IDENTIFYING STATE AND TRANSITION MODELS IN THE MITCHELL GRASSLANDS

David G. Phelps[1]*, Ockert J.H. Bosch*[2] *and Kirsten N. Bates*[1]

[1] Department of Primary Industries, PO Box 519 Longreach 4730 Qld Australia
[2] Landcare Research NZ LTD, PO Box 69 Lincoln 8152 Canterbury New Zealand

INTRODUCTION

The Mitchell grasslands are the most extensive and productive native pastures of semi-arid western Queensland. The grasslands are dominated by the long-lived perennial *Astrebla* spp. (Mitchell grasses). Rainfall is highly variable, leading to fluctuations in both pasture yield and composition, particularly of annual and ephemeral species growing between these perennial tussocks (Orr and Holmes 1984). These fluctuations create problems when attempting to assess rangeland condition and trend which is often based upon single, or short term, data. Furthermore, Everist and Webb (1975) concluded "the extrapolation from observations made at any one time can be misleading and inaccurate". This paper summarises an approach by which State and Transition theory (Westoby *et al.* 1989) and the Degradation Gradient Method (Bosch and Kellner 1991) were used to develop models of vegetation change which were able to account for this inherent variability.

VEGETATION SURVEYS

One hundred and sixty two survey sites, 30 by 30 m square were permanently marked to represent different conditional states (fence line effects, piosphere transects and stock camps) within relatively homogeneous grazing areas (RHGAs) of the Mitchell grasslands in Queensland. Sites were surveyed in August 1989, January 1990, May 1990, May 1991, May 1993 and May 1994. The nearest plant within 200 mm of a set strike was recorded approximately every 1 m. Additional data, such as soil pH, topography and erosion activity were determined for each site at the commencement of the study with pasture biomass and grazing pressure estimated on each survey date (Phelps 1999).

DEFINING STATES, TRANSITIONS AND DEGRADATION GRADIENTS

Vegetation data from each recording date was ordinated separately in a time-series approach (ie each survey date analysed individually) to avoid rainfall patterns unduly influencing the proportional plant abundance data. The ordination techniques, Decorana and Reciprocal Averaging, were used to identify different vegetation groups (Bosch *et al.* 1992). These groups were treated as states within each recording date. The movement of each site within a state was traced over time. Most sites retained their grouping from date to date, providing evidence of generalised vegetation states. Some sites moved from one state to another over time, providing evidence of transitions. These states and transitions were then combined to form a generalised State and Transition model for each RHGA.

The existence of a degradation gradient was then confirmed or rejected by plotting edaphic factors and known management histories (eg protected sites, sites with known utilisation levels within grazing trials, sites near watering points and stock camps) on the ordination diagrams of each date. This defined the main ecological factor(s) responsible for the positioning of the states along the first axis. For example, a degradation gradient was defined for the Longreach district (Figure 1). Vegetation states ranged from the perennial grassland of State I (good condition) to the less stable herbfield states dominated by forbs and bare ground (poor condition). This was confirmed by the grazing histories of a number of sites within the ordinations, the extent of surface litter, erosion activity, and bare ground . Most lightly utilised sites occurred in State I, while the light to moderate and moderate to highly utilised sites occurred in State II. Sites that were overgrazed and/or severely disturbed (near watering points, stock camps and in overgrazed corners) occurred only in the herbfield states. Erosion activity was also highest in the herbfield states, while the amounts of litter were highest in States I and II.

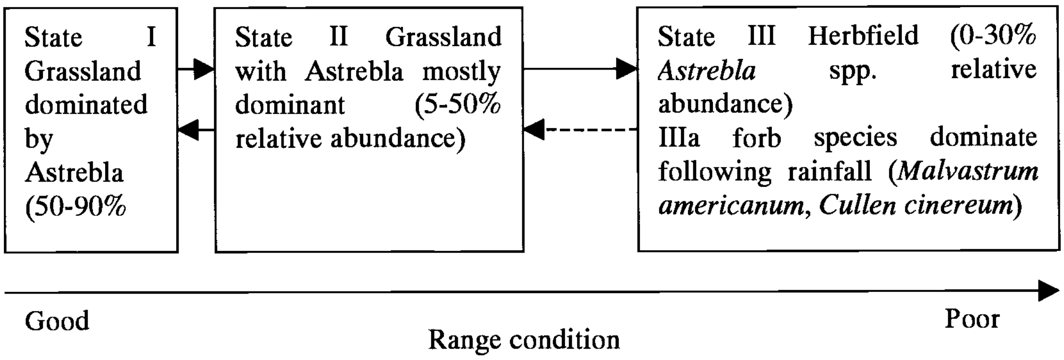

Figure 1. A simplified State and Transition model for the Mitchell grasslands of the Longreach district (from Phelps 1999).

DETERMINING INDICATOR SPECIES

If a degradation gradient existed, then indicator species could be identified. Firstly, species abundances were plotted along the time specific vegetation states and Gaussian fit regression analyses performed. Where rainfall patterns were similar at different dates (eg rains following a seasonal drought) similarities were also found in both species abundance and behaviour. This made it possible to summarise the indicator species according to rainfall patterns. Key indicator species of the states along the gradient were identified as those with high r^2 values, and with relatively high abundances.

CONCLUSION

This approach was effective in quantitatively defining states, transitions, degradation gradients and indicator species for the Mitchell grasslands. These models can now be used to interpret data from other vegetation monitoring programs. Our model further develops the general State and Transition model of McArthur *et a*l. (1994) through the use of quantitative data collected in smaller areas of Mitchell grassland.

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