EFFECTS OF TREES ON TEMPERATE NATIVE PASTURE PRODUCTIVITY

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Certainly Dame Nature, with apparent whimsicality, will sometimes remove a forest that has existed for ages, and leave a bare plain where once it stood, as in New Zealand; or cover with scrub country that was open within the memory of man, as in Queensland. And so in ages past, grown tired of the landscape here, she may have covered once naked ranges with the vast mantle of a Gippsland forest. But man has rudely torn it off, never more to be replaced; and the gaunt skeleton of its once mighty bulk alone remains in the forest of dead trees that stands bleached and white, a monument alike of the great scrub and of the industry that cleared it.

–T.J. COVERDALE, The Scrub, in *The Land of the Lyre Bird: A Story of Early Settlement in the Great Forest of South Gippsland,* published for the Committee of the South Gippsland Pioneers Association, 1920.

Sheep sheltering under trees during hot weather, site VW. **photo. D. Williams**

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Mutjinde Katjiua preceded me in this study and this thesis is a temporal continuation of his work and an attempt to expand on it. I am indebted to him for use of the data he collected during his work. My supervisors, Dr David Williams and Dr Nick Abel have provided me with invaluable advice and support without which I couldn't have done this work and I thank them greatly. Suzanna Podreka, Wayne Robinson and Peter West were an enormous help with the large amount of fieldwork that this project required. Dr John Harris gave encouragement and advice where needed and helped to keep me going when things were getting me down. And last, but far from least, I give heartfelt thanks to my wife Carol who put up with my ups and downs and did her very effective best to hold me on course and in good spirits throughout the process.

Abstract

The goal of this work was to quantify the effects of eucalypt woodland blocks on the productivity of native pastures. This research was conducted on the Southern Tablelands of New South Wales. Tree planting or retention is seen by many as an important tool in addressing the problems of soil degradation resulting from clearing and pasture improvement that threaten the sustainability of pasture systems. In particular these are dry land salinity and erosion, both of which affect large areas of agricultural lands in the south east of Australia. Whilst native tree cover remains over substantial portions of Australian pasture lands, mainly on steeper slopes and poorer soils, little has been done to measure the effects of trees on pasture productivity and soil fertility on the Southern Tablelands. Previous studies in other areas have shown a range of effects—from facilitation to inhibition—of pasture growth in the presence of trees. Soil fertility beneath trees has been shown by a number of workers to be elevated in comparison with situations in the open. Given that the range of effects may be highly site dependent, application of results from one area to another may not be valid. Thus it is necessary to measure tree effects on a regional scale if results are to be reliable.

Pasture productivity was assessed over a two year period on four sites in the vicinity of Bungendore, New South Wales. A pair of plots was selected on each site, one plot in a block of eucalypt woodland, and the other nearby in an exposed, open situation. Plots were chosen to be as similar to each other as possible with the exception of tree cover. Treed plots had a tree basal area of between 10 and 20 m^2 ha^{-1} and plots had an area of 900 m^2. Two of the sites were on granitic soils and had a tree cover consisting predominantly of *Eucalyptus pauciflora*. The remaining two sites were on soil derived from sedimentary rocks with tree cover consisting mainly of *E. mannifera, E. dives* and *E. melliodora*. Perennial native pasture species present were similar across all sites, although their relative contributions to standing biomass varied between sites. As the plots were grazed during the period of measurement, productivity and offtake were measured seasonally using exclosure cages on each plot. Pasture standing biomass was assessed using the comparative yield technique.

Microclimate was monitored in each plot by automatic weather stations. Soil moisture to a depth of 45 cm was measured by time domain reflectometry using permanent

probes in each plot. Ten additional survey plots on each site, covering the range of tree basal area from 0 - 30 m^2 ha^{-1}, were assessed each season in the second year for standing biomass, soil fertility and pasture quality; expressed by nitrogen content and dry matter digestibility. Pasture floristics were measured using the dry-weight-rank method. These additional plots were chosen to be as representative of the paddocks as possible.

