final report

Project code: DAQ.090

Prepared by: Piet Filet and David Osten

QDPI, EMERALD

Date published: October 1996

ISBN: 9781741917437

PUBLISHED BY
Meat & Livestock Australia Limited
Locked Bag 991
NORTH SYDNEY NSW 2059

ECOLOGY OF A GRAZED WOODLAND KEILAMBETE GRAZING TRIAL TECHNICAL REPORT 1994-1996

Meat & Livestock Australia acknowledges the matching funds provided by the Australian Government to support the research and development detailed in this publication.

CONTENTS

Key Summary

1. **Background to project** 1

2. **Grazing trial design** 3

3. **Site profile**
   - 3.1 Location 5
   - 3.2 Land System 5
   - 3.3 Soil type 5
   - 3.4 Soil analysis 5
   - 3.5 Climate 6

4. **Weather conditions**
   - 4.1 Rainfall 7
   - 4.2 Other weather data 8
   - 4.3 Future issues 8

5. **Tree-shrub overstorey**
   - 5.1 Density 9
   - 5.2 Basal area 10
   - 5.3 Management 11
   - 5.4 Future issues 11

6. **Pasture growth and pasture yields**
   - 6.1 Pasture growth 12
   - 6.2 Pasture yields:exclosure 14
   - 6.3 Pasture yields: grazed paddocks 14
   - 6.4 Future issues 16

7. **Botanical composition**
   - 7.1 Species frequency 17
   - 7.2 Pasture composition by weight 20
   - 7.3 Pasture composition as a percent of total yield 21
   - 7.4 Future issues 22

8. **Pasture basal area**
   - 8.1 Trends 23
   - 8.2 Future issues 24

9. **Population dynamics of key species**
   - 9.1 Plant densities 25
   - 9.2 Plant size 27
   - 9.3 Future issues 28

10. **Soil seed reserves**
    - 10.1 Magnitude of soil seed reserves 30
    - 10.2 Future issues 31

11. Cattle Performance
11.1 Seasonal growth patterns 32
11.2 Cumulative yearly performance 33
11.3 Future issues 34

12. Run-off and soil loss
12.1 Preliminary trends 35
12.2 Pasture cover 36
12.3 Future issues 36

13. Concluding comments
13.1 Experimental approach 38
13.2 Treatment contrasts after 2 years of grazing 38
13.3 Key species behaviour 40
13.4 Management implications 40

14. Acknowledgments 42

15. References
15.1 Report references 43
15.2 Additional recommended reading 43

Appendices

KEY SUMMARY - KEILAMBETE GRAZING TRIAL

- the establishment of a grazing trial investigating the ecology of a grazed silver-leaved ironbark woodland provides biological information previously not available for the *Aristida/Bothriochloa* native pasture community

- the grazing trial has been designed to allow comparisons of replicated treatments across an undulating landscape with minimal land and soil type variation. Monitoring of key ecological processes allows comparisons to be made both at the component and system scale.

- after 2 years of grazing, pasture basal area and pasture cover were the two parameters most sensitive to increases in grazing pressure

- the botanical composition of all treatments differ little after 2 years and it is foreshadowed that major undesirable changes will require at least 4 to 10 years of continuous heavy grazing

- annual pasture growth is in the range of 1,700 to 2,000 kg DM/ha at this site. Increased pasture growth as a result of clearing was only 400 kg DM/ha in the 1994/95 season and in the 1995/96 season cleared treatments had similar pasture growth rates as uncleared treatments.

- at the site, long lived key perennial grasses are *Bothriochloa ewartiana* and *Chrysopogon fallax*, whilst *Heteropogon contortus* is a short lived perennial grass. *H. contortus* can build up large soil seed reserves, which resulted in a recruitment of 12 plants/m^2 in 1995.

- the woodland has an average basal area of 7.7m^2/ha and a high density of 1,400 plants/ha of suppressed small trees (less than 1.5m high)

- average annual cattle growth was 155 and 140 kg/head in 1994/95 and 1995/96 respectively for droughtmaster weaner steers (starting weights of 200 kg)

- run-off and soil loss were greatest under the high grazing pressure treatment, which has the lowest pasture cover levels of all the grazing pressure treatments

1. BACKGROUND TO PROJECT

The grazing industries in Queensland have a strong reliance on native pastures spread throughout the State. Management practices which maintain and enhance the long-term productivity of this grazing resource have and will continue to be a critical issue for industry and sustainable resource management. Studies into the ecology and production potential of grazed native pasture communities have provided a sound base for the development and augmentation of practical grazing management strategies. Native pasture communities that have had significant periods of technical investigation in Queensland, include the black spear grasslands and the pastures of the Mulga and the Mitchell grasslands.

In 1990, a major community deficient in technical studies was the *Aristida/Bothriochloa* pasture community, which is associated with semi-arid eucalypt woodlands. The full extent of this community is from the Gulf of Carpentaria to the New South Wales border in a band between the coastal black speargrass lands to the east and the Mitchell grasslands to the west. Large tracts of brigalow are intermixed throughout the *Aristida/Bothriochloa* community and this has important ramifications in terms of type of grazing enterprise. In the Central Highlands and Maranoa, roughly located between 22° S and 27° S, this community (Figure 1) occupies some 10.7 million hectares. An obvious component of the community is a eucalypt overstorey, and given a moderate density of trees the community is defined as a woodland.

A fundamental understanding of the ecology and production potential of the *Aristida/Bothriochloa* community is lacking. Past assessments of the community have estimated the total area of the community as 20-60% good, 30-60 fair and 10-30% in terms of pasture condition (Weston *et al.* 1981) and recently the assessment was 20% in class A, 50% in class B and 30% in class C (Tothill and Gillies 1992). Both assessments identify scope for condition improvement. Not only must management practices improve the condition of the community, but all land managers need to be aware of the early warning signs that indicate that undesirable change is about to occur.

A grazing study has been initiated to better understand the *Aristida/Bothriochloa* community. A key issue is to provide an objective base for selecting grazing management practices that can improve and maintain the condition of grazed *Aristida/Bothriochloa* pastures.

A preliminary proposal for this work was submitted to the MRC (then AMLRDC) in 1990, under the project title ENHANCE: Extensive native pasture husbandry to advance northern cattle enterprises (Pressland 1990). However it was not until 1992 that the current project, "Enhancing pasture stability and profitability for producers in *Aristida/Bothriochloa* woodlands" - DAQ.090, was supported. Site selection was undertaken during 1993 and in October 1993 agreement was reached on establishing a grazing trial at "Keilambete", Rubyvale. The site was constructed from January 1994 to April 1994 and cattle were first introduced to the site in November 1994.

This project, often referred to as the AB project, involves staff based at Emerald, Roma and Toowoomba. The wide distribution of this community has necessitated a similar grazing trial study in the Maranoa and a site is established at "Glentulloch", Injune. The experimental design of both trials is identical. General comparisons in the behaviour of the community are feasible when considering the results from both sites, but their distance apart and differing land types precludes any formal statistical comparisons between either site.

In this report results are presented from the first two years of experimentation. Issues for future analysis and site management are also discussed.

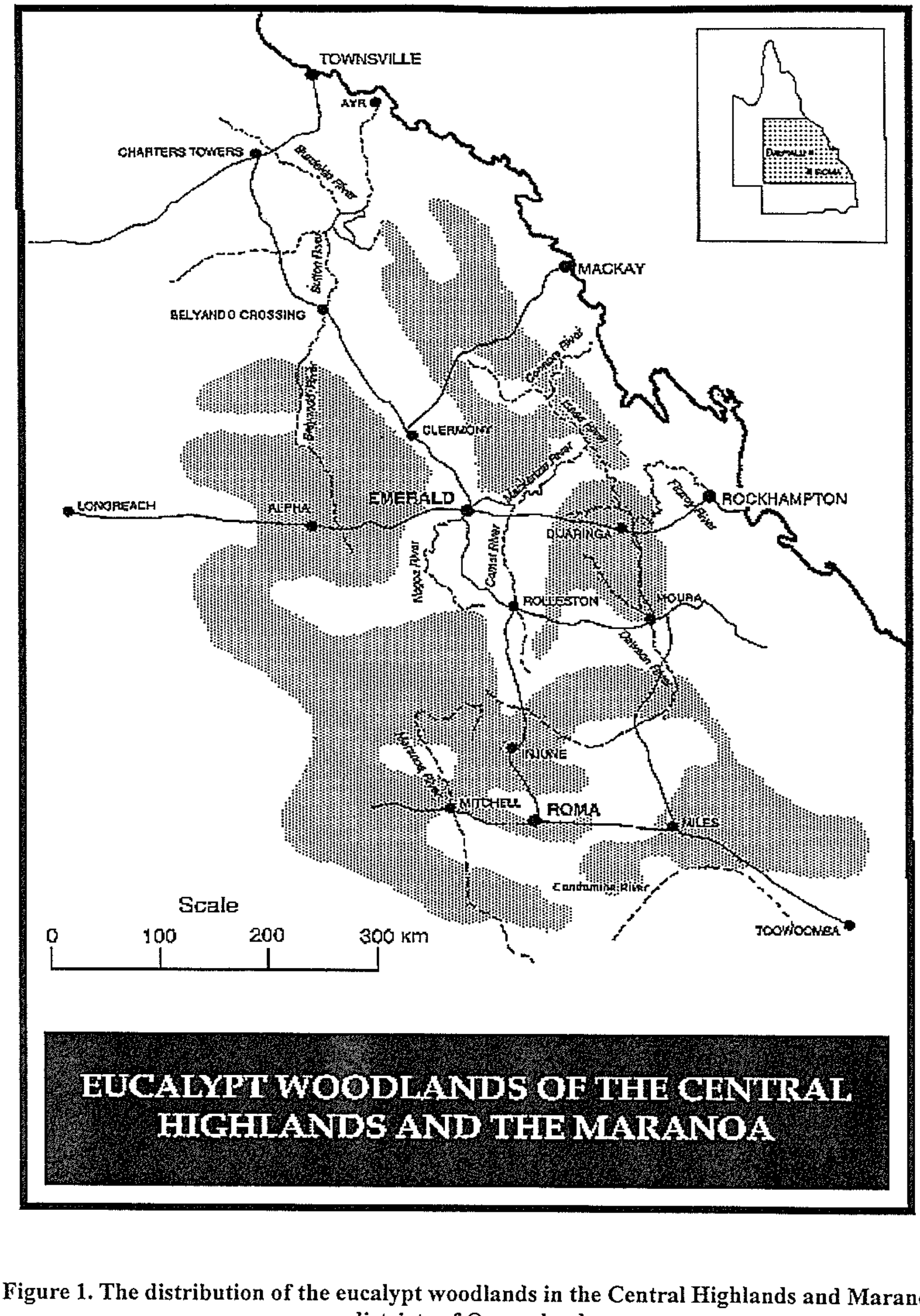


Figure 1. The distribution of the eucalypt woodlands in the Central Highlands and Maranoa districts of Queensland.

