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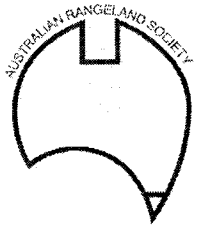

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REPORTING ON OUR SOUTHERN RANGELANDS – AN INTEGRATED APPROACH ACROSS THREE STATE BOUNDARIES

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ABSTRACT

Reporting on rangeland condition and trend across State boundaries is possible due to the complementary nature of the respective States' rangeland monitoring systems. While the State monitoring programs have evolved for different reasons, a commonality of core attributes makes cross-jurisdictional reporting possible. Woody plant density, composition and cover are such attributes that have been measured in the southern rangelands of Australia for the past decade or so. The ability of the current monitoring programs to report at a regional or vegetation community scale enables Interim Biogeographic Regionalisation of Australia (IBRA) regions to be used as logical units for national reporting. This paper provides a first attempt at cross-jurisdictional reporting.

An increase in woody plant density and cover was found for all reporting IBRAs across the southern rangelands in the last decade. Similarly an increase in recorded species diversity can be noted for all but one IBRA.

INTRODUCTION

There is an increasing need for reporting on the state of our rangeland resources on a national scale. While the semi-arid and arid areas of Australia receive increasing public attention through national issues such as native title, biodiversity conservation, mining impacts, native animal management and carbon storage the community demands more information on the status and trend of the condition of these areas. Reporting on a national scale has in the past been spasmodic, uncoordinated and responsive to immediate need through mechanisms such as State of the Environment Reporting and national programs such as Aussie GRASS. Most recently the National Land and Water Resources Audit (NLWRA) identified seven key natural resource management themes for inclusion, rangelands being one of them. The Rangelands Theme aimed to provide a framework for the regular (5 yearly) reporting on rangeland condition and change at national and regional scales. Consistencies between State data were identified and a framework called The Australian Collaborative Rangelands Information System (ACRIS) was developed to deliver State monitoring data in a standardised and web-based format for public access.

This paper provides a first attempt at reporting across the southern rangelands of Australia, via IBRAs using data from the existing State monitoring sites. While the States have established rangeland monitoring systems to satisfy independent needs, there are many commonalities between the monitoring objectives that enable cross border reporting to be meaningful. This paper presents data on the change in plant communities in the southern Australian rangelands over a decade of State rangeland monitoring. Data from twelve IBRAs within the pastoral zone across the southern rangelands have been used in this paper. Six additional IBRAs could be reported on when reassessments are completed.

METHODS

Data presented were derived from three State rangeland monitoring programs summarised below –

Western Australia (Western Australian Rangeland Monitoring System) – The current WARMS network of shrubland sites was established from 1993 to 1999 in the rangelands south of the Pilbara with a planned five to six year reassessment interval. The first round of shrubland reassessment began in 2000, due for completion in 2004. There are almost 950 sites with at least one site on all leases bigger than about 50,000 ha. The system is designed to report at the vegetation type or regional/district scale and not at the lease scale (Watson *et al.* 2001). A direct census method is used to derive the demography for each species. The maximum crown dimensions of all shrubs are also recorded along with landscape function attributes.

New South Wales (Rangeland Assessment Program) – The RAP network of sites was established from 1989 to 1992. The program aims to look at long term changes in the abundance and composition of plant communities as well as changes in the soil surface characteristics. There are 338 core sites stratified into seven major rangetypes throughout the western half of NSW (Green *et al.* 2001). Approximately one quarter of all Western Lands Leases participate in the program. Sites are also located on National Park estate. The program is designed to report at a rangetype or regional scale. Sites are monitored annually stratified into those read in Spring (northern half) and Autumn (southern half). Sites are 300 m^2 and located within a 500 m^2 homogeneous area. Woody chenopod density and pasture composition and frequency are measured at chenopod sites along with soil surface characteristics. Woody cover is measured at sites where trees and woody shrubs are present.