Over the two years that productivity was measured, it was found to be higher under trees than in the open. This was predominantly due to higher winter and spring growth within treed plots. Grazing offtake was also found to be higher under trees, partly accounting for lower standing biomass found in the treed plots.

Wind run, evapotranspiration and photosynthetically active radiation were all reduced by the presence of trees. Beneficial effects of shelter from winds may largely explain the higher productivity observed in the treed plots, and could outweigh negative effects of below ground competition and radiation interception by tree canopies at low to moderate tree densities. Soil moisture was not affected by the presence of trees. Soil fertility also did not differ between treed and open plots nor was there any difference in pasture nitrogen content or dry matter digestibility.

On the sites where soils were derived from sedimentary rocks, pasture floristics were found to be related to tree basal area. *Themeda australis* biomass was negatively related to tree basal area, and was partially replaced by large tussock species such as *Poa sieberiana* and *Chionochloa pallida*. A reduction of pasture quality resulted, particularly as the latter species is not grazed to any significant extent.

Given the desirability of having deep rooted perennial components in grazing lands, the results of this study indicate that it may be possible to utilise trees to assist in preventing or reducing a range of adverse environmental consequences arising from agricultural activities, without unduly compromising pasture productivity. Additionally, the wide range of environmental conditions provided by a mix of treed and open pasture promotes a higher degree of heterogeneity of the herbaceous layer. This may assist in maintaining productivity over a greater range of climatic conditions than would be the case with a more homogeneous pasture.

Contents

Abstract 1

Chapter 1 Introduction and Aims 3

1.1 Introduction 3

1.2 Aims 5

1.3 Literature review 5

1.3.1 Biomass and productivity 7

1.3.2 Effects of Trees on Soil 13

1.3.3 Microclimatic effects of trees 15

1.3.4 . Summary 20

1.4 Specific Research Objectives 21

Chapter 2 Methods 22

2.1 Site descriptions 22

2.1.1 Snow Gum woodlands (VE and VW) 25

2.1.2 Box woodlands (M1 and M2) 32

2.2 Experimental design 40

2.2.1 Permanent plots 40

2.2.2 Survey plots 45

2.3 Climate 47

2.4 Sampling effort 50

2.5 Biomass determination 52

2.5.1 Tussocks 54

2.6 Productivity Measurement 56

2.7 Species Composition 61

2.8 Tree Basal Area 63

2.9 Soil Moisture 65

2.10 Microclimate 65

2.11 Photosynthetically Active Radiation 68

2.12 Soil Fertility 68

2.12.1 Nitrogen 68

2.12.2 Phosphorus 69

2.12.3 Organic Carbon 69

2.12.4 Soil pH 69

2.13 Pasture Quality 69

2.13.1 Digestibility 70

2.13.2 Nitrogen Content 70

Chapter 3 Comparison of treed and open plots—
the permanent plots 72

3.1 Introduction 72

3.2 Comparison of pasture productivity and offtake between treed and open plots ... 77

3.2.1 Biomass 77

3.2.2 Productivity 77

3.2.3 Offtake 81

3.2.4 Soil Moisture 81

3.2.5 Microclimate 85

3.2.6 Photosynthetically active radiation 90

3.3 Discussion 90

Chapter 4 Paddock surveys at a range of tree densities 99

4.1 Introduction and Methods 99

4.1.1 Analysis 100

4.2 Results 102

4.2.1 Biomass 102

4.2.2 Forage Quality 102

4.2.3 Soil Fertility 117

4.2.4 Tree litter 117

4.3 Discussion 121

Chapter 5 Synopsis 127

5.1 Tree cover effects on pasture 127

5.2 Microclimate 129

5.3 Below ground conditions 130

5.4 Overview of tree/grass interactions 130

5.5 Further Avenues for Research 133

5.6 Implications for management 135

5.7 Conclusions 135

Figures

Figure 2-1. Location of sites on the Southern Tablelands of NSW. 23

Figure 2-2. Frequency histograms of tree stem diameter at the permanent treed plots. . 23

Figure 2-3 . Soil profile of VE and VW permanent plots. 26

Figure 2-4. General view of site VE. 29

Figure 2-5. View NW from the permanent open plot at VE. 29

Figure 2-6. Site VE, showing dense *Poa labillardieri* tussock on low lying areas.. 30