2. GRAZING TRIAL DESIGN

At the Keilambete site various grazing management options are compared. Differences and similarities between the options is what will provide a measure of the sensitivity of the various ecological processes that occur in a grazed woodland. Monitoring, based on a systems framework, measures the following key processes:

- pasture growth
- animal production
- pasture population dynamics
- tree overstorey and shrub understorey population dynamics
- run-off and soil loss

Grazing management of large paddock areas (500 to 10,000 hectares) is reliant on simple operational practices. In this study the options contrasted are:

- grazing pressure
- timber development
- fire

The above set of management options are examined in two separate studies:

1. The main investigation examines the impact of timber development at 3 grazing pressures (GP), namely
- low - "*L*" - aim is for stock to utilise 25% of annual pasture growth
- medium - "*M*" - aim is for stock to utilise 50% of annual pasture growth
- high - "*H*" - aim is for stock to utilise 75% of annual pasture growth

Each treatment is grazed in both a cleared - "*Cleared*" (Velpar stem injection - March 1994) and wooded - "*Trees*"- situation, giving a treatment set of six. Each treatment is replicated twice, resulting in a set of twelve grazed paddocks. Three weaner steers continuously graze each paddock, which differ in size to provide the comparative grazing pressures (Table 1).

Table 1 Treatment paddock sizes (ha).

Grazing Management Treatment	Treatment Code	Paddock size (ha)
Cleared - Low grazing pressure	CL	11
Cleared - Medium grazing pressure	CM	5.5
Cleared - High grazing pressure	CH	3.5
Trees - Low grazing pressure	TL	21.5
Trees - Medium grazing pressure	TM	11
Trees - High grazing pressure	TH	7

2. The second investigation examines the effects of fire on cleared and wooded pastures. These treatments are not grazed, as logistically the additional area and effort required to monitor such a treatment set was not feasible. An annual burn is planned for late spring or early summer each year, if an adequate fuel load is present. For each *Cleared* and *Trees* treatment burnt - "*burn*" there is a corresponding treatment set unburnt - "*non burn*", giving a treatment set of four. Each treatment is replicated three times, resulting in a set of twelve (1 hectare) exclosures.

The location of treatment paddocks at the site is detailed in Figure 2. The area labelled Stock paddock is a 50ha uncleared paddock grazed at a medium grazing pressure with 15 weaner steers. This paddock also allows demonstration of various commercial options, e.g. benefits of spear traps, how to operate a monitoring site (Grasscheck method).

The methods and techniques required to monitor and measure site attributes are described in the Methodology Manual (Filet 1995). Plant species names that are abbreviated are detailed in full in Appendix 1.

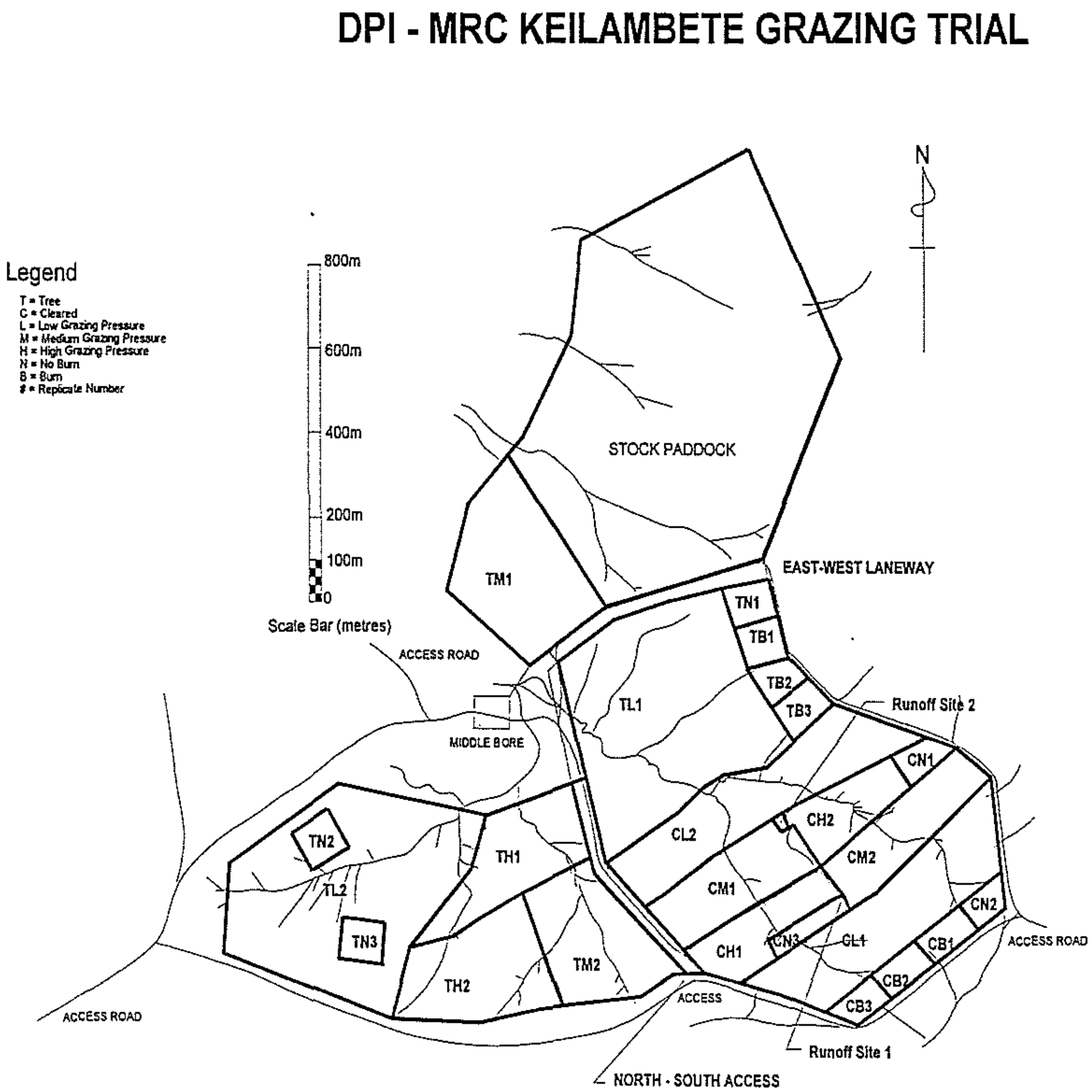


Figure 2 Keilambete grazing trial site design

3. SITE PROFILE

3.1 Location: Ervine Paddock, "Keilambete", Rubyvale.
latitude 23°23' longitude 147°35' east

3.2 Land System: *Peak Vale* - undulating country with silver-leaved ironbark (*Eucalyptus melanophloia*) and texture contrast soils on granite exposed below the Tertiary weathered zone (Nogoa-Belyando, CSIRO Land Research Series 18, 1967). This land systems covers 185,000 hectares between Rubyvale and Clermont.

3.3 Soil type: Duplex Non calcic brown (Great Soil Group classification)
Red duplex - Dr2.12 (Northcote classification)
Chromosol/ Red/ Eutrophic/ Haplic (Isbell classification)

Soil type variation across the site is minimal. Some differences are found in the immediate vicinity of watercourses and on ridge tops. A soil survey at the site details the range of soil profiles (Appendix 2).

3.4 Soil analysis

Soil analysis was undertaken on samples taken at Runoff sites 1 and 2, in the cleared area. Details of the results are presented in Table 2.

Table 2 Soil analysis results.

	Depth cm	pH	EC[1]	Cl[2]	NO_3 N[2]	P[2]	Ca[3]	Mg[3]	Na[3]	K[3]	CEC[3]	15 Bar[4]	OC[4]
Site 1	0-10	7.6	.10	20	11	7	11	3.5	.25	.51	19	10	1.60
	10-30	8.4	.18	27	1	3						11	.51
	30-60	9.1	.37	173	1		11	6.2	4.10	.07	18	13	
Site 2	0-10	7.4	.06	14	10	8	6.8	2.0	.09	.40	11	6	1.10
	10-30	6.7	.04	16	2	4						15	.57
	30-60	6.9	.04	17	2		14	4.5	.27	.21	18	14	
	60-90	7.0	.03	11								11	

units: 1 = mS/cm, 2 = mg/kg, 3 = meq/100g, 4 = %

Results of interest are :

- soil P levels are too low to support any successful sown pasture development. Buffel grass has been distributed in parts of Ervine paddock, but it has failed to successfully establish.
- a neutral pH through most of the profile
- site 1 recorded a spike of chlorine at the 30-60cm layer, which has affected EC and pH values at this layer. The level of 173 mg/kg is low and there should be no limitation to plant growth.
- a typical concentration of key nutrients in the surface 0-10cm layer, as reflected in higher NO_3-N, organic carbon and phosphorus levels in the 0-10cm layer than in lower soil layers

3.5 Climate

The area has a sub-tropical climate. The rainfall is highly variable, and the occasional occurrence of particularly wet years makes the mean annual rainfall higher than the most commonly occurring annual rainfall (Table 3). High temperatures, 40°C or greater, are common during early summer, but are much less frequent once cloudiness and rainfall occur during summer. Diurnal temperature ranges are high, particularly in winter and spring, on account of the continental climatic conditions.

Annual mean rainfall[1]: 657mm **Annual median rainfall[1]:** 635mm

1 - rainfall year calculated on a September to August time interval

Table 3. Monthly average climate.

Month	Rainfall[a] (mm)	Pan Evaporation[b] (mm/day)	Mean Maximum Temperature[b] (°C)	Mean Minium Temperature[b] (°C)
January	112	8.4	33.7	21.4
February	113	7.0	32.8	21.2
March	70	6.2	31.7	19.6
April	36	5.5	29.6	16.2
May	36	4.3	25.7	12.1
June	34	3.7	22.9	8.7
July	28	4.1	22.4	7.1
August	22	4.9	24.7	8.9
September	21	6.5	28.1	12.1
October	41	8.3	31.7	16.4
November	57	9.6	33.8	19.4
December	91	9.6	34.3	20.7

[a] = data from Anakie Railway Station (20km southeast of the site)
[b] = data from Emerald Post Office

4. WEATHER CONDITIONS

4.1 Rainfall

The period of potential pasture growth in any one year follows a pattern of early growth in September to November, followed by significant growth over the summer and autumn period, with a subsequent decline and poor response during the winter months. On this basis, the annual rainfall totals are calculated on a September to August time period. This period also coincides with the time period that each draft of cattle graze the trial.

Rainfall totals (mm) at Keilambete homestead (10 km to south of site) in sequential years was::

1992/93	*1993/94*	*1994/95*	*1995/96*
351	416	438	350

All totals are lower than mean and medium values recorded at Anakie Railway Station (Section 3.5) and is a reflection of the recent run of dry years. During the establishment period of the trial in early 1994, rainfall conditions improved compared to the previous year when urea molasses feeding had occurred in Ervine paddock. Continued rains in 1994/95 provided good growth conditions for perennial grass species, particularly blackspear grass (Section 7). In contrast, lower rainfall was received in 1995/96 and this highlights the typical annual rainfall variation that can occur between years at this location.

Intra annual variation is also typical for this site (Figure 3). The monthly patterns of rainfall amounts have been different for each growing season at this site, with the only consistent feature being at least one major summer/autumn rainfall event (eg March 1994, January and February 1995, January and April 1996).

