bill for the month, the ARS is still one of the most affordable organisations to subscribe to.

The last two years has given me an opportunity to further consolidate and streamline the role of Subscriptions Manager. Although a few problems still exist with overseas subscriptions, the process in enabling overseas members to subscribe to the Society is now so much easier with a fixed subscriptions address, the use of credit cards, and an expanding international reputation.

As we travel with this next South Australian Council into the next millennium, I encourage you to support the Society by way of your intellectual and financial membership. I would like to thank the Queensland Council for all their good humour, hard work and dynamic work attitude.

REPORT OF THE PUBLICATIONS COMMITTEE

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

Peter Johnston has already covered much of the news from the Publications Committee in his President's report so I will not repeat it here apart from one item. Wal Whalley has accepted the position of Journal Editor following Allan Wilson's retirement. Allan did an outstanding job as editor for almost nine years and was instrumental, along with Margaret Friedel, in giving the journal's profile and reputation a major boost. I'm confident that Wal will continue the fine work and I welcome him to the position. Wal, of course, is not new to the Journal, having served many years as an Associate Editor.

Membership of the Publications Committee is presently Gary Bastin (*RMN* Editor), Don Burnside, David Eldridge, Ken Hodgkinson, Malcolm Howes (Production Manager), Craig James, Peter Johnston, Wal Whalley and myself. The Committee has not met during the last year but has continued its business by e-mail and telephone. The next face-to-face meeting of the Committee and Associate Editors will be held during the IRC at Townsville in July.

Electronic publishing is becoming increasingly popular. So far we have refrained from entering this exciting new domain, apart from placing the titles of Journal articles and some *RMN* articles on the IRC web site and developing the electronic bibliographic database with the Society for Range Management (see below). We have also recently agreed to establish an arrangement with 'Uncover', a web-based document delivery service, in which our journal articles will be available for downloading from their web site or as conventional hard copy

for a small royalty fee. However, the Committee has decided there is a need to prepare a comprehensive policy on electronic publishing to guide us in the development of this aspect of publishing for the Society. In developing this policy we will be considering the potential benefits and impact (for the Society's publications and its members) and the implications for membership/subscriptions, costs and workload. We welcome your views on these matters, so if you would like to contribute please contact a member of the Publications Committee.

The Committee has decided to continue publishing special issues of the journal on a biennial basis. The issue 'Water in the Rangelands: from Rainfall to Rivers' edited by Allan Wilson and published in December last year brought together a range of interesting and important papers, and the issue has been well received. The next special issue is due for publication in December next year. We are currently exploring several possible themes for the issue and potential guest editors.

We expect to soon hear from *Current Contents* concerning the outcome of our application for listing of the Journal. A recent letter from them indicated that they are close to completing their comprehensive assessment of the Journal. Let's hope it is good news.

Geoff Pickup recently resigned from his position as an Associate Editor. I would like to acknowledge Geoff's valuable contribution to the Journal over almost 10 years.

Malcolm Howes is currently working on typesetting the latest Journal index and I understand it will soon be ready for the printers. You can therefore expect to see it appearing in your mail box in the near future.

The Society for Range Management (SRM) has now produced an in-house version of the joint bibliographic database. We will provide ARS members with details of where they can obtain a copy once we receive this information from the US. SRM are still negotiating with a publishing house to have the database produced commercially.

Once again it is with pleasure that I acknowledge the hard work by our editors, associate editors, production manager and members of the Publications Committee in producing and maintaining high quality publications on behalf of the Society. I would also like to thank Council for its support throughout the year.

SUBSCRIPTION SECRETARY'S REPORT

Bruce Alchin, University of Queensland, Gatton College QLD 4345

The number of members of the Society has continued to be relatively stable. However, there has been an increasing number of inquiries regarding the Society and membership. These inquiries are from overseas as well as from within Australia

Aspects of importance regarding membership include the IRC, web page, the survey of members, direct approaches to rangeland stakeholders and use of media.

IRC: The IRC will provide an excellent springboard to attract national (and international) interest in the Society. The Society will have a stand at the IRC to promote interest in its work.

Web Page: The Society's web page has been established. It has been suggested that this be permanently located on a computer at the registered office. Material from the IRC web page will be available to the Society after the Congress. This page will be interactive (similar to the SRM web page).

Survey of members: It is anticipated that the current survey of members will provide insight into ongoing development of membership.

Reciprocal Membership with Society for Range Management: Arrangements have been finalised with the SRM regarding reciprocal arrangements for membership.

Direct approach to rangeland stakeholders: There is an ongoing opportunity to make direct approaches to organizations and individuals regarding the role of the Society. The range of potential contacts include primary producer organizations, tertiary institutions (including libraries), organizations involved with conservation, Aboriginal interests, tourism, mining and institutional finance.

Media: It is proposed that the development of a video and a display board could enhance the opportunities to promote the Society.

The continuing role and value of the Society depends on active membership. It is envisaged that the outworking of the survey of members and events such as the IRC will result in furthering the role of the Society as a forum for all aspects of rangeland management.

In conclusion, I would like to thank the Society for the opportunity to serve as Subscription Secretary. I also pay particular thanks to Rob Richards, the Subscription Manager, who has maintained the difficult task of membership records and subscriptions.