South Australia (Rangeland Monitoring Program) – Over the last ten years a baseline monitoring system has been established over all pastoral properties in the State. There are approximately 5,500 photopoint monitoring sites assessing lease condition as a requirement under the Pastoral Land Management and Conservation Act [1989]. The system aims to detect grazing-induced change using different techniques in the northern cattle areas from those used in the southern sheep districts. Land Condition Index sample points are used in the southern sites to monitor vegetation change. Density and frequency of perennial plants are measured at each of these sites. A pilot study in the Gawler Ranges and Kingoonya Soil Conservation District aims to determine necessary monitoring reassessment intervals (Gould *et al.* 2001)

Raw data of woody shrub density, plant cover and species richness were used from the State monitoring programs as described above. The number of sites contributing to the study across the southern Australian pastoral zone is shown in Table 1. As the reassessment interval varies between States, data were combined into two "reference periods" so that change could be observed between the early 1990s and the late 1990s/early 2000s. Raw data were used to indicate change between the periods and not time standardised. These reference periods vary between States as shown in Figure 1 below. The complementarity between periods will improve over time as full reassessments are completed for both South Australia and Western Australia.

Figure 1. Data sampling period used as "reference periods".

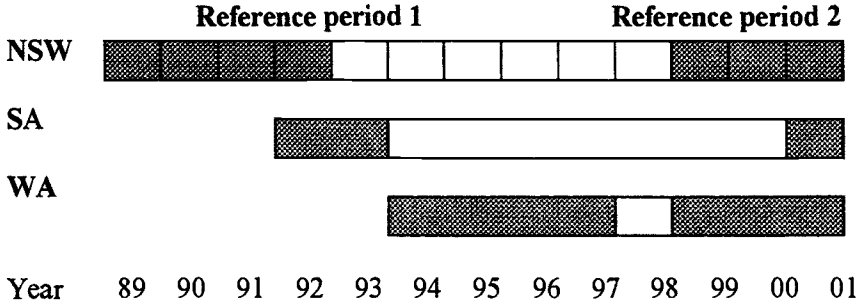

Table 1. Number of State sites within IBRAs for which reassessment data are available and used in this paper.

IBRA	DENSITY			SPECIES	*COVER*
	All Woody Perennials	Maireana spp.	Atriplex spp.	DIVERSITY	
BHC	20	20	17	20	46
CAR	57	32	16	57	57
COO	26	24	23	26	26
CP	N/a	N/a	N/a	22	8
DRP	36	18	9	41	28
GAS	170	79	27	170	170
GAW	76	71	66	73	N/a
GVD	8	7	7	8	8
MDD	40	40	18	84	50
MUR	156	127	57	156	156
PIL	7	1	0	7	7
RIV	33	28	19	35	2
TOT	**629**	**447**	**259**	**699**	**558**

BHC= Broken Hill Complex, CAR=Carnarvon, COO=Coolgardie, CP=Cobar Peneplain, DRP=Darling Riverine Plain, GAS=Gascoyne, GAW=Gawler, GVD=Great Victoria Desert, MDD=Murray Darling Depression, MUR=Murchison, PIL=Pilbara, RIV=Riverina

Spatial depiction was used for showing change in vegetation density and cover across the southern rangelands.

1. For each of density, species richness and cover, the ratio of the attribute value at reference period 2 (REF 2) to the value at reference period 1 (REF 1) was calculated for each individual site within each IBRA. The proportion of sites within each IBRA for which this ratio was at least 1.0 was then calculated.

$$\frac{\text{REF 2}}{\text{REF 1}} \geq 1$$

This provides information on the proportion of sites contributing to the change within the IBRA and indicates how widespread the result is. For example if the metric was derived randomly, 50% of sites would show a ratio greater than 1.0 and 50% of sites less than 1.0.

2. The scale of the change by site was calculated by taking the average of the ratio between REF 2 and REF 1 for each of density, species richness and cover within each IBRA. This metric weights each site within each IBRA on an equal basis but is influenced heavily by sites that experience large changes. For example, in NSW some sites had zero values at REF 1 but large values at REF 2 which is quite possible. A random result would provide an average site change of 1.0.

$$\frac{\sum^{1-n} \text{REF2/REF1}}{n}$$ where n= number of sites

3. To provide information on an IBRA-wide basis, ie. weighted by the attribute values at each site, a pooled ratio of change across all sites within each IBRA was also calculated. This figure indicates the overall amount of change observed on an IBRA basis. It is less influenced by sites showing large proportional increases.

$$\frac{\sum \text{REF2}}{\sum \text{REF1}}$$

Density - Change in total density for all woody shrubs was calculated. Calculations were done for *Maireana* spp. and *Atriplex* spp. separately across all IBRAs. As these are the major genera common across all States with available data it was worth looking at their contributions to the change in total

woody perennial plant density. An IBRA map was produced to show the change in total density of woody perennials. (Figure 2)

Species Richness - Woody perennial species diversity across IBRAs in WA and SA was calculated. In NSW total species diversity was calculated including all perennial and annual pasture species recorded which may be influenced by seasonal differences between REF1 and REF2.