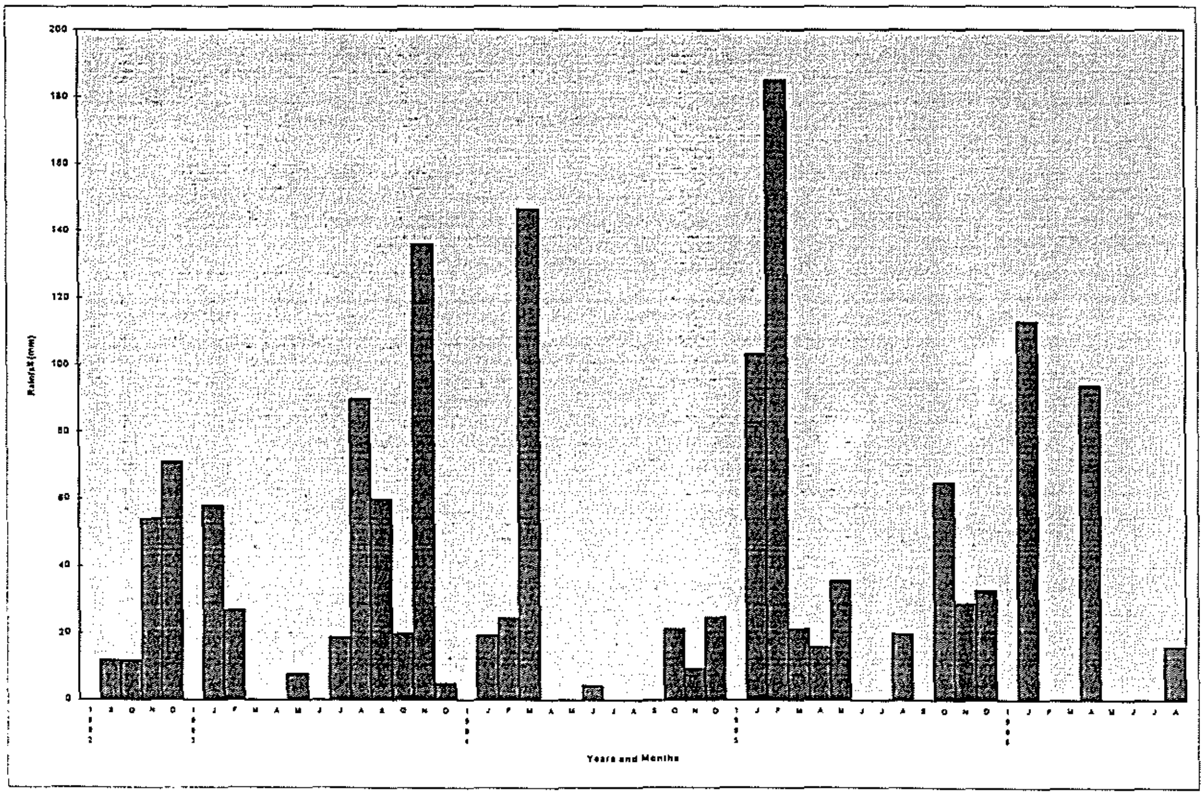


Figure 3 Monthly rainfall at Keilambete from September 1992 to August 1996.

4.2 Other weather data

A weather station is located at the site and logs daily measurements. Data that is collected describes temperature, rainfall, humidity, evaporation, wind run and radiation. Appendix 3 lists data collected to date.

4.3 Future issues

- weather station data needs to be down loaded regularly each month and the data processed to provide monthly summaries
- liaison with a modeller is required to clarify which core climatic data needs to be collected and where deficient, adjustments are made
- install an additional weather station in a fully timbered location, to provide contrast with weather data from a cleared location. This option would help clarify the grazier advisory group's perspective that climatic conditions are milder in uncleared areas than in cleared areas.

5. TREE-SHRUB COMPONENT

The following results are based on the mean values of measurements made in the six Tree paddocks. These measurements were undertaken within 12 months of the start of the trial and it is assumed that no grazing pressure effects had impacted on tree or shrub attributes during this period.

5.1 Density

The average tree density of 2,200 plants/ha was dominated by silver-leaved ironbark (73% of total). Other significant species were *Archidendropsis basaltica* - dead finish (11% of total), *Bursaria incana* - prickly pine (7% of total) and *E. erythrophloia* gum-topped bloodwood (5% of total). Density of the tree height classes <0.5m and 0.5 to 1.5m was 1416 plants/ha and 347 plants/ha respectively, which together was 81% of the total tree population. Figure 4 highlights the dominance by silver-leaved ironbark and the density dominance by small height classes. This high proportion of small trees, particularly those less than 0.5m, is not obvious when observing these woodlands as it is the taller trees that are most obvious. Density details on species by height class intervals are listed in Appendix 4.

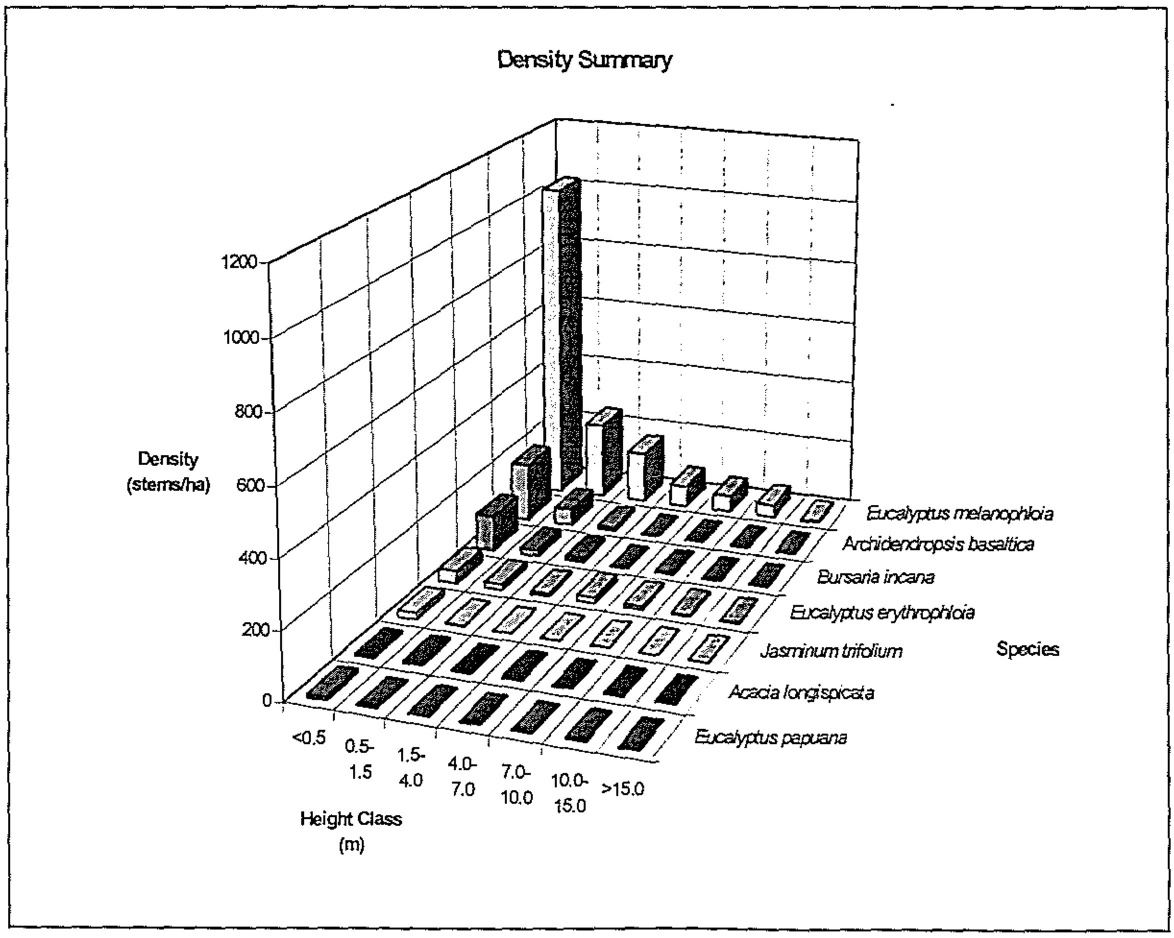


Figure 4 Mean tree and shrub densities (plants/ha) of the major species in all woodland paddocks.

5.2 Basal area

The average tree basal area of the woodland totaled 7.7 m^2/ha. Silver-leaved ironbark was the dominant component of basal area (85% of total) and gum-topped bloodwood (11% of total) was the other significant component. In contrast to tree density, dead finish (0.4% of total) and prickly pine (1.8% of total) were only minor components of the total basal area. Tree height classes of 4 to 7m and > 7m made up 85% of the total basal area, whilst the <0.5 and 0.5 to 1.5m classes were only 6% of the total basal area. Figure 5 highlights the dominance by silver-leaved ironbark and the basal area dominance by tree height classes greater than 4m. Density details on species by height class intervals are listed in Appendix 5.

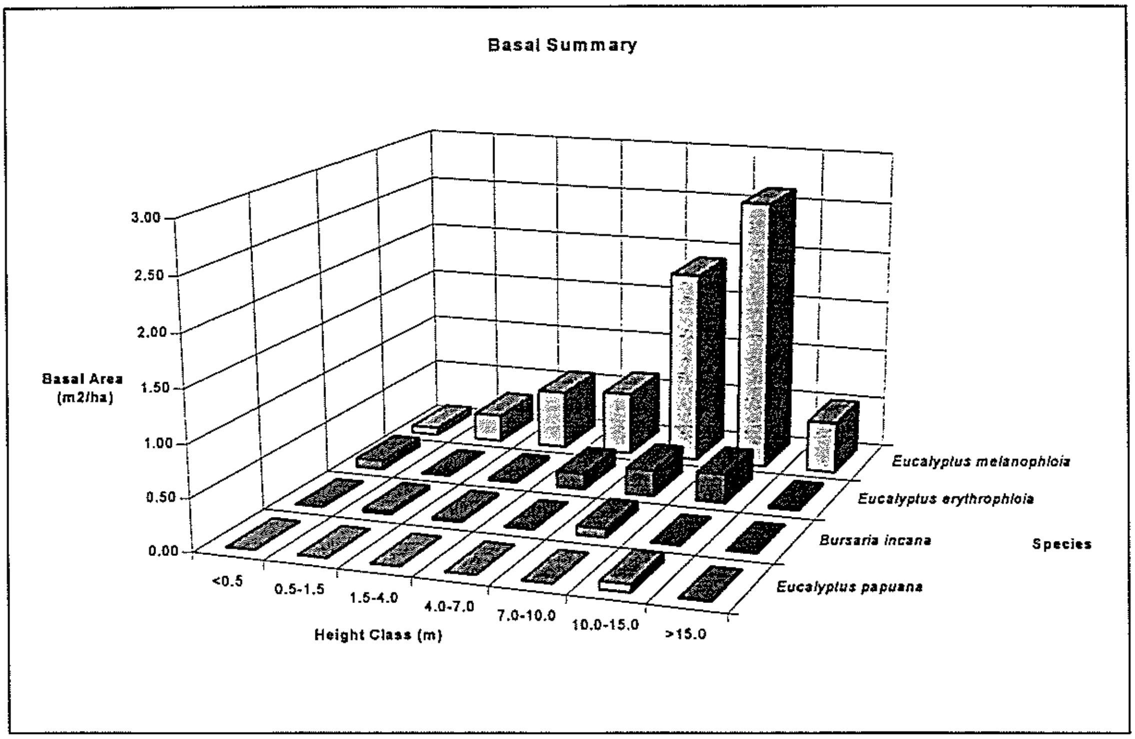


Figure 5 Mean tree and shrub basal areas (m^2/ha) of the major species in all woodland paddocks.

Tree basal area estimates were also determined by Bitterlich stick sampling on a grid pattern across each paddock. The average basal area using this method was 6.6 m^2. Contrasts with the fixed line TRAPS sampling for each paddock were similar for most paddocks (Table 4).

Table 4 Tree basal area (m^2/ha) in each paddock determined by 2 sampling methods, 1995.

