ASSESSING LANDSCAPE FUNCTION IN THE SOUTHERN BLACK SPEARGRASS RANGELANDS: A CASE STUDY IN THE SOUTH BURNETT REGION OF QUEENSLAND (STUDENT)

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ABSTRACT

Landscape Function Analysis monitoring compared two adjacent sites in the Southern Black Speargrass rangelands of the South Burnett region in Queensland. Both sites carried black speargrass (*Heteropogon contortus*), forest blue grass (*Bothriochloa bladhii*) and wire grass (*Aristida* spp.) in an open woodland dominated by silver-leaf ironbark (*Eucalyptus melanophloia*) trees. Site 1 carried a dense stand of *E. melanophloia* saplings on an ungrazed road reserve. Site 2 carried sparser, mature *E. melanophloia* and was managed with light to moderate grazing pressure. Site 1 exhibited a greater capacity for retaining and capturing resources than site 2, but only in terms of a soil surface assessment. When assessing landscape organisation, Site 2's functional capacity was higher. Because of this paradox, further interpretation of the implications of Landscape Function Analysis is required to effectively assess and compare the impacts of grazing and tree demographics in this rangeland type.

INTRODUCTION

This case study was undertaken to examine the landscape function of a Southern Black Speargrass Rangeland ecosystem, under two varying management regimes. Landscape Function Analysis (LFA) (Tongway & Hindley, 2005) was applied based on the concept that a loss of resources from a landscape is undesirable and that such loss, and an inability to capture replacement resources, constitutes a dysfunctional landscape. Alternately, a functional landscape retains its resources and has the capacity to capture new resources, transferred from elsewhere. Specifically, this study used LFA to determine the impacts of grazing and non-grazing on the landscape's functional capacity to retain and capture water and other resources.

The study site was located in open woodlands with a perennial grassland understorey characterised by the decreaser species black speargrass (*Heteropogon contortus*), forest blue grass *(Bothriochloa bladhii*), Queensland blue grass (*Dichanthium sericeum*), Rhodes grass (*Chloris gayana and C. divaricata*) and green panic (*Panicum maxiumum*), and the increaser Type I species, wire grass (*Aristida* spp.) (Henry *et al.* 1995; Orr *et al.* 2001). Trees commonly found in this area include, narrow-leaf iron bark (*Eucalyptus crebra*), silver-leaf iron bark (*E. melanophloia*), blue gum (*E. tereticornis*), spotted gum (*E. maculata*) and Moreton Bay ash (*E. tesselaris*) (Partridge 1993). However, at the study site only *H. contortus*, *B. bladhii*, *Aristida* spp. and *E. melanophloia* are present. The anticipated annual rainfall in the area is 700 – 1200 mm, the majority of which is expected during the summer months (Partridge 1993). However, in the season prior to this study the rainfall was below average and erratic. The soil is a grey vertosol derived chiefly from rhyolitic and basaltic parent material (M. Andrews, pers. comm.).

METHODS

Two parallel twenty metre transects were established on the mid-slope of a north-east facing hill. Each transect followed the direction of potential water flow, down a gradient of fifteen per cent. Both transect sites were homogenous in all respects except grazing, which also affected tree demographics. Transect 1 (Analogue) was established on an ungrazed road reserve among a thicket of *E. melanophloia* saplings. Transect 2 was located in a paddock carrying light to moderate grazing pressure by *Bos indicus* cattle, with a sparser stand of mature *E. melanophloia.* During severe drought conditions in 2002, Site 1 was grazed out over a period of a week by travelling stock; it later regenerated, and was moribund at the time of assessment. Neither site has been exposed to fire within the last ten years.

Both components of the Landscape Function Analysis method, the landscape organisation assessment and the soil surface assessment, were carried out. Measurement and assessment of the zone proportions provided the landscape organisation results. Interpretation of each zone's surface condition, through qualitative and quantitative means, provided the soil surface assessment results, which culminated in three comparative indices rating Stability, Infiltration and Nutrient Cycling capacity. These indices were applied to each transect, each zone within each transect and determined the proportion that each zone contributed towards each transects' indices.