Cover – Change in total woody cover (trees and shrubs) across all IBRAs was calculated. In NSW averages were calculated for 1989-1992 to determine REF1 and for 1999-2001 to determine REF2 as cover is measured every 3 years.

RESULTS AND DISCUSSION

An increase in woody perennial plant density, species richness and woody cover levels was found across all IBRAs in the southern pastoral zone. Contributing to the total woody perennial density was an increase in *Maireana* spp. and *Atriplex* spp. in all but one IBRA.

Figure 2A illustrates the proportion of sites within IBRAs where an increase in the total density of woody perennials (chenopods in NSW) was observed from REF1 to REF2. A large proportion of sites throughout all central and western IBRAs showed increases in density. In eastern Australia despite the Murray Darling Depression and Darling Riverine Plain IBRAs having a low proportion of sites that increased in density, the average change per site and pooled change across the whole IBRA suggests that a few site showed very large changes in density. This is consistent with good rainfall events for germination occurring in 1999 and 2000 at some sites.

Figure 2B illustrates the proportion of sites within IBRAs where woody cover has increased from REF1 to REF2. It is worth noting that the proportional change does not indicate the actual cover change that has occurred at sites or IBRAs. Large proportional changes are seen at sites where initial (REF1) cover levels were very low and small proportional change at sites where initial cover levels were high such as the Cobar Peneplain (CP). WARMS data shows that an increase in canopy area was observed for all species in the Gascoyne–Murchison (Watson & Thomas, 2002).

Species Richness

Table 2 below summarises the site data for change in species richness within IBRAs. All IBRAs with the exception of the Broken Hill Complex showed an increase in species richness.

Table 2. Changes in species richness within IBRAs in southern Australia over the study period.

IBRA	SPECIES	PROP REF2/REF1 ≥ 1	AVG SITE	POOLED IBRA
MDD	All pasture species	0.99	3.11	2.63
BHC	All pasture species	0.15	0.65	0.64
DRP	All pasture species	0.54	1.14	1.01
CP	All pasture species	0.59	1.10	1.06
CAR	All woody perennials	0.92	1.15	1.04
COO	All woody perennials	0.92	1.20	1.10
GAS	All woody perennials	0.87	1.13	0.99
RIV	All pasture species	0.97	2.07	1.91
MUR	All woody perennials	0.83	1.12	1.06
GAW	All woody perennials	0.75	1.12	1.11

It is important to note that the NSW data represents all pasture species recorded in REF 1 and REF 2. This includes all annual, ephemeral and perennial plants. The abundance of annual and ephemeral pasture species is seasonally influenced.

A more detailed study of WARMS in the Gascoyne-Murchison region of WA showed that recruitment was observed on all 223 reassessed sites and that for a range of analyses there was little if any difference between results for those species known to decrease abundance under livestock grazing and those species known to increase (Watson & Thomas, 2002). As well as individual sites becoming more species rich, individual species increased their occurrences across sites.

Given that perennial vegetation is recognised as a key contributor to rangeland condition, the indicators used suggest that widespread improvement has occurred in the rangelands of southern Australia in the last decade. The study demonstrates that despite the State monitoring systems being designed to meet individual State objectives, data can be used to show cross jurisdictional change.

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The State rangeland monitoring programs exist due to the contribution of many permanent and temporary field and office staff who have collected, collated, processed, summarised and analysed data for the last decade or so. Instrumental to this are the program drivers or "champions" in each State who take on the roles of trainer, administrator, negotiator, ecologist, artist, biometrician, computer technician and field hack. The one thousand odd landholders that participate in the State monitoring programs must be acknowledged also. This paper is the result of the efforts of all these people. In particular the efforts of Wayne Fletcher and Kerry Skinner in WA and Koshy Varghese in NSW. Thanks to Aaron Colbran, DLWC Dubbo for his GIS skills in producing the IBRA maps.