Paddock	Whole Paddock - Bitterlich Stick Estimates	TRAPS Transect Lines - measured circumferences
TL1	8	7.3
TL2	4.9	4.4
TM1	7.3	6.5
TM2	7.7	11.5
TH1	6.6	9.6
TH2	5.4	6.8
Average	6.7	7.7

5.3 Management

Implications for management from these results is that the current suppression of pasture growth by trees is limited to a small population of trees greater than 4 metres in height (Figure 6). However, if a large proportion of the current <0.5m class height group were allowed to grow through to trees greater than 4 metres, suppression of pasture growth would increase dramatically. Management practices that will prevent this occurrence are:

- strategic use of fire following above average rainfall seasons;
- grazing pressure limited to low to moderate pasture utilisation rates so that fuel for a fire can accumulate.

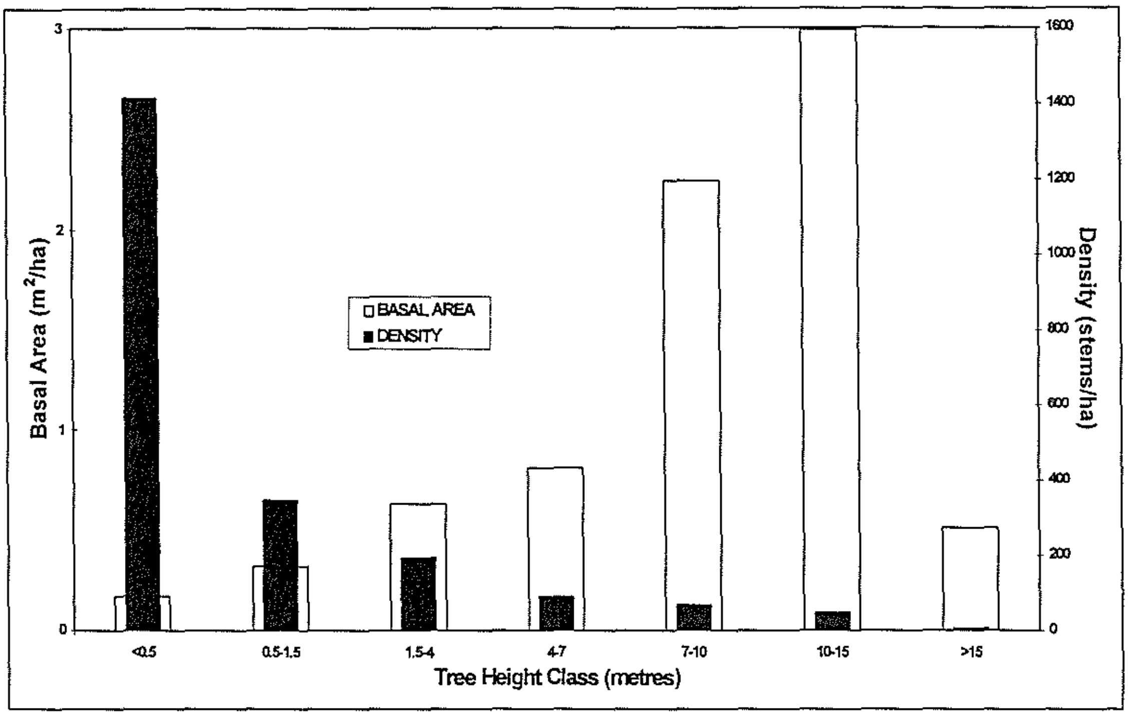


Figure 6 A relative comparison of the magnitude of basal area (m^2/ha) and density (plants/ha) for each height class of all woodland species.

5.4 Future issues

- data recorded in the cleared grazed paddocks and in the exclosures requires processing
- the sequence of future TRAPS sampling of the grazed paddocks is winter 1997 and winter 2000. This will provide a total of 3 samplings prior to the end of the NAP3 period.
- sampling in the exclosure paddocks need only occur in the winter subsequent to any burn event
- in the analysis of the data there is the potential to have a demographic approach where individual plants are followed over time, using the same approach as in the pasture species demographics. This will ensure that new recruits and mortalities are clearly identified. The current approach only compares tree height class groups and as a result individual comparisons of species does not occur.

6. PASTURE GROWTH AND PASTURE YIELDS

6.1 Pasture growth

A measure of pasture growth is required in the absence of grazing to describe total biomass productivity. The association of the project with colleagues with interest in the GRASP model lead to the adoption of the Swiftsynd technique as the means to measure pasture growth. Data collected in this format can be used in calibrating the GRASP model for this location.

Enclosed sites were established in 1994 in areas with and without trees. Despite differences in the amount and distribution of rainfall in the first 2 seasons, similar total pasture growth yields were recorded (Table 5). The absence of any increase pasture yield due to tree removal is very surprising. In 1994/95, the cleared site had a basal area of 2.6%, whilst the trees site had a basal area of 3.1%. On closer examination the cleared site also showed some minor signs of scalding and was abandoned after the 1994/95 season. In the 1995/96 season again no difference was observed in the yield estimates. Basal area comparisons were 3.2% in the cleared site and 2.5% in the trees site. Comparison with other exclosure yields and grazed paddock yields is necessary to clarify these results (Section 6.2)

Table 5 Total pasture growth (kg DM/ha/year) in Swiftsynd exclosures.

Year	Cleared	Trees
1994/95	1680	2000
1995/96	1890	1850

Changes in phenology and growth rates of key species were also measured by this technique. Table 6 compares these attributes at the maximum yields in each of the two years. *Bothriochloa ewartiana* and *Heteropogon contortus* were the major components of total growth, whilst *Chrysopogon fallax* recorded lower growth rates. This contrast was also observed in the pasture yields in paddock surveys (Section 7.2). Contrasts in phenology portrays *B. ewartiana* with a greater stem proportion than *H. contortus*, which tends to be a much leafier plant. Different to both is *C. fallax*, which has little stem at all and is a leafy base growing plant in this environment. In the monsoon areas of north Australia, *C. fallax* has a lot more stem and is frequently avoided by stock, but in this environment cattle actively seek *C. fallax*. Further details on growth and phenology at all harvest dates are presented in Appendix 6.

Soil moisture is an important determinant of pasture growth. As modelling inputs, the relationships between rainfall, soil moisture and pasture growth derived from these Swiftsynd sites are a critical requirement for any extrapolation or simulation exercises proposed for this project. At this site, soil moisture levels are typified by fluctuations in the surface layer (0-10cm) and generally stable lower levels (Figure 7). Given that the majority of pasture plant roots are in the 0-10cm layer management practices need to optimise the amount of moisture that is retained in this layer. A contrast that appears to be associated with treatment differences is the higher soil moisture levels at depth in the cleared areas (Figure 7). Confirmation of this observation requires some further soil moisture sampling across a larger area of cleared and wooded areas. Soil moisture data for each 10cm layer at each harvest is presented in Appendix 7.

Table 6 Species yields (kg DM/ha) and plant proportions (%) at maximum yields, in Swiftsynd exclosures.

	1994/95		1995/96	
Pasture yield	Cleared	Trees	Cleared	Trees
Bot ewa	652	565	789	433
Het con	449	779	501	799
Chr fal	73	354	207	205
Other grasses	359	252	340	346
Forbs	147	52	52	68
Plant parts (%)				
Bot ewa				
Green leaf	25	15	26	11
Dead leaf	36	35	32	10
Green stem	32	31	27	19
Dead stem	6	19	3	1
Seed head	1	0	3	2
Het con				
Green leaf	50	53	20	25
Dead leaf	15	26	59	29
Green stem	32	16	11	13
Dead stem	1	trace	4	0
Seed head	3	5	12	11
Chr fal				
Green leaf		43	48	38
Dead leaf		48	53	20
Green stem		2	5	5
Dead stem		4	0	7
Seed head		3	0	3

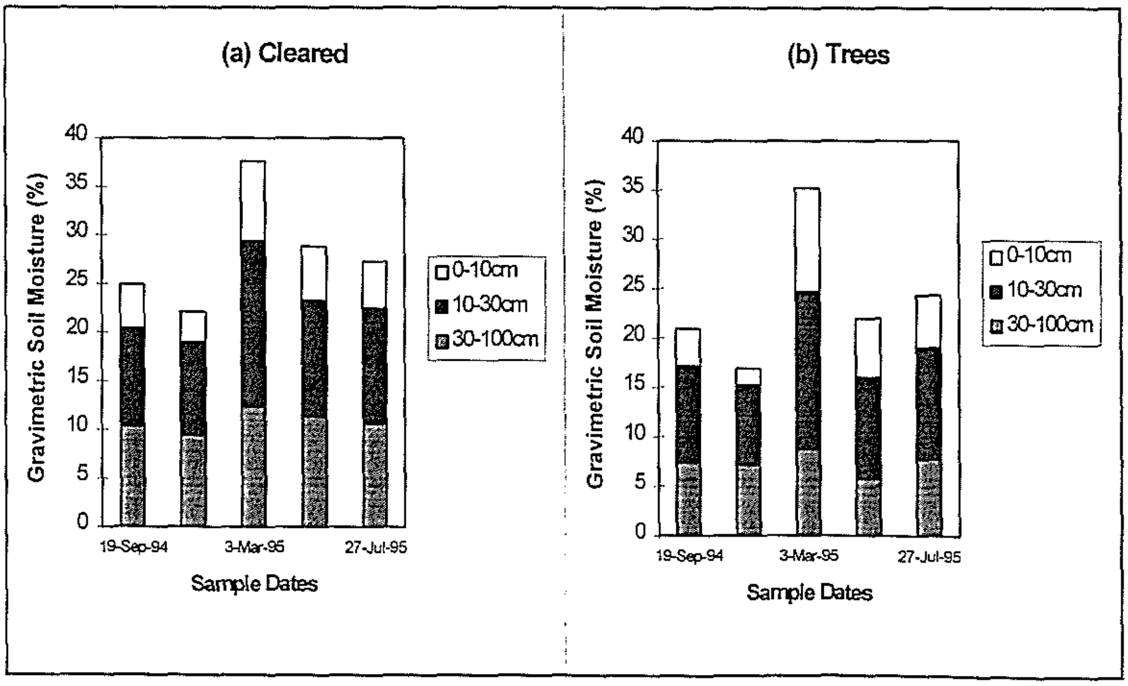


Figure 7 Gravimetric soil moisture (%) in (a) Cleared and (b) Trees Swiftysnd exclosures during the 1994/95 growing season.

6.2 Pasture yields: exclosures

An indication of pasture growth at this site can also be derived by examining pasture yields in the burn/non burn exclosures and in the grazed paddocks. The benefit of this alternative approach is that both data sets are derived from areas considerably larger than the Swiftsynd sites. The following pasture yields were derived during the paddock surveys (Botanal) in April 1995 and 1996. These dates coincide with peak yields. Yield estimates in this survey technique also include carry over dead material from the previous growing season. Nevertheless, the comparison between treatments is a valid approach to contrast yield accumulation.

Exclosure yields in 1995 recorded a 400 kg DM/ha benefit (LSD .05% 185) as a result of clearing in that year, on comparison of the mean of all cleared exclosure with all tree exclosures (Table 7). This difference does highlight that a clearing benefit occurred. However the order of magnitude of the benefit is not as great as what was expect. Assumptions made by the project team was that the benefit would be in the order of 1,000 kg DM/ha in an average rainfall year and this has not been the case in 1994/95.

Table 7 Exclosure yields (kg DM/ha), April 1995 and 1996.