Figure 2-7. Valley West paddock showing typical tree distribution. 30

Figure 2-8. Site VW—treed plot. 31

Figure 2-9. Site VW—open plot, looking to the south west.. 31

Figure 2-10. Site M1 showing extensive cleared areas. 33

Figure 2-11. Under trees at site M1. 34

Figure 2-12. Soil profile of M1 permanent plots. 35

Figure 2-13. Typical treed area in site M2. 37

Figure 2-14. General view of site M2 37

Figure 2-15. Soil profile of M2 permanent plots. 38

Figure 2-16. Site M2—under trees. 39

Figure 2-17. Mean annual wind direction distribution for Canberra Airport 43

Figure 2-18. Exclosures used during the first year. 44

Figure 2-19. Exclosures used in the second year 44

Figure 2-20. Mean monthly temperatures for open plots in sites M2, VW and Canberra Airport during the study period 48

Figure 2-21. Mean monthly maximum and minimum temperatures for open plots in sites M2, VW and Canberra Airport during the study period........... 48

Figure 2-22. Total monthly precipitation and mean monthly Penman evaporation for open plots in sites M2 and VW during the study period. 49

Figure 2-23. Sampling effort versus expected error for measured pasture biomass....... 51

Figure 2-24. Comparison of observed biomass (CY_2) and predicted biomass of exclosures using quadratic relationship.. 59

Figure 2-25. Diagrammatic description of calculation of t_{OY1} from EY_1 and EY_2. 59

Figure 2-26. Typical weather station installation (Environdata), site VW, open plot.... 67

Figure 3-1. An example of the breakpoint regression approach used for the calibration quadrats in some early samples. 74

Figure 3-2. Pasture standing biomass in treed and open plots over six seasons. 78

Figure 3-3. Pasture productivity in treed and open plots over six seasons.. 79

Figure 3-4. Pasture offtake in treed and open plots over five seasons.......................... 82

Figure 3-5. Soil moisture (%) for each month when data were recorded 84

Figure 3-6. Mean daily temperature in treed and open plots at sites M2 and VW......... 87

Figure 3-7. Mean maximum temperature in treed and open plots at sites M2 and VW 87

Figure 3-8. Mean daily minimum temperature in treed and open plots at sites M2 and VW. 88

Figure 3-9. Mean daily Penman evaporation in treed and open plots at sites M2 and VW 88

Figure 3-10. Mean daily wind run in treed and open plots at sites M2 and VW............ 89

Figure 3-11. Mean daily relative humidity in treed and open plots at sites M2 and VW 89

Figure 3-12. Transmission of photosynthetically active radiation (PAR) in treed plots at winter solstice and spring equinox. ... 93

Figure 3-13. Night time wind run and temperature in the open plot at VW ... 96

Figure 4-1. Standing pasture biomass at M2, VE and VW in September 1996. ... 103

Figure 4-2. Standing pasture biomass at M1, M2, VE and VW in December 1996. ... 103

Figure 4-3. Standing pasture biomass at M1, M2, VE and VW in February 1997 ... 104

Figure 4-4. Standing pasture biomass at M2, VE and VW in April 1997 ... 104

Figure 4-5. Total nitrogen content of bulk samples of pasture biomass ... 108

Figure 4-6. Total nitrogen content of samples of pasture species (*Themeda australis*, *Microlaena stipoides* and *Danthonia* spp.) ... 109

Figure 4-7. Acid pepsin digestibility of bulk samples of pasture biomass ... 110

Figure 4-8. Dry matter digestibility of samples of pasture species (*Themeda australis*, *Microlaena stipoides* and *Danthonia* spp.) ... 111

Figure 4-9. Standing biomass of *Themeda australis* and large tussocks (*Chionochloa pallida* and *Poa* spp.) ... 113

Figure 4-10. Standing biomass of *Themeda australis* and large tussocks (*Chionochloa pallida* and *Poa*. spp.) ... 113