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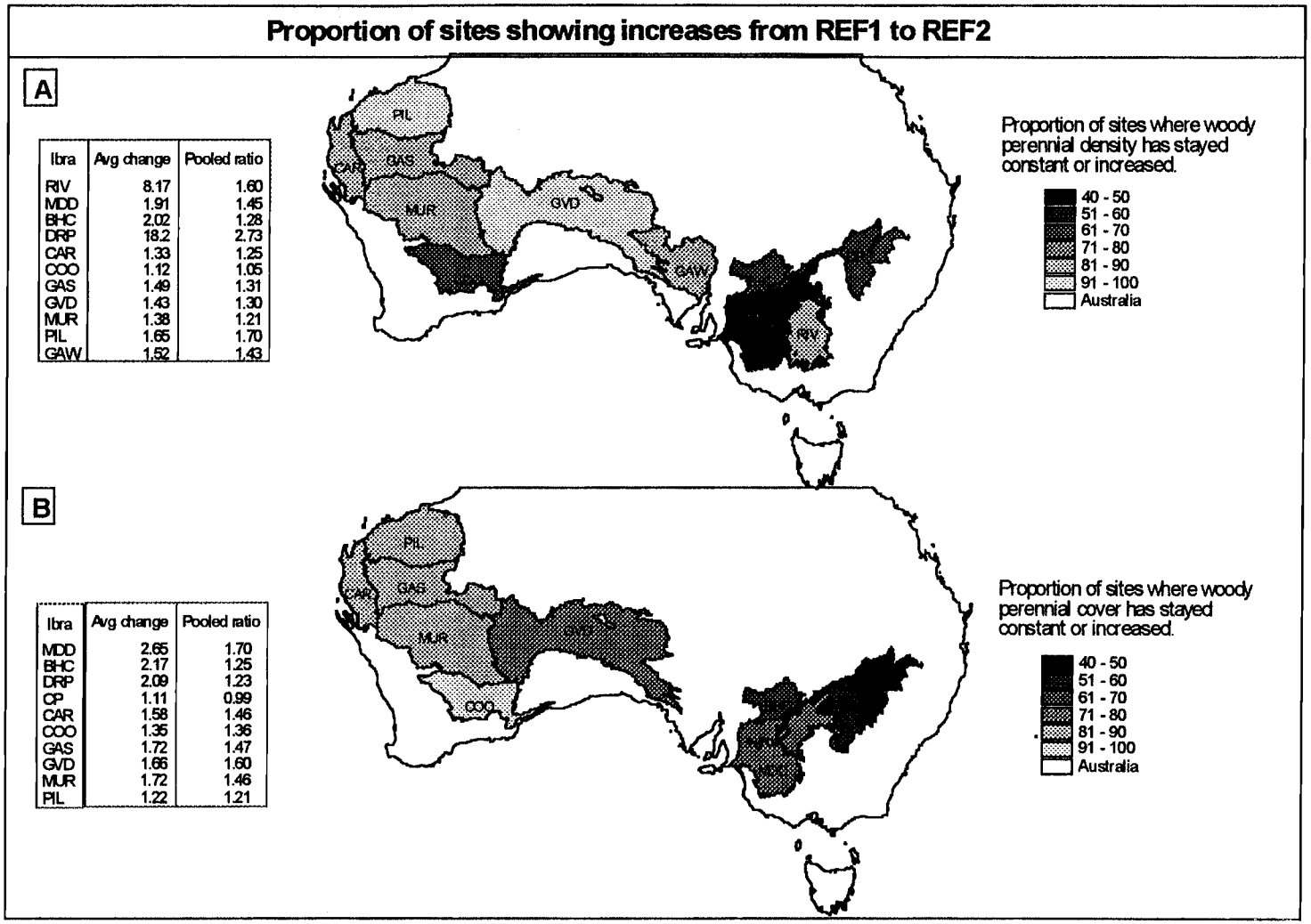

Figure 2. Proportion of sites within IBRAS where the density of perennial woody plants has increased (top map) where the cover of woody perennials has increased (bottom map). The corresponding tables show the average change at each site in the IBRA (Avg change) and the overall change across the IBRA (Pooled ratio)