	1995		1996	
Treatment	**Mean**	**se**	**Mean**	**se**
Cleared non burn	2303	210	3275	243
Cleared burn	1950	40	1914	433
Trees non burn	1950	287	3417	535
Trees burn	1440	91	2060	131

Exclosure yields in 1996 showed no benefits of clearing (Table 7). The burn exclosures in both Cleared and Trees were burnt, with a low intensity patchy fire in October 1995, hence the lower yields compared to the unburnt exclosures. Yields in the burnt exclosures in 1996 were similar to the amount of growth measured in the Swiftsynd exclosures in 1996 (Table 5), which deflates some concerns that the sampling area in the Swiftsynd sites is too small.

6.3 Pasture yields: grazed paddocks

The pasture yields in the grazed paddocks are a measure of the amount of growth and the amount of carry over standing dead material, less the amount of pasture grazed by stock. Intake by an average beast in this trial is crudely estimated as 2,740 kg DM/head/year (determined as an intake of 10 kg/animal equivalent/day x 0.75 animal equivalent x 365 days). On this basis the estimated pasture losses in each treatment due to animal intake are presented in Table 8. These estimates are very much "ball park estimates" as changes in intake occur due to changes in seasonal conditions and animal growth rates. But as a means to consider contrasts between pasture yields they are a useful estimate.

Table 8 Estimated animal intake (kg DM/ha/year) per treatment, based on treatment stocking rates (1994/95 and 1995/96 seasons).

Treatment	Stocking rate (ha/head)	Calculated Annual Intake (kg DM/ha/year)
Cleared Low GP[a]	3.6	760
Cleared Medium GP	1.8	1520
Cleared High GP	1.2	2280
Trees Low GP	7.2	380
Trees Medium GP	3.6	760
Trees High GP	2.4	1140

[a] GP = grazing pressure

The pasture yields in most grazing pressure comparisons were similar in 1995 (Table 9): discussion on the Cleared High treatment follows shortly. Given that the intake requirement was higher in all the Cleared treatments than in the Trees treatments (Table 8) the similarity in pasture yields may be best accounted due to higher pasture growth rates in the Cleared than in the Trees treatments. The estimated benefit from clearing ranges between 300 kg DM/ha (low GP) and 700 kg DM/ha (medium GP). The measured increase from the exclosure results in 1995 was 400 kg DM/ha (Section 6.2), which compares favourably with this range.

Table 9 Treatment pasture yields (kg DM/ha) in April 1995 and 1996.

Treatment	**April 1995**	**April 1996**
Cleared Low GP[a]	1625	1585
Cleared Medium GP	1315	530
Cleared High GP	785	235
Trees Low GP	1550	1925
Trees Medium GP	1355	1285
Trees High GP	1015	170

[a] GP = grazing pressure

In 1996 the Trees Low and Medium GP treatment pasture yields were greater than their corresponding cleared treatments by 340 and 755 kg DM/ha respectively. These differences are very similar to the contrasts in estimated intake between the corresponding treatments (Table 8) and can account for the difference in pasture yields when corresponding low and medium GP treatments are compared. This suggests that there was no response in pasture growth due to clearing in 1996 . This similar result was observed both at the Swiftsynd sites (Table 5) and in the burn/non burn exclosures (Table 7).

The anomaly with the pasture yields of the Cleared High GP being lower than the Trees High GP in 1995 (Table 9) was attributed to the CH2 paddock having a significant large scald area, which increased the grazing pressure in that paddock and reduced pasture yield. This contrast was also observed in lower live weight gains in this paddock than in the CH1 paddock in 1994/95. Subsequently stock numbers grazing this paddock were reduced to two beasts per paddock. In the 1995/96 growing season live weight gain/head of stock in CH1 and CH2 were similar and supports the decision to adjust stock numbers in CH2. In the above discussion comparison between Cleared and Trees High GP treatments is not possible as destocking of treatments occurred during the 1995/96 season.

6.4 Future issues

- there is an immediate need for an assessment that all requirements for the GRASP model are being collected at the site. It is also necessary that calibration of the GRASP model is undertaken on data collected to date, to ensure availability of this modelling tool for future simulations.
- during the 1996/97 growing season soil moisture sampling continue at the two previous Swiftsynd sites
- during the 1996/97 growing season yield estimates are undertaken of all grazed paddocks every 10 to 12 weeks. This is needed to help in determining any need for stock number adjustments. This activity could also provide a defacto set of growth data, if it is adjusted for animal pasture intake prior to each sampling. This yield estimation can be by either Botanal yield estimation or by height measurement, as per the XXXX stubby carton rising plate height method .
- in future years if the botanical composition alters significantly, new relationships between soil moisture and pasture growth need to be derived - ie new Swiftsynd sites
- given the declining basal area that is occurring in some treatments (Section 8.1) it can be expected that the pasture growth potential in those treatments will also decline. Adjustment and consideration to this need needs to be made both in stocking capacity and the description of pasture growth.
- the magnitude of pasture growth increase due to clearing needs to be evaluated in terms of animal production benefits, which in turn are costed against the cost of clearing. The economic feasibility of timber development is a critical question that the results from this trial can address.

7. BOTANICAL COMPOSITION

7.1 Species frequency

The number of pasture species recorded at the site to date totals 83 grasses, 58 forbs and 20 native legumes. One option is to undertake an analysis based on single species, but in an attempt to provide some simplification and ease of interpretation 22 key groups have been formed from all species. The main interest in this report is on the behaviour of grass species and to further aid interpretation the key groups are allocated to one of 6 grass groups. Field data collection was based on plant identification to species or genus level, but analysis, using the Botanal package, is based on the frequency of the 22 key groups. The "renumber" routine in botanal allows the individual species number codes to be reallocated and grouped to the various key groups.

At the outset of the grazing trial, May 1994, the frequency of the key groups in each of the treatments at the Keilambete site was similar (Table 10). The only significant differences ($P<.05$) were *T. triandra* being higher in the Cleared treatments than in the Trees treatments (21% vs 14% respectively) and for *Digitaria* spp. and *Paspalidium* spp being lower in the Cleared treatments than in the Trees treatments (both 2% vs 4%).

The major change during the first year of grazing was an increase in *H. contortus* (frequency change of 15% - Table 11) and is associated with the good summer rains in 1995. A net increase in the numbers of *H. contortus* plants by 12 plants/m^2, as measured in the plant population studies (Section 9), was associated with this change. The majority of the remaining perennial grasses have not altered during the first 3 years, although *T. triandra* and *Panicum* spp recorded a decline from 1995 to 1996. The frequency of forbs and native legume groups have declined markedly during the first 3 years and is mainly due to sampling times not corresponding to their peak frequencies in any one year.

Contrasts between treatments in frequency change have been rare. Only a small number of meaningful trends occurred between 1995 and 1996 (Table 12). When differing grazing pressure is compared, *T. triandra* declined more in the medium and heavy GP treatments than in the low GP and *Aristida* spp increased significantly in the low GP treatments in comparison to the medium and high GP treatments. A significant contrast between Cleared and Trees treatments was a greater decline in the Cleared treatments for *T. triandra, Dichanthium serecium* and *Panicum* spp., whilst *Aristida* spp. and *Chloris* spp. recorded increases in the Cleared treatments.

Complete details on key group frequencies for all treatments in 1994, 1995 and 1996 and for the changes between each year are listed in Appendix 8.

The Trees treatment set and Cleared treatment set represent State 1 and State 2 respectively of the *Aristida/Bothriochloa* community State and Transition model (Hall *et al* 1994). After the initial years of grazing both states have maintained similar botanical compositions, irrespective of contrasting grazing pressures. Derivation of the less desirable States 3 and 4 require considerable more time to derive, but in the interim (next 3 to 4 years), achievement of less productive forms of State 1 and 2 are possible under the high grazing pressure treatments.

Table 10 Key group frequency (%), April 1994.

Plant Category	Plant Group	Cleared Low	Cleared Medium	Cleared High	Trees Low	Trees Medium	Trees High
Major Perennial Grasses	*Bot ewa*	35.3	35.2	33.7	29.3	39.0	31.8
	Chr fal	36.7	44.8	38.4	46.0	42.2	39.0
	Het con	26.1	27.3	20.1	22.8	23.1	25.6
	The tri	20.4	20.9	22.5	12.3	17.1	11.9
Minor Perennial Grasses	*Dic ser*	3.8	5.9	3.1	4.4	7.0	7.3
	Dig spp	2.1	0.8	2.9	5.1	3.1	2.9
	Eul aur	14.9	14.1	14.0	13.6	11.8	13.7
	Pan spp	18.0	20.1	27.3	18.5	20.7	21.4
Undesirable Perennial Grasses	*Ari spp*	22.3	25.8	15.0	18.9	14.4	16.9
Mixed types grass group	*Chl spp*	1.8	1.9	2.0	3.0	5.1	1.6
	Enn spp	15.7	19.4	21.8	13.7	14.3	17.0
	Era spp	7.5	10.6	11.1	10.1	6.4	8.9
	Eri spp	1.7	1.5	1.0	1.3	2.3	3.6
	Other grasses	1.3	0.8	2.0	2.3	0.8	1.3
	Pas spp	2.9	1.4	1.4	5.0	3.6	4.3
	Spo spp	0.7	0.8	1.6	0.6	2.3	1.1
Low height grasses	*Dac rad*	0.7	0.4	0.5	1.5	0.2	0.7
	Tra aus	0.9	0.0	0.5	1.3	0.5	0.8
	Tri lol	14.8	9.4	14.5	13.5	11.2	9.7
Non grasses	*Forbs*	75.6	73.4	75.8	73.3	73.6	66.4
	Nat legume	64.6	62.1	60.2	56.6	75.8	54.4
	Sedges	27.0	16.6	14.6	35.0	32.7	24.2
Cover	*Bare*	1.8	0.8	2.7	1.2	1.0	3.5

Table 11 Key group frequency (%), averaged for all treatments in April 1994, 1995 and 1996.

Plant Category	Plant Group	1994	1995	1996
Major Perennial Grasses	*Bot ewa*	34	40	44
	Chr fal	41	42	39
	Het con	24	39	36
	The tri	17	16	9
Minor Perennial Grasses	*Dic ser*	5	4	2
	Dig spp	3	4	1
	Eul aur	14	11	11
	Pan spp	21	15	8
Undesirable Perennial Grasses	*Ari spp*	19	17	18
Mixed types grass group	*Chl spp*	3	2	5
	Enn spp	17	20	23
	Era spp	9	5	3
	Eri spp	2	2	2
	Other grasses	1	2	1
	Pas spp	3	3	4
	Spo spp	1	4	2
Low height grasses	*Dac rad*	1	2	0
	Tra aus	1	2	3
	Tri lol	12	12	14
Non grasses	*Forbs*	73	59	37
	Nat legume	62	47	9
	Sedges	25	25	22
Cover	*Bare*	2	1	2

Table 12 Key group frequency (%) changes from 1995 to 1996, (a) grazing pressure contrasts and (b) timber development contrasts

