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CAN AERIAL VIDEOGRAPHY INDICATE LANDSCAPE FUNCTION?

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ABSTRACT

Conservation of water and nutrients within landscapes is critical for successful plant growth. Fully functioning landscapes successfully hold these resources while degraded areas lose nutrients and water and are described as being "leaky" or dysfunctional. In this paper, we examine if various measures of perennial vegetation patches derived from classified aerial videography have value for indicating landscape leakiness, hence, landscape function.

INTRODUCTION

Vegetation patches of various types can indicate how well a rangeland landscape is functioning to conserve water and nutrients (Tongway and Ludwig 1997). For example, in semi-arid woodlands, vegetation is often structurally organised into distinctive tree grove and intergrove units which repeat down local topographic gradients (Ludwig and Tongway 1995). These units function to capture resources where, for example, water and nutrients lost from an upslope intergrove are captured by the grove below it. At even finer scales of patchiness, clumps of grass tussocks function to capture water and nutrients from adjacent open interclump sources.

Directly measuring the capture of water and nutrients is time-consuming and costly, therefore simple indicators of these landscape processes have been used (Tongway and Ludwig 1997). Indices of landscape function include the number and cover of perennial vegetation patches, patch width, mean fetch length between patches, and fetch-to-patch ratio (Tongway and Ludwig 1997). Measurement has usually been made along field-based line transects but these can only provide a small sample (a slice) of the landscape. Is it possible to obtain similar information about landscape function from larger areas using high resolution remotely-sensed data? In this poster, we illustrate how aerial videography was used to examine the size of vegetation patches within intact landscapes and in areas altered by grazing. These patch measures may contribute to an improved understanding of landscape function.

METHODS

Digital aerial video images of intact and altered landscapes at 20 or 33 cm pixel resolution were acquired in the Victoria River and Alice Springs pastoral districts. Intact areas included a long-established grazing exclosure and lightly and intermittently grazed holding paddocks. The Victoria River site was on a calcareous red loam and the Alice Springs sites were on a clay loam growing gidyea (*Acacia georginae*) and sandy loam with mulga (*A. aneura*). Images were classified into cover types of patch (perennial vegetation) and fetch (bare soil, annuals and litter). Ground verification (results not shown) demonstrated that classified patches corresponded well with areas that would capture and hold water and nutrients moving across each landscape. Various landscape statistics were then calculated from the classified patches.

RESULTS AND DISCUSSION

The Victoria River sites had higher patch cover than the Alice Springs sites (Table 1), presumably due to the influence of higher, and more reliable, annual rainfall. Patch cover was considerably higher on all intact sites compared with altered sites. Patch density was similar at both the intact and altered sites in the Victoria River district. In the Alice Springs district, the intact clay loam (gidyea) site had the lowest patch density while the intact sandy loam (mulga) site had, by far, the highest density. The altered sandy loam site had a high density of small patches. Intact sites at all locations had a higher mean patch size than altered sites but the range in overall values was small. This occurred because there were a large number of very small patches (<1 m^2), particularly on the intact sites, and fewer large patches. Weighted mean patch size (Li and Archer 1997) increased the separation between sites with the intact site in the Victoria River district having an extreme value. Here, patches had coalesced to form a small number of very large patches (largest patch = 17,853 m^2); squaring this highly skewed patch size-class distribution thus greatly inflated weighted mean patch size.

Table 1. Some descriptive statistics of perennial vegetation patches at three sites in the Northern Territory as determined from aerial videography.

Landscape statistic	Victoria River district		Alice Springs district			
	calcareous red loam		clay loam (gidyea)		sandy loam (mulga)	
	intact site	altered site	intact site	altered site	intact site	altered site
area (ha)	4.17	3.17	5.44	9.79	21.40	16.84
% patch cover	68.1	48.8	23.4	5.5	33.7	8.4
# patches/ha	2,442	2,988	1,894	2,602	10,244	5,694
mps[a] (m^2)	11.2	4.8	6.4	1.8	6.1	2.0
wmps[b] (m^2)	21,840	3,411	1,852	30	5,644	32
fpr[c]	0.47	1.05	3.28	17.34	1.96	10.91
fetch Euc dist[d]	19.0	52.9	365.2	593.2	128.6	434.0

[a] mean patch size
[b] weighted mean patch size (Li and Archer 1997). This index weights patches by the square of their size.
[c] fetch-to-patch ratio (area of fetch divided by area of patch)
[d] total Euclidean distance of fetches (m) divided by site area

Values of both the fetch-to-patch ratio and fetch Euclidean distance, as a measure of fetch length, declined as patch cover increased. Fpr and cover had a curvilinear trend ($fpr=204.19*cover^{-1.371}$, $R^2=0.982$), while the trend between Euclidean distance and patch cover was more linear (Euc dist=547-8.98*cover, $R^2=0.871$).

These results showed that simple indices such as % patch cover, fetch-to-patch ratio and Euclidean distance (as a measure of fetch length) derived from classified aerial videography could separate sites according to the influence of rainfall and disturbance by past grazing. The patch density and mean patch size indices were less effective in partitioning sites. Weighted mean patch size increased the separation between sites along a gradient of perennial cover but index values appeared to be unduly influenced by the presence of a small number of very large patches at increasing patch cover. Although the former statistics (patch cover, fetch-to-patch ratio and fetch Euclidean distance) provided information about patch size, they did not contribute direct information about patch arrangement that could be used to develop an index of landscape leakiness and conversely, resource conservation. Work is continuing to develop such an index that will allow useful information about landscape function to be derived from aerial videography.

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