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ASSESSING THE VALUE OF TREES IN SOUTHERN QUEENSLAND RANGELANDS

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ABSTRACT

A balanced view of the role trees play in grazing systems is required to improve landscape level management and planning. Producers are monitoring the value of retained native vegetation on their properties in terms of beneficial (pasture quality; micro-climate; cycling of water, carbon and nutrients; and biodiversity) and competitive effects (competition for water and nutrients). The work presented in this paper summarises the initial findings from two case study properties in the southern brigalow bioregion. The results demonstrate that retaining trees in what would be otherwise fully-cleared paddocks provides positive benefits to the production system and aids the conservation of elements of the endemic biodiversity.

INTRODUCTION

The design of sustainable pastoral systems requires an improved understanding of the role trees play in landscapes, both the competitive and beneficial effects. Compared to other parts of Australia, southern Queensland has had significant levels of tree clearing in the past decade. Clearing is conducted to increase pasture production and maintain or increase carrying capacity. There is growing community concern over the potential losses of biodiversity from over-clearing and inappropriate management (e.g. over-grazing, changes to fire regimes). There are also concerns over accelerated soil loss, soil compaction and changes to hydrological regimes, and the increasing risk of dryland salinity. Finding the balance between native vegetation retention that provides for production, gives shelter for stock and wildlife, and provides ecosystem services is essential in managing productive grazing systems in southern Queensland. Producers are monitoring the value of retained native vegetation on their properties in terms of beneficial (pasture quality; micro-climate; cycling of water, carbon and nutrients; and biodiversity) and competitive effects (competition for water and nutrients).

Three different research components were undertaken:

1. The ecosystem services provided by vegetation retention were reviewed. Traditional scientific research methods were used, including collation of published information and scientifically acceptable data acquisition methods.
2. On-farm monitoring trials were established in conjunction with community groups (landcare and catchment groups), employing participatory action research (PAR) methods. The aim was to scientifically test long-standing folklore (eg. "trees cause erosion") and/or provide evidence to support anecdotal observation and local knowledge. A suite of different methodologies was employed depending on the interests of the community group and the individual landholders.
3. Individual landholders and community groups were encouraged to undertake their own experiments in order to test local hypotheses. This was achieved through empowering groups and individuals by providing appropriate methods, techniques and interpretative support.

METHODS

Four grazing properties located in the brigalow bioregion in southern and central Queensland were sampled between 1999 and 2002. Data from two locations, Dukes Plains and Worrawa are presented in this paper. On each property, native vegetation was retained in a strip configuration at sampling locations, although the design varied depending on landholder preference and vegetation type.

Dukes Plains is an 8000 ha grazing property in the southern central highlands of Queensland. There are two distinct land types on the property: Brigalow Downs (*Acacia harpophylla*) and forest country, dominated by spotted gum (*Corimbya maculata*) and ironbark (*Eucalyptus* spp.). Short-term, intensively controlled rotational grazing (known as cell grazing) is employed on the property. Two tree retention strategies were adopted in the experimental paddocks:

1. Narrow grass strips (ranging in width between 4 and 6m) containing young brigalow regrowth (up to 6 years old) ranging from one tree wide to a maximum of 6m wide; and
2. Wide grass strips (120m wide) containing strips of 20 year old brigalow regrowth approximately 20m wide.

Worrawa is a 2000ha mixed grazing and cropping property located in the Moonie River catchment in the Murray Darling basin, 20km west of Moonie. The property is predominately Brigalow Downs and has a large red sand ridge supporting ironbark (*Eucalyptus melanophloia*) and cypress (*Callitris endlicheri*) through the length of the property. Paddocks dominated by Brigalow Downs have been cropped, and have brigalow/belah shadelines of various widths on their margins. The vegetation of the sand ridge is retained through the length of the property, linking Southwood National Park to the Moonie River.

Measurements

At Dukes Plains, ambient air temperature was measured hourly, with periodic measurements of soil moisture status and grass growth rate. A rainfall simulator was used to assess effects of trees on water infiltration. Topsoil (0-5cm) nutrient measurements were taken from beneath and between strips. Soil biota were surveyed over a five-day period in December 1998 by pitfall trapping and soil core extraction.

At Worrawa, climatic data and volumetric soil moisture (0-30 cm) were measured hourly. Surface soil biota were sampled over a five-day period in April 2001 by pitfall trapping. Surface soils (0-5 cm) were sampled for cotton strip assays under constant temperature and moisture in the lab. All data are presented in relation to the distance from the edge of the tree strip.

RESULTS AND DISCUSSION

Substantial evidence of both production and biodiversity benefits from retained vegetation has been collected.