(a) Change in key group frequency averaged across similar grazing pressures

Plant Category	Plant Group	Low	Medium	High	LSD P=.05
Major Perennial Grasses	*Bot ewa*	4.5	8.1	-1.1	ns
	Chr fal	-6.5	-2.4	0.0	ns
	Het con	-2.0	2.2	-9.1	ns
	The tri	-3.2	-11.4	-7.6	5.9
Minor Perennial Grasses	*Dic ser*	-1.1	-1.9	-3.8	ns
	Dig spp	-1.9	-1.8	-4.2	ns
	Eul aur	-1.3	-0.4	1.0	ns
	Pan spp	-4.8	-8.9	-7.8	ns
Undesirable Perennial Grasses	*Ari spp*	7.1	-1.9	-1.1	3.1
Mixed types grass group	*Chl spp*	1.8	4.8	1.9	ns
	Enn spp	3.9	4.7	1.3	ns
	Era spp	-1.9	-1.9	-2.7	ns
	Eri spp	0.2	0.1	-2.3	ns
	Other grasses	-1.5	-0.7	-0.6	ns
	Pas spp	1.1	0.2	1.8	ns
	Spo spp	-1.1	-4.8	-2.6	ns
Low height grasses	*Dac rad*	-1.4	-1.6	-3.4	ns
	Tra aus	0.6	1.5	3.5	ns
	Tri lol	2.6	1.1	2.8	ns
Non grasses	*Forbs*	-21.8	-24.1	-21.2	ns
	Nat legume	-33.3	-44.5	-37.5	ns
	Sedges	-4.2	-0.6	-5.8	ns
Cover	*Bare*	0.5	0.0	1.5	ns

(b) Change in key group frequency averaged across timber treatments

Plant Category	Plant Group	Cleared	Trees	LSD P=.05
Major Perennial Grasses	*Bot ewa*	5.8	1.9	ns
	Chr fal	-0.7	-5.2	ns
	Het con	-2.6	-3.4	ns
	The tri	-10.6	-4.1	4.8
Minor Perennial Grasses	*Dic ser*	-4.0	-0.6	3.1
	Dig spp	-3.3	-2.0	ns
	Eul aur	0.3	-0.8	ns
	Pan spp	-9.6	-4.8	4.1
Undesirable Perennial Grasses	*Ari spp*	3.6	-0.9	2.5
Mixed types grass group	*Chl spp*	4.5	1.2	2.3
	Enn spp	3.3	3.3	ns
	Era spp	-2.4	-1.9	ns
	Eri spp	0.3	-1.7	ns
	Other grasses	-0.5	-1.3	ns
	Pas spp	0.4	1.7	ns
	Spo spp	-1.5	-4.1	ns
Low height grasses	*Dac rad*	-2.1	-2.2	ns
	Tra aus	2.2	1.5	ns
	Tri lol	1.5	2.9	ns
Non grasses	*Forbs*	-23.0	-21.7	ns
	Nat legume	-40.3	-36.6	ns
	Sedges	-1.6	-5.5	ns
Cover	*Bare*	0.2	1.1	ns

7.2 Pasture composition by weight

At the start of the trial the majority of the key groups in all treatments had similar yields (Appendix 9). Where treatment differences were recorded the yield difference of the key group between treatments was low.

Mean yields across all treatments have fluctuated (Table 13). The better rainfall conditions of 1994/95 season compared to previous season resulted in an increase for most species, most particularly for *H. contortus.* This response by *H. contortus* corresponds with its behaviour in other parts of the state, where more favourable rainfall years results in an increase in yield, whilst a decline occurs with a series of drier years. In contrast *B. ewartiana* yields appear less variable than *H. contortus* (Table 13), and in fact during the drier 1995/96 season *B. ewartiana* yields increased compared to *H. contortus* yields. This contrast in 1996 appears to be associated with *B. ewartiana* ability to maintain significant yields under low and medium grazing pressures given the rainfall conditions (968 and 625 kg DM/ha respectively). *H. contortus* in comparison, declined significantly with increasing grazing pressure (421, 163 and 40 kg DM/ha for low, medium and high grazing pressures respectively - LSD 118 kg DM/ha). The studies of the population dynamics of these key species will clarify these views in due time.

Table 13 Key group pasture yields (kg DM/ha) averaged across all treatments, April 1994, 1995 and 1996.

Plant Category	Plant Group	1994	1995	1996
Major Perennial Grasses	*Bot ewa*	223	398	561
	Chr fal	102	135	31
	Het con	137	364	208
	The tri	33	64	16
Minor Perennial Grasses	*Dic ser*	13	15	4
	Dig spp	4	10	1
	Eul aur	51	57	24
	Pan spp	36	38	6
Undesirable Perennial Grasses	*Ari spp*	30	49	59
Mixed types grass group	*Chl spp*	6	5	3
	Enn spp	29	43	15
	Era spp	12	10	2
	Eri spp	7	7	1
	Other grasses	4	5	7
	Pas spp	4	3	3
	Spo spp	0	2	0
Low height grasses	*Dac rad*	0	1	0
	Tra aus	1	1	1
	Tri lol	3	4	3
Non grasses	Forbs	26	25	9
	Nat legume	15	16	1
	Sedges	14	18	3

Not surprisingly, contrasts in key group pasture yields have resulted due to the effects of increasing grazing pressure. Significant declines in pasture yield due to grazing pressure occurred in 1995 for *B. ewartiana, C. fallax, H. contortus, T. triandra, Eulalia auera* and *Aristida* spp group (Appendix 9). In 1996 the same species maintained that trend, as well as *Panicum* spp, *Enneapogon* spp, *Eragrostis* spp and *Eriochloa* spp groups (Appendix 9).

7.3 Pasture composition as a percent of total yield

Key group percent composition was also similar for all treatments in 1994 (Appendix 10). The total pasture yields at this site is dominated by *B. ewartiana, H. contortus* and *C. fallax* (Table 14). A group with secondary dominance include the grasses *T. triandra, E. auera, Panicum* spp., *Aristida* spp. and *Enneapogon* spp. and at various times forbs, native legumes and sedges are also a minor group making a yield contribution (Table 14).

Table 14 Key group percent of total yield averaged across all treatments, April 1994, 1995 and 1996.

Plant Category	Plant Group	1994	1995	1996
Major Perennial Grasses	*Bot ewa*	29.4	31.1	55.9
	Chr fal	13.5	10.3	5.5
	Het con	18.0	28.4	20.0
	The tri	4.7	5.0	1.3
Minor Perennial Grasses	*Dic ser*	1.7	1.1	0.3
	Dig spp	0.5	0.8	0.2
	Eul aur	4.9	4.3	2.6
	Pan spp	4.1	3.2	0.6
Undesirable Perennial Grasses	*Ari spp*	6.7	3.9	5.0
Mixed types grass group	*Chl spp*	0.9	0.5	0.7
	Enn spp	3.9	3.5	2.6
	Era spp	1.6	0.8	0.3
	Eri spp	0.9	0.6	0.3
	Other grasses	0.6	0.6	0.5
	Pas spp	0.5	0.3	0.4
	Spo spp	0.1	0.2	0.2
Low height grasses	*Dac rad*	0.1	0.1	0.0
	Tra aus	0.1	0.1	0.3
	Tri lol	0.4	0.4	0.7
Non grasses	Forbs	3.5	2.0	1.9
	Nat legume	2.0	1.3	0.1
	Sedges	1.8	1.5	0.9

In 1995 the only key group contrasts recorded were due to differences between cleared and trees treatments (Appendix 10). *B. ewartiana* was 7% higher in the trees treatments than in the cleared treatments (34.6 and 27.6% respectively - LSD 5.5). In 1996 contrasts due to the effects of grazing pressure were recorded for *C. fallax, Enneapogon spp., Tragus australianus* and *Tripogon loliiformis* and in each case the percent of total yield was highest under the high grazing pressure (Appendix 10). Of this group, only *T. australianus* recorded a corresponding significant increase in species frequency under heavy grazing pressure (Appendix 8) and also in pasture yield (Appendix 9). This combination of parameter responses suggest an increase in the population of *T. australianus* as the grazing pressure increases. The remaining members of the group appear to have increased their percent composition of total yield due to a relative preference by stock for other species. Both *C. fallax* and *Enneapogon* spp. recorded a decline in pasture yield with increased grazing pressure (Section 7.2), but not to the same extent as other grazed species. *T. triandra* was also affected by grazing pressure, but in an opposite trend to that of the previous group (Appendix 10). The sensitivity of *T. triandra* to increasing grazing pressure has been widely observed and this result is further support.

7.4 Future issues

- the lack of any significant change in pasture composition after only 2 years of imposed treatments foreshadows that detecting floristic change at this site requires a medium (3 to 7 years) to long term time (greater than 10 years) monitoring period.
- the results presented were compared using an analysis of variance approach. An alternative approach is to use ordination analysis, whereby the complete floristics of a treatment may be plotted on an annual basis (Foran *et al* 1986). Contrasts between treatments may then be associated with contrasting directional paths.
- there is scope to undertake the analysis based on the 6 plant category groupings (the renumber routine in Botanal is required to recalculate frequency for each group)

8. PASTURE BASAL AREA

8.1 Trends

In 1994 when the initial pasture basal areas were determined, the pasture at this site had endured 2 previous summers of below average rainfall. The basal area range at that date (1.8 to 2.4%) can be considered low for a sub tropical climate, but there is a dearth of data with which to compare the site values. In subsequent years (Table 15), under low grazing pressure and the rainfall received basal areas have increased. This endorses a view that the site prior to 1994 had been under some form of environmental stress and that previous grazing management practices had not reduced the capacity of the pasture to recover.

Table 15 Pasture basal area (%) and pasture basal area change for 1994, 1995 and 1996.

	CLEARED TREATMENTS				
	1994	***Change 94 to 95***	**1995**	***Change 95 to 96***	**1996**
Low GP	2.25	*0.60*	2.85	*0.34*	3.19
Medium GP	2.27	*0.15*	2.42	*-0.62*	1.80
High GP	2.34	*-0.12*	2.22	*-0.30*	1.92
	TREES TREATMENTS				
Low GP	1.98	*0.36*	2.34	*0.46*	2.80
Medium GP	1.84	*0.46*	2.30	*-0.11*	2.19
High GP	2.30	*-0.50*	1.80	*-0.33*	1.47

Basal area responses have been similar for both cleared and trees treatments (Table 15).

Sensitivity to grazing pressures and contrasting seasonal conditions area apparent (Figure 8). Under heavy grazing pressure, basal area declines readily. At the medium grazing pressure the fluctuating trend at this early stages suggests that under a wetter 1994/95 season basal area was maintained, but declined under the drier conditions of the 1995/96 season.

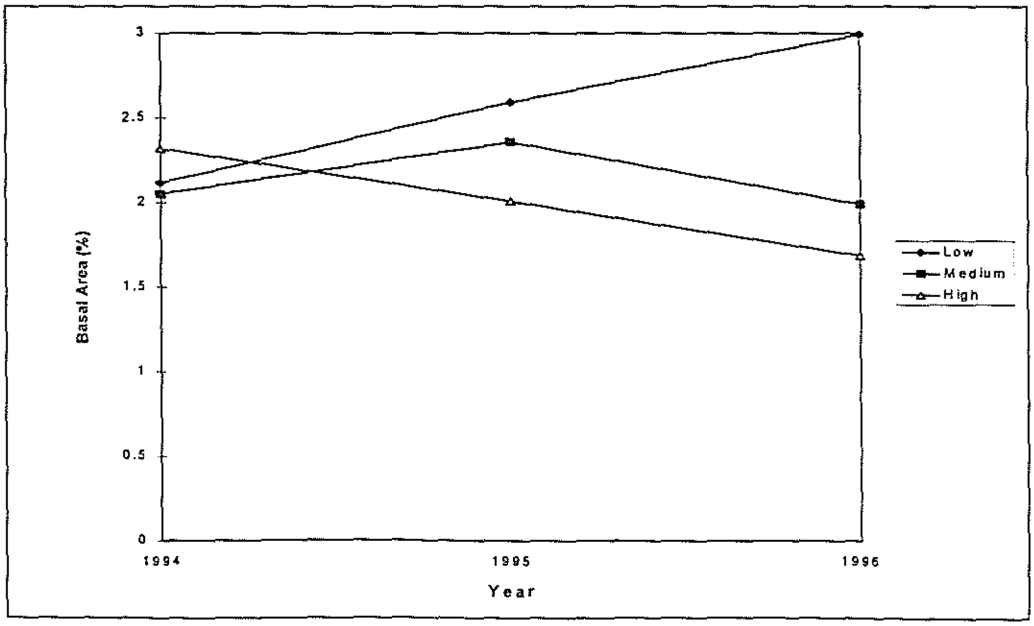


Figure 8 Basal area (%) averaged for similar grazing pressures in 1994, 1995 and 1996.

