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USING SATELLITE DATA TO DETERMINE LANDSCAPE RESILIENCE FOR IMPROVED LAND MANAGEMENT

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ABSTRACT

We show how the magnitude of vegetation response to major rainfalls can be determined from satellite data and be used to produce scaled paddock maps of landscape resilience. These maps assist in separating grazing effects from rainfall and landscape variability and should be a useful tool for paddock planning and future land management.

INTRODUCTION

Episodic rainfall provides infrequent opportunities for vegetation to recover from grazing in the arid rangelands. The extent of vegetation response following each rainfall event, or its resilience, varies widely across large paddocks. It is generally difficult to determine to what extent vegetation recovery is controlled by rainfall variability, site factors and the effects of past grazing by domestic and pest animals (e.g. rabbits). Yet this separation is the very information that land managers and their advisers need in order to adapt grazing practices and to ensure that the rangelands are managed for sustainable production.

Because abiotic factors exert strong control over the vegetation of the Australian rangelands, there is only a weak linkage between grazing and its effect on the vegetation in the short term. However, in the longer term there can be important feedback mechanisms whereby grazing influences subsequent vegetation response to rainfall. As researchers and pastoralists, we have tested a technique known as the Resilience Method (Pickup *et al.* 1994) to determine how well vegetation recovers from grazing and other forms of disturbance. Plant cover-based information required to calculate an index of resilience is obtained from satellite data and is processed to provide landscape-scale maps of vegetation resilience. This poster demonstrates the method and evaluates its success in determining future management options for a 340 sq km paddock located south of Alice Springs in the Northern Territory.

CALCULATING RESILIENCE VALUES

Landsat MSS data acquired either side of a major rainfall event (350 mm) in March 1989 were radiometrically standardised and geometrically rectified to produce dry and wet period images of vegetation cover. Fencelines and waterpoints were digitised from maps, updated with a GPS and included as GIS layers. Because the large paddock contained several vegetation types of varying grazing preference to cattle, mapped land systems describing these vegetation types were digitised and included in the GIS. Resilience values were calculated as scaled residuals from the regression of mean cover response following the rainfall event (y variate) against initial (pre-rain) cover (x variate). The regressions and residuals were computed for each land system separately. The residuals were then reduced to three response categories about the mean (below average through average to above average) and combined into a single image for interpretation (Fig. 1).

THE RESILIENCE MAP AND LAND MANAGEMENT

The resilience map indicates that much of the paddock had an average to above-average vegetation response to the March 1989 rainfall event. The largest area of above-average response was in a broad watercourse in the north-eastern part of the paddock where alluvial soils and runon water combined to produce ideal conditions for herbage growth. Light grey areas to the south-west and west of this floodout (Fig. 1) are mainly associated with poor vegetation response on eroded country. Semi-saline country in the central western part of the paddock had a moderate cover of low shrubs (e.g. samphire, oldman saltbush) in March 1989 but many of these shrubs were dislodged by flowing water, giving rise to the apparent below-average vegetation response in this part of the paddock. The elongated strip of below-average response mapped towards the south-eastern corner of the paddock is associated with a heavily shrubbed watercourse where high dry-period cover retarded the magnitude of vegetation response to rainfall.

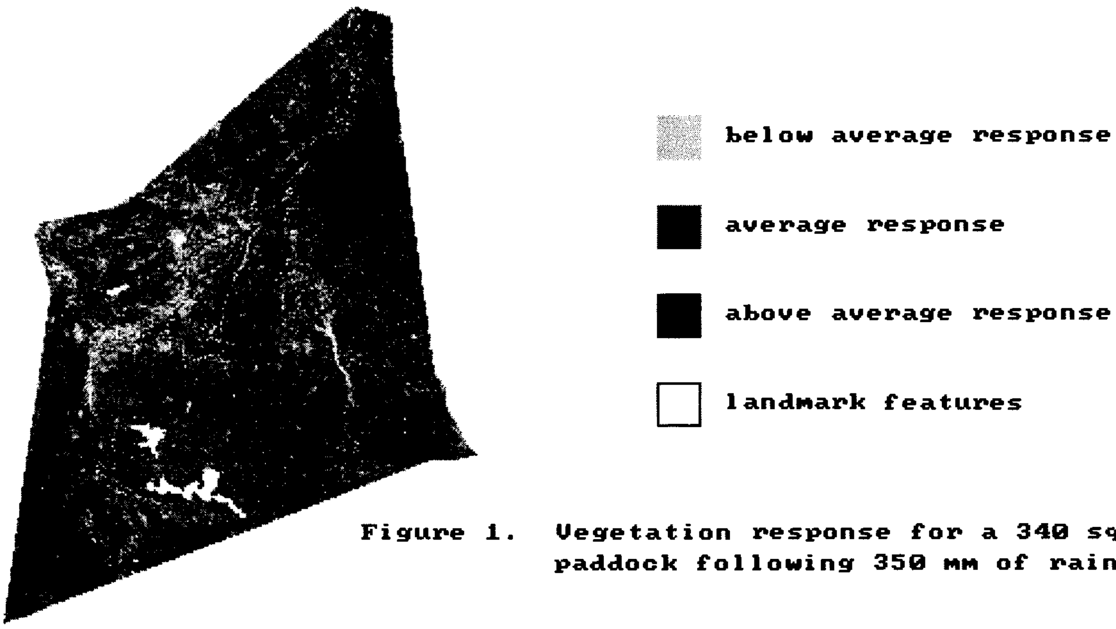

Figure 1. Vegetation response for a 340 sq km paddock following 350 mm of rainfall

The Resilience Method has the potential to improve paddock management. Management suggestions arising from this example include:

- Piping water to two additional locations in lightly grazed country in the eastern part of the paddock. This area is lightly and intermittently grazed and recovers well from grazing.
- Closing access to waters associated with below-average vegetation response except when yards at these waters are required for mustering.
- Redirecting reclamation activity by concentrating efforts on only partly degraded areas which have a higher potential for assisted recovery and will produce a higher return per dollar invested.

In the longer term, further resilience maps can be produced in a repeatable manner following future good rains and the output used to assist in evaluating range trend under continued, or changed, grazing management. This has the potential to both assist pastoralists in their paddock management and to complement ground-based monitoring programs being conducted by State land management agencies.

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