Given the level of loose litter cover at both sites, careful measurement of perennial grass basal area was used to differentiate between patch and interpatch zones. This was to ensure that interpatch zones were clearly distinguished from swards of functionally linked patches. Observations indicated that water had run through some of the interpatches, under the layer of litter cover.

RESULTS

Landscape Organisation

Five patch types and two interpatch types were recorded. The dominant patch type, Patch Type 1 (P1), was characterised by the presence of mixed perennial grasses; *H. contortus*, *B. bladhii* and *Aristida* spp. P1 was the only patch type observed along Transect 1. Other patch types, only present on Transect 2, were characterised as fallen timber (P2), an unidentified woody forb (P3), common verbena (*Verbena officinalis)* (P4) and large, loose basaltic rock (P5). The dominant interpatch type, Interpatch Type 1 (IP1) was characterised by bare soil with thick loose litter cover. Interpatch Type 2 (IP2) was characterised by bare soil and lighter, more mobile litter cover. IP1 was the only interpatch type present along Transect 1, whereas Transect 2 exhibited both IP1 and IP2. Transect 1 was divided into 36 patches and 37 interpatches, compared to Transect 2's 46 patches and 41 interpatches.

Interpatch spacing dominated both transects, representing 77% of Transect 1 and 58% of Transect 2. Along Transect 2, this interpatch proportion was comprised of 42% IP1 and 16% IP2. P1 constituted the remaining 23% of Transect 1 and 36% of Transect 2. Patch types P2 to P5 contributed less than 7% to Transect 2. Transect 2 had more perennial plant basal area cover than Transect 1. Transect 2's individual patch types were longer (P1 avg. 0.21 m) than the patches along Transect 1 (P1 avg. 0.13 m), with the exception of the single occurrence of P3 (0.05 m). Transect 2's patch swards were also wider (avg. 0.76 m) than Transect 1's (avg. 0.28 m). Correspondingly, interpatch spacing along Transect 2 was shorter (avg. 0.28 m) than along Transect 1 (avg. 0.42 m).

Soil Surface Assessment

Transect 1 scored higher in all three soil surface assessment indices, Stability (68%), Infiltration (48%) and Nutrient Cycling (43%) than Transect 2 (62%, 44% and 34%, respectively). The chief contributor to the higher rating of Transect 1 was the high individual index ratings achieved by the bare soil and heavy litter cover of IP1 (Stability: 66%; Infiltration: 48% and Nutrient Cycling: 42%). IP1's high ratings contributed 74%, 77% and 76%, respectively, to Transect 1's total index values, but only 38%, 45% and 42%, respectively, to Transect 2's total index values. Even including the contribution of IP2, interpatch zones still only contributed 51%, 56%, and 55%, respectively, to the total index values of Transect 2. These results are thought to arise jointly from the favourable functional capacity of IP1 and its greater presence along the total length of Transect 1. By comparison, the dominant patch type, P1, also received high individual index ratings for soil stability (70%), infiltration (45%) and nutrient cycling (37%), but contributed only 26%, 23% and 24%, respectively, to Transect 1, and slightly more, 41%, 37% and 39%, respectively, to Transect 2. The contributions of other patch zones to the total index values of Transect 2 were comparatively negligible.