8.2 Future issues

- it would follow that a declining basal area level will lead to a similar decline in pasture growth. In the heavy grazing pressure treatments, a significant decline in the maximum pasture growth will mean that stock numbers will have to be adjusted to ensure that greater than 70% utilisation is not occurring.
- the measurement of basal area is a disciplined and systematic process. Any change in operator must attempt to account for any difference in operator measurement, but can be minimised by ensuring a similar decision process is in place.

9. POPULATION DYNAMICS OF KEY SPECIES

9.1 Plant densities

At the start of the trial a decision was made to focus initially on 3 key perennial grasses. Each of the species have a high frequency throughout the site and are the major components of the total pasture growth. The dynamics of the population of charted key species are presented in Table 16. Significant treatment differences are not apparent after 2 years of treatments. However contrasts in the behaviour of the key species are evident.

Table 16 Population changes for key species populations from 1994 to 1996: area monitored is 15m²

Golden beard grass group													
Treatment Average	Total Plant # 1994		Mortality # 94-95		Recruitment # 94-95		Total Plant # 1995		Mortality # 95-96		Recruitment # 95-96		Total Plant # 1996
CL	90	-	13	+	18	=	96	-	10	+	8	=	94
CM	80	-	11	+	17	=	86	-	4	+	4	=	86
CH	72	-	11	+	27	=	88	-	7	+	4	=	85
TL	83	-	7	+	9	=	85	-	11	+	1	=	76
TM	80	-	22	+	17	=	74	-	4	+	9	=	79
TH	73	-	5	+	11	=	79	-	10	+	3	=	72
Black speargrass group													
Treatment Average	Total Plant # 1994		Mortality # 94-95		Recruitment # 94-95		Total Plant # 1995		Mortality # 95-96		Recruitment # 95-96		Total Plant # 1996
CL	64	-	11	+	208	=	261	-	141	+	26	=	147
CM	77	-	18	+	200	=	259	-	158	+	8	=	109
CH	63	-	10	+	239	=	292	-	150	+	12	=	154
TL	69	-	14	+	122	=	177	-	82	+	8	=	103
TM	69	-	24	+	175	=	220	-	132	+	36	=	124
TH	69	-	16	+	169	=	222	-	148	+	9	=	83
Forest Mitchell group													
Treatment Average	Total Plant # 1994		Mortality # 94-95		Recruitment # 94-95		Total Plant # 1995		Mortality # 95-96		Recruitment # 95-96		Total Plant # 1996
CL	65	-	5	+	23	=	83	-	13	+	8	=	78
CM	64	-	7	+	26	=	83	-	10	+	3	=	75
CH	62	-	16	+	51	=	97	-	31	+	3	=	69
TL	72	-	6	+	6	=	72	-	6	+	1	=	66
TM	81	-	16	+	24	=	89	-	12	+	7	=	84
TH	71	-	8	+	20	=	82	-	15	+	15	=	83

C. fallax - golden beard grass total plant number has changed little and this is due to a low rate of mortality matched to a similar low rate of recruitment. The recruitment of *C. fallax* is a mystery, as the lack of seedling recruitment observations and negligible soil seed reserves (Section 10) suggests that any recruitment is clonal. The persistence of the initial mapped group, a mixed age group called Cohort X, was similar for the majority of treatments and was on average higher than the other 2 plant species (Figure 9).

H. contortus - black speargrass total plant numbers have fluctuated markedly (Table 16). During 1994/95 a recruitment density of 12 plants/m² resulted in a significant increase in numbers. In the subsequent year 35% of this cohort (mean of all treatments - Table 17) died and as a result total plant numbers declined. During the same period cohort X also suffered a decline. By 1996 *H. contortus* cohort X had the lowest persistence proportion of the three species (Figure 9), which suggests it is a plant with a shorter life span duration than the other species.

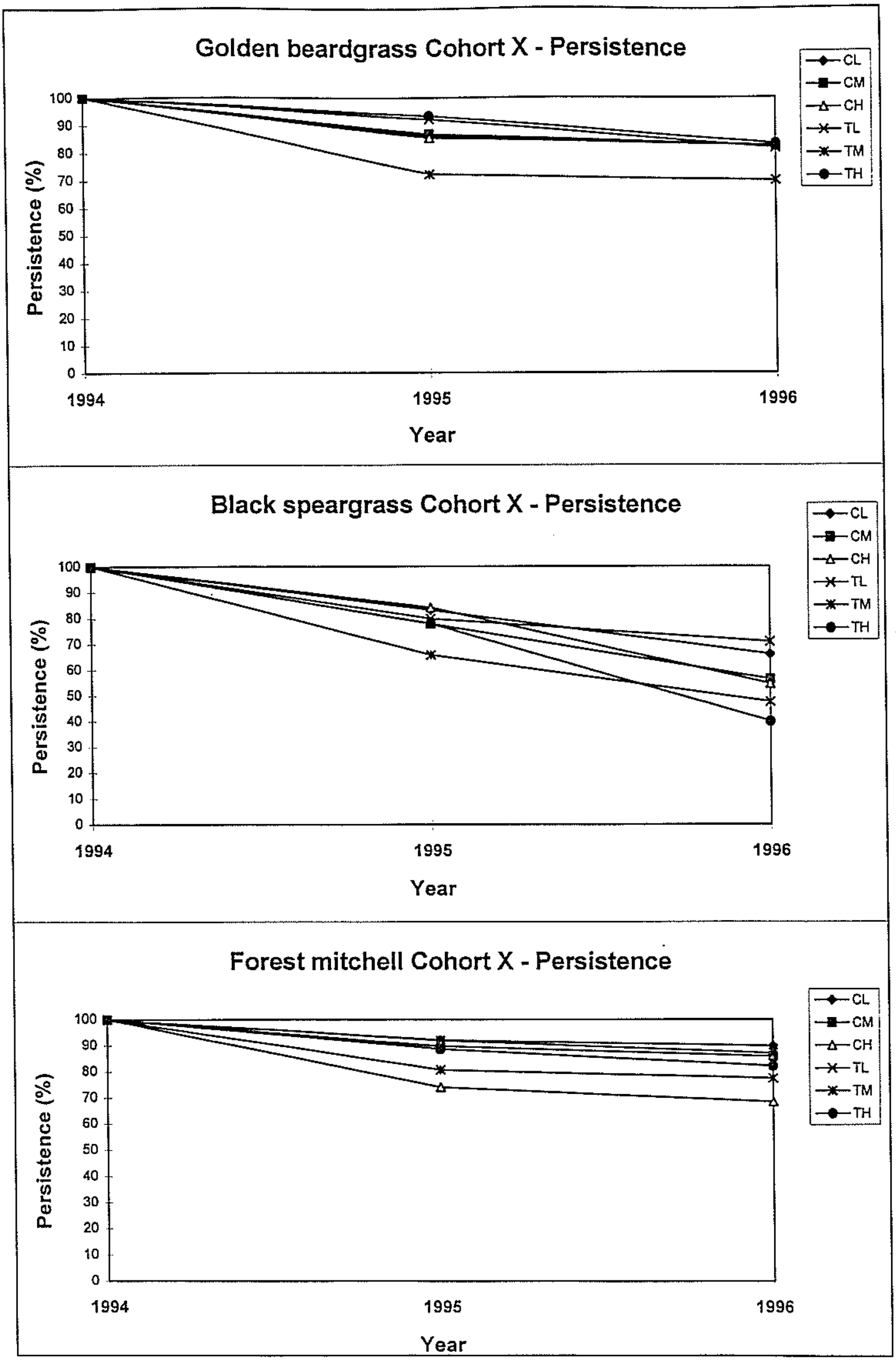


Figure 9 Persistence (%) of cohort X (mixed age cohort) for the 3 key species.

B. ewartiana - forest mitchell behaviour appears intermediate to that of the other two, as seen in 94-95 recruitment and 95-96 mortality (Table 16). The Cohort X group had limited mortality during the 1995/96 period (Figure 9), which suggests an ability to better withstand dry seasonal conditions compared to *H. contortus*.

The contrasts observed in the population behaviour of *H. contortus* and *B. ewartiana* supports similar contrasts in the botanical composition behaviour of these two species (Section 7). The increase in *H. contortus* frequency and biomass from 1994 to 1995 is supported by the high recruitment levels in all treatments (Table 18). However the lower persistence of both Cohort X (Figure 8) and the 1994/95 cohort (Table 17) of *H. contortus* compared to *B. ewartiana* identifies *H. contortus* as a shorter living plant than *B. ewartiana* and a plant that is less tolerant of dry conditions.

Table 17 Persistence (%) of 1994-95 recruits (Cohort 1) in 1996 of the 3 key species.

	Chrfal	*Hetcon*	*Botewa*
CL	71	35	45
CM	98	30	71
CH	81	45	46
TL	84	39	55
TM	84	36	61
TH	72	27	48

Table 18 Recruitment rates (plants/m^2) of the 3 key species in 1995 and 1996.

	Chrfal 1995	*Chrfal* 1996	*Hetcon* 1995	*Hetcon* 1996	*Botewa* 1995	*Botewa* 1996
CL	1.2	0.5	13.9	1.7	1.5	0.5
CM	1.1	0.3	13.3	0.5	1.7	0.2
CH	1.8	0.2	15.9	0.8	3.4	0.2
TL	0.6	0.1	8.1	0.5	0.4	0.0
TM	1.1	0.6	11.6	2.4	1.6	0.4
TH	0.7	0.2	11.3	0.6	1.3	1.0

The higher recruitment rates in 1995 than in 1996 (Table 18) are considered due to the better rainfall conditions of 1994/95 compared to 1995/96. All 3 key species were responsive to the better rains of 1994/95. The ability of *H. contortus* to germinate such a high level of new recruits due to the better rainfall conditions is linked to its ability to accumulate a high soil seed reserve (Section 10) and is a feature of plant types that have an opportunistic strategy of quickly responding to changes in environmental conditions.

9.2 Plant size

In the process of charting plant locations, individual plant basal dimensions are also recorded. Plant areas are calculated and for each cohort group a population of plant sizes are listed. Individual plant basal areas were compared between years. Each population was categorised on the basis of the basal area increasing by 20% , decreasing by 20% or remaining either 19% greater or lower (no change) than the previous year. The proportions of the key species populations in each category were calculated and the mean values across all treatments are presented for Cohort 1 (Figure 10) and Cohort X (Figure 11).

The key species in Cohort 1 (1995 recruits) all recorded at least 50% of their plants increasing in size despite the drier conditions of 1995/96 (Figure 10).. *B. ewartiana* was best able to establish its new plants under the rainfall condition, given that 88% of those recruits increased in size.

