Grassy vegetation: the effects of agricultural management on native plant species richness

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Introduction

Improving the conservation of biodiversity in grassy vegetation in temperate Australia requires an understanding of the effects of past and current agricultural management. Our project aims to determine the influence of management on the floristics of grassy vegetation in grazed landscapes on the Northern Tablelands, NSW (Figures 1, 2). Here we focus on the influences of grazing, fertilizer and cultivation history on the species richness of native plants.

Figure 1. Area dedicated for conservation management: an ungrazed, uncultivated, unfertilized site.

Figure 2. Area managed for production: grazed, cultivated, fertilized site.

Objective

To determine the influence of grazing, fertilizer and cultivation management on species richness of native plants in grassy vegetation.

Methods

Sampling of vascular plants occurred in 6 x 5 m plots (Figure 3) at 373 sites, and was completed within a 60 km radius of Armidale, NSW (Figure 4) from January to April in 2001 and 2002. Management history and environmental variables were recorded at each site. Confounding of management influences was overcome by stratified sampling in relation to the main management variables and lithology:

- Cultivation (primarily for sown pasture species) – never, > 20 and 10-20 years ago
- Grazing – not grazed, episodically grazed (i.e. only grazed briefly on irregular occasions), planned rest (also called cell or rotational grazing) and continuous grazing
- Single superphosphate fertilizer application – never, low (< 125 kg/ha/year in last 50 years and high (≥ 125 kg/ha/year in last 50 years)
- Lithology – basalt, metasediment, granitic parent material

This enabled 19 comparisons, the most significant of which are presented here.

Figure 3. Photograph of a 6 x 5 m (30 m^2) quadrat.

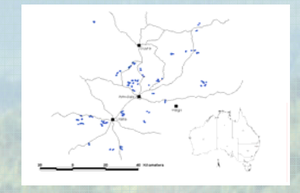

Figure 4. Locations of the 373 sites.

Grazing Results

- On granite soils that had never been cultivated or fertilized, ungrazed and episodically grazed sites had higher native species richness than planned rest and continuously grazed sites (Figure 5).
- Planned rest sites was associated with significantly lower native species richness than continuous grazing on basalt uncultivated sites with low fertilizer history. This was not the case on unfertilized granite sites (Figure 5).

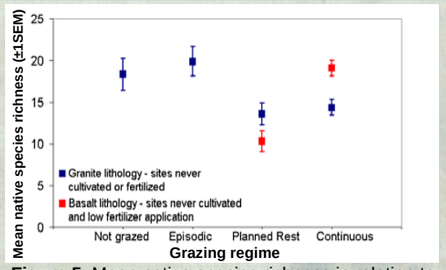

Figure 5. Mean native species richness in relation to grazing history on basalt (F = 32.26, df = 1,18, P < 0.001) and granite (F = 4.31, df = 3,48, P = 0.009) lithologies.

Fertilizer Results

- Basalt sites with a history of high fertilizer application had significantly lower native species richness than sites that had never been fertilized or with a history of low fertilizer application (Figure 6).

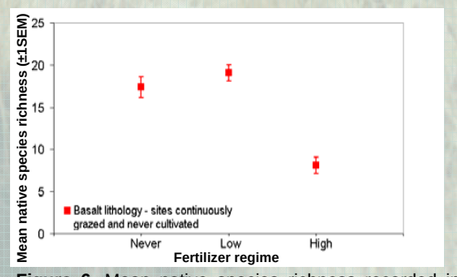

Figure 6. Mean native species richness recorded in relation to fertilizer history on basalt lithologies (F = 31.67, df = 2,27, P < 0.001).

Cultivation Results

- Cultivated sites had lower native species richness than comparable uncultivated sites on granite under planned rest grazing and with a high fertilizer history (Figure 7).
- On basalt, continuously grazed sites with a high fertilizer history cultivated > 20 years ago had higher native species richness than sites never cultivated or cultivated 10-20 years ago (Figure 7).

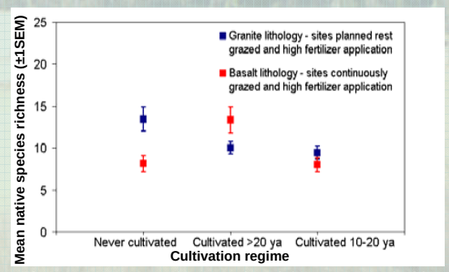

Figure 7. Mean native species richness recorded in relation to cultivation history on basalt (F = 7.31, df = 2, 31, P = 0.003) and granite (F = 4.17, df = 2, 35, P = 0.02) lithologies.

Conclusions

- Increased intensity of management generally leads to a decrease in native species richness although this influence is strongly influenced by lithology.
- Ungrazed and occasionally grazed sites have higher native species richness than more intensively grazed sites, particularly on granite lithology.
- High fertilizer application strongly reduces native species richness.
- Recent cultivation diminishes native species richness regardless of lithology probably due to the disturbance and higher stocking pressure as graziers attempt to recoup their investment.
- However, on fertile soils, native species richness is higher under continuous grazing than planned rest, probably because regular long spells without grazing results in the competitive exclusion of interstitial species by dominant grasses.

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