PROCEEDINGS OF THE AUSTRALIAN RANGELAND SOCIETY BIENNIAL CONFERENCE

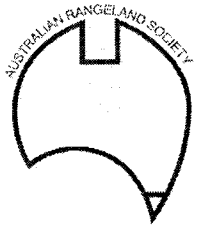
Official publication of The Australian Rangeland Society

Form of Reference

The reference for this article should be in this general form;
Author family name, initials (year). Title. *In*: Proceedings of the nth Australian Rangeland Society Biennial Conference. Pages. (Australian Rangeland Society: Australia).
For example:
Anderson, L., van Klinken, R. D., and Shepherd, D. (2008). Aerially surveying Mesquite *(Prosopis* spp.) in the Pilbara. *In*: 'A Climate of Change in the Rangelands. Proceedings of the 15th Australian Rangeland Society Biennial Conference'. (Ed. D. Orr) 4 pages. (Australian Rangeland Society: Australia).

Disclaimer

The Australian Rangeland Society and Editors cannot be held responsible for errors or any consequences arising from the use of information obtained in this article or in the Proceedings of the Australian Rangeland Society Biennial Conferences. The views and opinions expressed do not necessarily reflect those of the Australian Rangeland Society and Editors, neither does the publication of advertisements constitute any endorsement by the Australian Rangeland Society and Editors of the products advertised.



The Australian Rangeland Society

QUANTITATIVE SPATIAL CHANGE IN CHENOPOD SHRUBLANDS

K.F. McGregor and M.M. Lewis

Department of Environmental Science and Rangeland Management, University of Adelaide, Roseworthy Campus, Roseworthy, South Australia 5371

ABSTRACT

Using relationships between survey data of chenopod retention in the North-West pastoral zone of SA and Landsat MSS imagery, spatial quantitative inventories of chenopod shrubs have been devised. Temporal extrapolation of the relationships to 1972 has highlighted shortcomings of using scaled density data rather than direct cover data with spectral indices. The use of landscape cover data has addressed these shortcomings, providing quantitative cover information for 1972-1993. This gives insight into the spatial dynamics of chenopod shrub stands and shows promise for the development of temporal shrub inventories.

INTRODUCTION

The beneficial application of remote sensing to rangeland monitoring has been realised since its inception over 20 years ago. Pinpointing areas of soil erosion, weed invasion and wildfire has been the dominant use for this technology. Production and use of change maps can direct managers to specific locations at which detected change can then be addressed. However, such maps are qualitative and in order to obtain a resource inventory and thus an understanding of the spatial and temporal dynamics of rangeland ecosystems, quantitative not qualitative information is required. Quantitative information can be obtained from qualitative image data by calibrating it with reference ground data. The acquisition of ground data for large rangeland areas is a costly process, resulting in high temporal spacing. This allows limited change information to be obtained. By coupling such surveys with remotely sensed data quantitative baseline images can be established from which forward and backward quantitative change can be determined. This paper reports the combination of a spatially intensive rangeland survey on chenopod shrubs, conducted by the SA Pastoral Management Branch (PMB), with remotely sensed data. It reports the setting up of a base quantitative image map and the resulting quantitative change detection for the 20+ years since satellite imagery inception.

METHODOLOGY

Several approaches were investigated through the course of this study.

1. A general +ve, -ve, no change assessment was conducted based upon 'in use' methodologies. This was conducted to determine where change had taken place, but not specifically what change had taken place, and thus provided the basis upon which to answer the question: what is the quantity of change that has occurred? This approach included the use of FCC (False Colour Composite) change maps (Graetz *et al.* 1992) and PD54 cover change maps (Pickup *et al.* 1993).
2. Using PMB collected ground data (Maconochie, this volume), Landsat MSS image base maps for 1993 were devised to delineate shrub stands based upon density and land system type. These were obtained using relationships between the CSIRO-developed cover index (PD54) and the traverse collected PMB shrub ratings. These maps were then subtracted from those derived for 1972 to determine the extent and abundance of shrub inventory change at the paddock level for each of six stations surveyed. Accuracy assessment of the 1993 base maps was undertaken as well as overall change agreement with PMB. This second approach was devised to introduce quantity of shrubs to the spatial image and thus provide direct conversion of linear PMB survey data into spatial maps with complete paddock coverage.
3. Using quantitative (wheelpoint) cover data of all landscape components from selected sites, image maps based upon change in organic cover were devised. Relationships between the percentage

cover of various components and derived indices formed the basis for this image data. These were intended to increase the accuracy of the PMB derived maps and give insight into the results obtained using PMB rating data, which uses a subjective rating scale of shrubs only.

RESULTS

1. Throughout the six stations analysed areas of change were found to be dominated by increases in the spectral cover index since 1972, with 1983 to 1993 having the greatest increase. Most recently, from 1993 to 1995, this cover index has declined slightly.
2. Pure shrub ratings were found to have unique spectral signatures. Overall, PMB shrub density ratings have a negative relationship with the PD54 cover index. The 1993 base maps developed using the derived relationships clearly delineated spatial shrub density (when stratified into land system type). The base maps used a modification of the PMB rating scale of 1-5 (to incorporate mixed shrub ratings), but were contiguous rather than discrete integers. Areas above or below the spectral thresholds at which shrubs occurred were also clearly delineated. Overall accuracy of prediction for the base map was 72% within one unit of rating when tested across station boundaries. Application of this base map temporally, resulted in images of chenopod distribution and density in the respective years. This allowed numeric inventory change to be determined for selected paddocks. Initial comparisons of these results with those derived by PMB show similar trends of change, however given the overall cover increase realised in section 1 (above), additional analysis is being undertaken prior to obtaining the overall shrub inventory for each paddock.
3. Relationships were found to be strongest between spectral values and overall organic cover, confirming the results of CSIRO researchers. This has resulted in quantitative cover maps, extrapolated temporally to determine actual cover change at the paddock level. A significant negative relationship between non-shrub cover and shrub cover suggests that specific spatial information on relative shrub inventories may be possible.

DISCUSSION

The use of ground data was successful in determining the quantitative distribution of chenopod shrubs concurrently with the 1993 PMB survey and has given a shrub inventory at the paddock level. Due to the negative relationships obtained between PMB chenopod densities and the spectral cover index, the overall increase in actual cover between 1972 and 1993 is perceived as a decrease in shrub density on the rating change maps. This goes against PMB findings of increased shrub densities and is believed to be due to the PMB rating scale's reliance on density rather than cover. Thus a virtually defoliated stand of shrubs with high exposed soil can be given a similar density rating as a healthy stand with low exposed soil. Work is continuing on analysing the spectral relationships between overall cover change and shrub cover, in an attempt to explain these results and increase the accuracy of temporal shrub inventory maps.

ACKNOWLEDGEMENTS

John Maconochie, SA Department of Housing and Urban Development, Primary Industries SA and the managers of Bulgunnia, Commonwealth Hill, Mulgathing, North Well, Wilgena and Mobella stations are all thanked for their cooperation and assistance and the use of data.

REFERENCES

Graetz, R.D., Fisher, R.P. and Wilson, M.A. (1992). Looking Back: The changing face of the Australian continent, 1972-1992. COSSA Publications, Canberra. 159 pp.

Pickup, G., Chewings, V.H. and Nelson, D.J. (1993). Estimating changes in vegetation cover over time in arid rangelands using Landsat MSS data. *Remote Sens. Environ.* 43: 243-263.