DISCUSSION

It was expected that interpatch spacing would account for most of each transect's length. However, it was unexpected that the ungrazed site would have more interpatch space than the grazed site. It was considered that, over time, grazing would have reduced the total perennial plant basal area coverage of the grazed site to a state of less coverage than the ungrazed site. It is an encouraging feature of the landscape function of the grazed site that this was not the case. However, the lower basal area coverage on the ungrazed site does present some concern. The long period of nil grazing by cattle has resulted in abundant plant matter, loose litter cover and sapling growth. The limiting effects of this moribund overgrowth, including reducing available sunlight, restricting air circulation and increasing competition for available moisture, may have impeded germination and recruitment of new grass plants. Therefore, the removal of some grass biomass on the grazed site appeared to offer an advantage. Additionally, the fewer, mature trees on the grazed site may not represent the same degree of competition for moisture as the sapling thicket, as the established trees are likely to be competing for resources deeper in the soil profile than the grass community. The virtual absence of *E. melanophloia* saplings on the grazed mid-slope could be the result of typical grazing habits. Saplings of various cohorts are abundant on steeper slopes within the same paddock. Consideration should be given to the value that these saplings impart to grazed mid-slopes and whether ensuring they are not entirely lost from such grazed mid-slopes would be beneficial to ecosystem functioning.

The higher incidence of patches and interpatches on the grazed site suggests that it is more fragmented. However, this is not supported by the data, which showed it had larger patch sizes and greater overall coverage. This pattern of incidence may suggest that patches, once much larger, are beginning to become interrupted. Alternatively it may suggests that the recruitment of new grass plants may be occurring well within the interpatch spaces, advantageously starting new patches, rather than just expanding existing patches under the protection of colonising, resources capturing patches. More importantly, patches on the grazed site are wider than on the ungrazed site. This pattern indicates that the landscape is less disrupted perpendicular to the slope of the hill and therefore offers greater opportunity for the capture of resources with the flow of runoff. Because of these aspects the grazed site possesses a clear advantage in achieving a positive landscape function, in terms of landscape organisation.

However, the landscape organisation results contrast with the soil surface assessment component of the analysis. The ungrazed site was assessed as having a landscape function advantage over the grazed site because of its soil surface condition. It is considered more stable, with greater infiltration and a higher nutrient cycling potential, signifying a greater capacity to hold resources, capture potential resources and reuse its existing resources. Furthermore, this advantage was attributed not only to the favourable condition of its interpatch spaces, but their relative abundance, a characteristic rated as a disadvantage in terms of landscape organisation. The high individual ratings achieved by the bare soil and litter interpatch indicate that the landscape function of this zone type is comparatively high and provides a valuable contribution to the overall landscape function of the site, particularly as the interpatches ultimately contribute more to the total stability, infiltration and nutrient cycling of both transects than all the patch types. The patch zones were expected to contribute more to landscape function than was evident; the reasons for this apparent anomaly were not evident from this study.

The ungrazed site holds the further advantage of homogeneity of composition, only exhibiting one patch type and one interpatch type. According to the State-and-Transition model for black speargrass (Orr *et al.* 1994), a more homogeneous pasture composition of perennial grasses is preferable. The mixed perennial grass patch zone can be considered more dominant on the ungrazed site than on the grazed site, despite its lower relative abundance, because it was the only patch type present on the former. On the grazed site, apart from the mixed perennial grass patches, there were patches of species that are less susceptible to grazing. This is concurrent with the ungrazed site having higher index values than the grazed site. This difference in pasture composition should be weighed against the difference that the mixed perennial grass patches contribute to the total basal area coverage of both sites to determine which is the more desirable feature.

CONCLUSIONS

The grazed site appeared to have a reduced landscape function capacity because of its lower soil surface assessment results. However, nil grazing resulted in overgrowth which appeared to reduce the landscape function capacity of the site by producing a less favourable landscape organisation pattern. Each management style has in some way limited the landscape function, reducing its capacity to retain, recapture and cycle resources.

Which of these components assessed by LFA should weigh more heavily in ultimately differentiating which site possesses the higher level of landscape function? Perhaps, further quantifying the contribution of each component of LFA would improve the application of this useful monitoring technique. This would be particularly valuable for the landscape ecosystems of the Southern Black Speargrass Rangelands, that exhibit diverse and complex landscapes, biota and land uses.

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