Microclimate effects

The retention of strips of trees in otherwise cleared grazing paddocks substantially affected the surrounding microclimate. At Dukes Plains, maximum temperature beneath strips of brigalow trees was on average 4.5°C lower than the open paddock. The difference was greater when the temperature in the open was above 35°C, being on average 7.2°C cooler in the shelterbelts. Similar microclimate effects were recorded at Worrawa, where temperature extremes (measured as the difference between maximum and minimum temperature) beneath trees were on average 15°C less, compared to open paddocks. The shelter effect of trees extended beyond the canopy boundary at both locations, with substantial declines in maximum temperatures at least 30-40m beyond the canopy (depending on tree height). This effect is likely to be due to cooling of turbulent flows around tree belts and the zone of influence will increase with tree height. Despite the introduction of heat tolerant cattle, the landholders believe that shade and shelter is important to maximise animal production per head. Shade may enable cattle to graze longer during the day and may extend the pasture usage to areas well away from watering points.

Soil effects

Retained vegetation had a positive effect on the soil's physical and chemical properties. Results from rainfall simulations at Dukes Plains demonstrated the influence of trees on soil infiltration to varying distances, with optimal infiltration observed between 15 and 30m from tree belts; corresponding with a reduction in surface soil (0-5cm) bulk density. At Worrawa, continuous monitoring of soil moisture (0-30cm) revealed that during a high intensity rainfall event, 30mm more water (of a 45mm rainfall event) infiltrated beneath trees, compared to the neighbouring open paddock. The result was contrary to the popular belief that trees cause runoff.

Changes in the soil nutrient status and soil biological status were also observed. At Dukes Plains, soil nitrogen and carbon levels were higher beneath tree strips than in adjacent grassed interspaces. Changes in soil biological status and activity are implicated in improving soil fertility, but the processes whereby trees improve soil fertility are numerous and difficult to separate (Young 1989).

Pasture quality

The nutritional quality of grass beneath the tree strips was enhanced compared to that of the open paddock. At Worrawa, beneath-tree pasture biomass was lower than open paddock (450kg/ha vs 3000kg/ha), but the total nitrogen concentration was greater (1.4% vs 0.6% N). This difference in nutritional quality would be expected to benefit animal performance, as nutrients, such as nitrogen, are often deficient in the diet of ruminants in tropical grasses. Grass pastures that are high in nitrogen can improve rumen fermentation leading to increased digestibility and intake of low quality fibrous grasses (such as those in the open paddocks) and hence improve animal production (Minson and Milford, 1967).

Biodiversity benefits

At Dukes Plains, differences in the soil mesofauna and surface dwelling invertebrates were observed. The number of individual ants was ten times higher beneath tree strips compared to the neighbouring open paddock (Aston, 1999). The tree strips also had higher ant species diversity, less generalist ants, and a greater numbers of mites and collembola. At Worrawa, few differences were apparent in the surface-dwelling ant species composition in the tree strips compared to similar native vegetation in the neighbouring national park. The exception was at the strip edges where opportunistic species were more prevalent.

Surveys of lizard diversity in the tree strips under tree strips at Worrawa found 14 species, being comparable to that of the neighbouring national park (20 species, R. Johnson personal communication). Reptiles are generally less dependent on habitat size per se but sensitive to habitat quality (Kitchener, *et. al.,* 1980). Although the strips at Worrawa are narrow, they offer good quality habitat for terrestrial and aboreal lizards. Strip clearing maintains small mosaics of remnant vegetation in what would otherwise be a fully cleared landscape. Maintaining the remnant in good condition has retained components of the endemic biodiversity that would otherwise have been lost.

Denser populations of soil fauna and invertebrates offer a potential mechanism to explain changes in soil physical and chemical properties. For example, cotton strip assay results from Worrawa indicate higher soil biological activity beneath trees compared to the open paddock. Soil organisms maintain soil fertility, structural stability and sustainability (Freckman *et al*., 1997) through their contribution to a number of processes including soil turnover rates, organic matter content, formation of stable soil aggregates, porosity, water infiltration and retention, gas exchange, decomposition and nutrient cycling, and regulation of microbial community composition. Management that encourages a diverse soil invertebrate community may maintain soil fertility and promote a stable, well-structured soil. (Sanginga *et al.,* 1992).

CONCLUSION

The results showed that retaining native woody vegetation in grazed landscapes could provide ecosystem services to the surrounding production system and provide direct production benefits (shade, nutrition) while contributing to an avoidance of the effects of overclearing such as rising watertables, salinity and greenhouse gas emissions (Main, 1999). Treed strips in what would otherwise be cleared paddocks may also aid on-farm biological conservation, especially if they link remnant vegetation and conservation reserves. Conservation practices, especially those that directly benefit the surrounding production system, should be a priority for land managers as species diversity inevitably is important to landscape and ecosystem functioning.

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