Figure 4-11. Mean standing biomass for two pasture species and two groups of pasture plants for plots at three levels of tree basal area for sites M1 and M2 ... 114

Figure 4-12. Mean standing biomass for two pasture species and two groups of pasture plants for plots at three levels of tree basal area for sites VE and VW ... 114

Figure 4-13. Interaction plot for site and tree basal area class for *Themeda australis*, *Microlaena stipoides*, large tussocks and forbs ... 116

Figure 4-14. Mean standing biomass for two pasture species and two groups of pasture plants for plots at four sites and three levels of tree basal area.. ... 116

Figure 4-15. Relationship between soil pH and tree basal area at three seasons for combined sites 118

Figure 4-16. Percentage area of ground covered by tree litter plotted against tree basal area for sites M2 and VE. 120

Figure 4-17. Relationship between standing biomass of the permanent treed plot at M1 and the survey plots – summer 96/7 122

Figure 4-18. Relationship between standing biomass of the permanent treed plot at M2 and the survey plots – summer 96/7 122

Figure 4-19. Relationship between standing biomass of the permanent treed plot at VW and the survey plots – summer 96/7 123

Figure 4-20. Relationship between standing biomass of the permanent treed plot at VE and the survey plots – summer 96/7 123

Tables

Table 1-1. Differences in soil temperatures between open sites and treed sites 19

Table 1-2. Calculated values of leaf and ground temperatures (°C) for sites in the open and under acacia and eucalypt trees in the morning and afternoon. 19

Table 2-1. Topography, lithology and location of paddocks containing the permanent plots. 24

Table 2-2. Specifics of physical features and tree cover at the permanent plots........... 24

Table 2-3. Annual weather summary for open plots: M2 and VW in 1996.................. 49

Table 2-4. Comparison of results obtained by measurement of tree basal area of treed plots by direct measurement and the Bitterlich method 64

Table 2-5. Correlations of results of three determinations of DMD............................. 71

Table 2-6. Means and standard deviations of the differences between acid pepsin and *in vivo/in vitro* determinations of DMD.. 71

Table 3-1. Harvest dates and number of days elapsed since beginning of study with season that the harvest was assigned to.. 76

Table 3-2. Analysis of variance for pasture mass in treed and open plots measured at six times across the four sites... 78

Table 3-3. Hierarchical ANOVA for pasture productivity measured in treed and open plots over five periods across the four sites.. 79

Table 3-4. Productivity data from the four sites... 80

Table 3-5. Hierarchical ANOVA for pasture consumption rate measured in treed and open plots over five periods across the four sites... 82

Table 3-6. Seasonal offtake averaged across treatment and sites................................ 83

Table 3-7. Results of single factor repeated measures ANOVA on surface soil moisture (0 - 15 cm)... 83

Table 3-8. Results of single factor repeated measures ANOVA on sub-surface soil moisture (15 - 45 cm) 83

Table 3-9. Mean weather conditions in treed and open plots calculated from all daily means (temperature and humidity) or totals (evaporation and wind run) recorded during the study 86

Table 3-10. ANCOVA results of photosynthetically active radiation transmission....... 93

Table 3-11. Seasonal production and offtake 97

Table 4-1. Tree basal area classes used to classify survey plots. 101

Table 4-2. ANOVA results and means of standing biomass for site M2........ 105

Table 4-3. ANOVA results and means of standing biomass for VW in December 1996 105

Table 4-4. Means of foliar nitrogen and acid pepsin digestibility for the four sites..... 107

Table 4-5. MANOVA results of analysis of biomass of *T. australis*, *M. stipoides*, large tussocks and forbs for all four sites combined and open to medium tree basal area classes. 115

Table 4-6. Results of Tukey HSD test for *Themeda australis*, *Microlaena stipoides*, and large tussock biomass at three different tree basal area classes. 115

Table 4-7. Mean soil fertility indices for sites M2, VE and VW in September 1996. . 119

Table 4-8. Mean soil fertility indices for sites M1, M2, VE and VW in December 1996. 119

Table 4-9. Mean soil fertility indices for sites M2, VE and VW in April 1997.......... 119