All key species in Cohort X (the mixed age group) recorded an increase in plant size during 1994/95 (Figure 11). The *H. contortus* population had the highest proportion of plants to increase (85%), whilst *C. fallax* had the lower proportion of plants to increase (66%). In 1995/96 of those remaining plants in Cohort X that persisted, at least 50% of *B. ewartiana* plants increased in plant size, whilst approximately 40% of *C. fallax* and *H. contortus* plants decreased in plant size. This behaviour again highlights the fluctuating behaviour of *H. contortus* to changing rainfall conditions, whereas *B. ewartiana* is less affected by changing rainfall conditions. The proportion of plants that did not change in plant size (8 to 22%) was similar for all key species and differed little for the 2 interval periods.

9.3 Future issues

- the data base developed for the analysis of this data has a lot of potential for wider use in other studies of plant demography
- an analysis yet to be undertaken is a description of the mortality population, in terms of the previous years plant size
- in future years, if any other pasture species become more frequent and dominant of the total pasture growth, then they also may need to be charted. New quadrats may well be required to achieve the initial population of 50 plants per paddock.

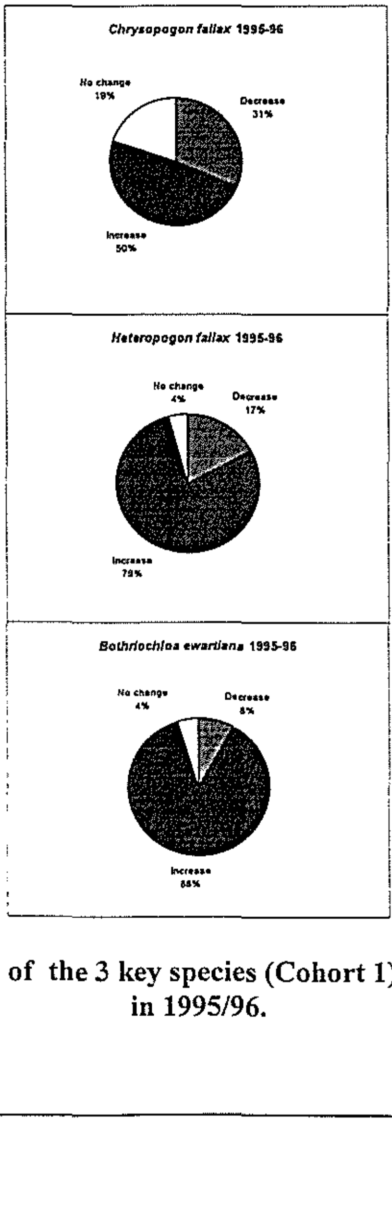


Figure 10 The proportion (%) of the 3 key species (Cohort 1) undergoing plant size changes in 1995/96.

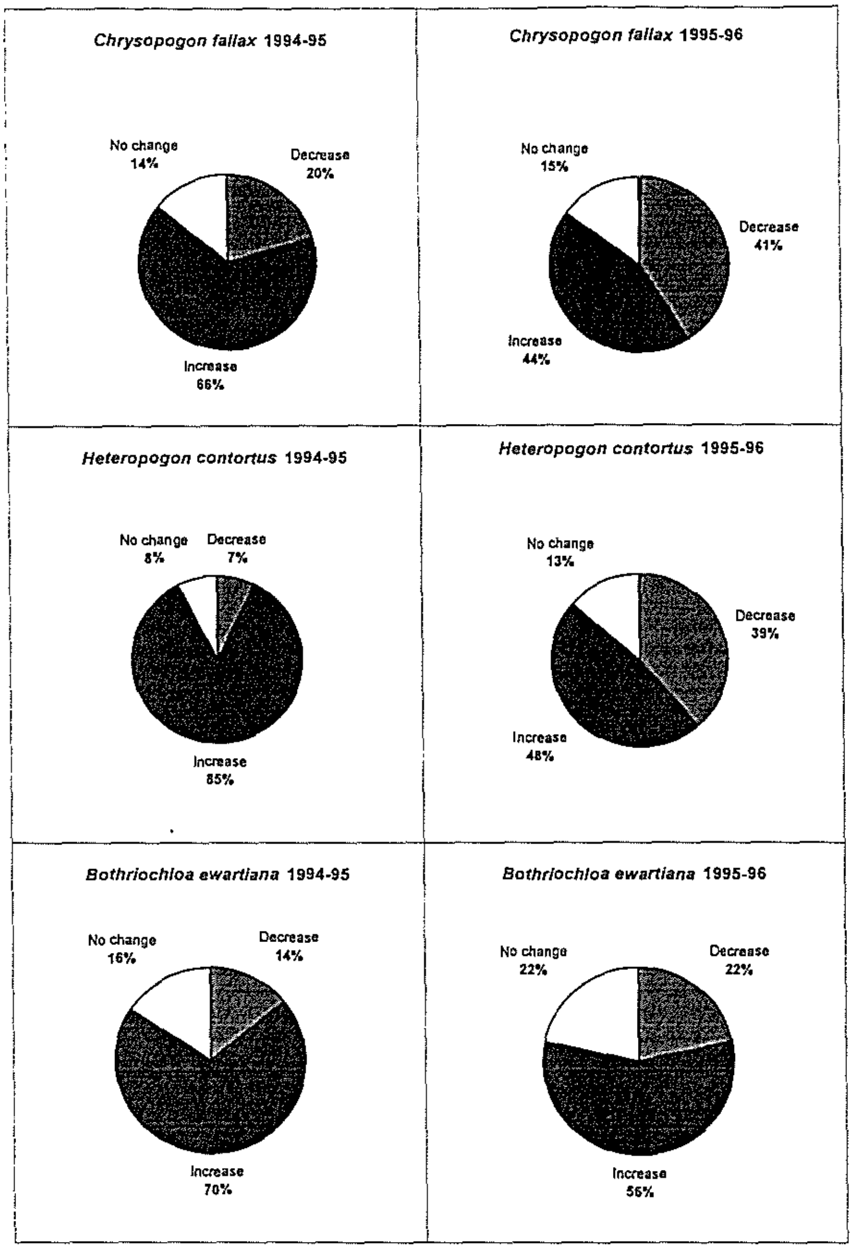


Figure 11 The proportion (%) of the 3 key species (Cohort X) undergoing plant size changes in 1994/95 and 1995/96.

10. SOIL SEED RESERVES

10.1 Magnitude of soil seed reserves

Soil seed reserves provide an insight into the potential that a species has for future seedling recruitment. The magnitude of soil seed reserves are also indicative of past environmental conditions and previous grazing management practices.

The measurement of soil seed reserves at this site has recorded a high variability between treatment paddocks (Appendix 11). In some instances some key species were not present in any of the 48 soil cores samples collected from a paddock. Given the heterogeneity of species occurrence and variable plant density it is plausible that a species may be missed, however if severe fluctuations in key species continues to occur alternative sampling options may need to be considered.

Grass soil seed reserves were dominated in 1994 and 1995 by *H. contortus*, *B. ewartiana* and *Enneapogon* spp group (Table 19). The high magnitude of the H. contortus soil seed reserves in 1994 of 108 seeds/m^2 has resulted from a previous wet summer followed by exclosure from grazing. This level of soil seed reserves is similar to that recorded at the Galloway Plains grazing trial site (DAQ.080 Report - May 1996). In the subsequent year soils seed reserves decline markedly for *H. contortus*, but less so for *B. ewartiana* and little for *Enneapogon* spp. This annual fluctuating behaviour of *H. contortus* in comparison to *B. ewartiana* supports previous statements on the ability of *B. ewartiana* to better persist through changing rainfall conditions, whereas *H. contortus* is highly sensitive to such changes.

Table 19 Soil seed reserves (seeds/m^2), averaged for all treatments, in 1994 and 1995.

GRASSES (seed/m^2)	Average (94)	Average (95)
Bothriochloa ewartiana	38.8	26.1
Chrysopogon fallax	4.8	2.4
Heteropogon contortus	107.7	27.8
Themeda triandra	0.0	0.8
Dicanthium serecium	7.9	2.4
Digitaria brownii	7.1	3.2
Eulalia aurea	0.0	0.8
Panicum effusum	2.4	6.3
Aristida ingrata	0.0	0.8
Aristida leptopoda	4.8	4.0
Aristida schultzii	3.2	3.2
Aristida species	0.8	0.0
Cenchrus ciliaris	0.0	1.6
Chloris divaricata	5.5	7.1
Enneapogon species	22.2	23.0
Eragrostis brownii	4.0	5.5
Eragrostis species	4.0	2.4
Eriochloa pseudoacrotricha	6.3	3.2
Not Known Grass	77.6	7.9
Paspalidium jubiflorum	0.8	0.0
Sporobolus australasicus	6.3	7.9
Dactyloctenium egyptii	0.8	3.2
Tragus australasicus	0.0	1.6
Tripogon lolliformis	2.4	15.4
Cyperus species	9.5	3.9
Fimbristylus species	9.5	3.2

FORBS (seed/m^2)	Average (94)	Average (95)
Acacia species	0.0	1.6
Alternanthera species	2.4	0.0
Desmodium varians	2.4	0.0
Euphorbia species	4.8	38.8
Evolvulus species	0.0	0.8
Glycine species	4.0	2.4
Gnaphalium species	7.9	9.5
Goodenia species	4.8	3.2
Hybanthus species	118.8	5.7
Indigofera species	9.5	14.3
Lillium species	0.0	3.2
Not Known Forb	99.0	87.9
Oxalis species	0.0	1.6
Phyllanthus species	11.8	19.8
Portulacca species	27.7	12.7
Pterocaulon species	0.0	9.5
Ruellia species	16.6	6.3
Sclerolaena species	0.0	0.8
Senecio lautus	0.8	1.6
Sesbania species	1.6	0.0
Sida species	0.0	19.0
Sonchus species	0.0	2.4
Spermacoce species	21.4	13.5
Tephrosia species	0.0	0.8
Whalenbergia species	6.3	13.6
Zornia species	3.2	3.2

The presence of *C. fallax* in the soil seed bank is considered an artefact of the sampling process. It is most probable that a core has contained some vegetative material and that this is the source of the observed seedling. At future pot germination, any *C. fallax* plants should be inspected to clarify this view.

Average recruitment rates (Table 18) as a percentage of the average soil seed load were 11.5 and 4.0% for *H. contortus* in 1995 and 1996 respectively and 4.4 and 1.5% for *B. ewartiana* in 1995 and 1996 respectively. The higher rate of seed to seedling by *H. contortus* is matched by a similar higher rate of mortality compared to *B. ewartiana*, but it is indicative of the strategy *H. contortus* employs to maintain a population.

Forb seed reserves (determined over a summer period) were of a similar magnitude to those of the grass species, but in fact may even be higher given that a forb field germination is occurring at various times throughout the whole year. The forbs, predominantly annual species, require a significant soil seed reserve to enable any opportunistic recruitment to occur. At this stage of the work the emphasis of soil seed reserve investigations remains on grass species dynamics. If forb species were to provide a function as a useful indicator species for management effects, then a more frequent sampling regime and seed germination program will be required.

10.2 Future issues

- a series of samples need to be maintained to confirm the longevity of soil seed reserves at this site. Much work to date suggests that grass soil seed reserves persist for only 1 to 2 years.
- close scrutiny of the field sampling technique needs to be maintained to ensure that reliable estimates are being obtained

11. CATTLE PERFORMANCE

11.1 Seasonal growth patterns

The pattern of daily growth rate of cattle grazing at this site was typical of cattle grazing in a sub-tropical and tropical environment (Figure 12). Peak growth rates were recorded subsequent to the major rains in both growing seasons (January-February 1995 and January 1996). In 1996 a major rainfall event in late April saw a minor response by the stock of all the trees treatments, but not in the cleared treatments.

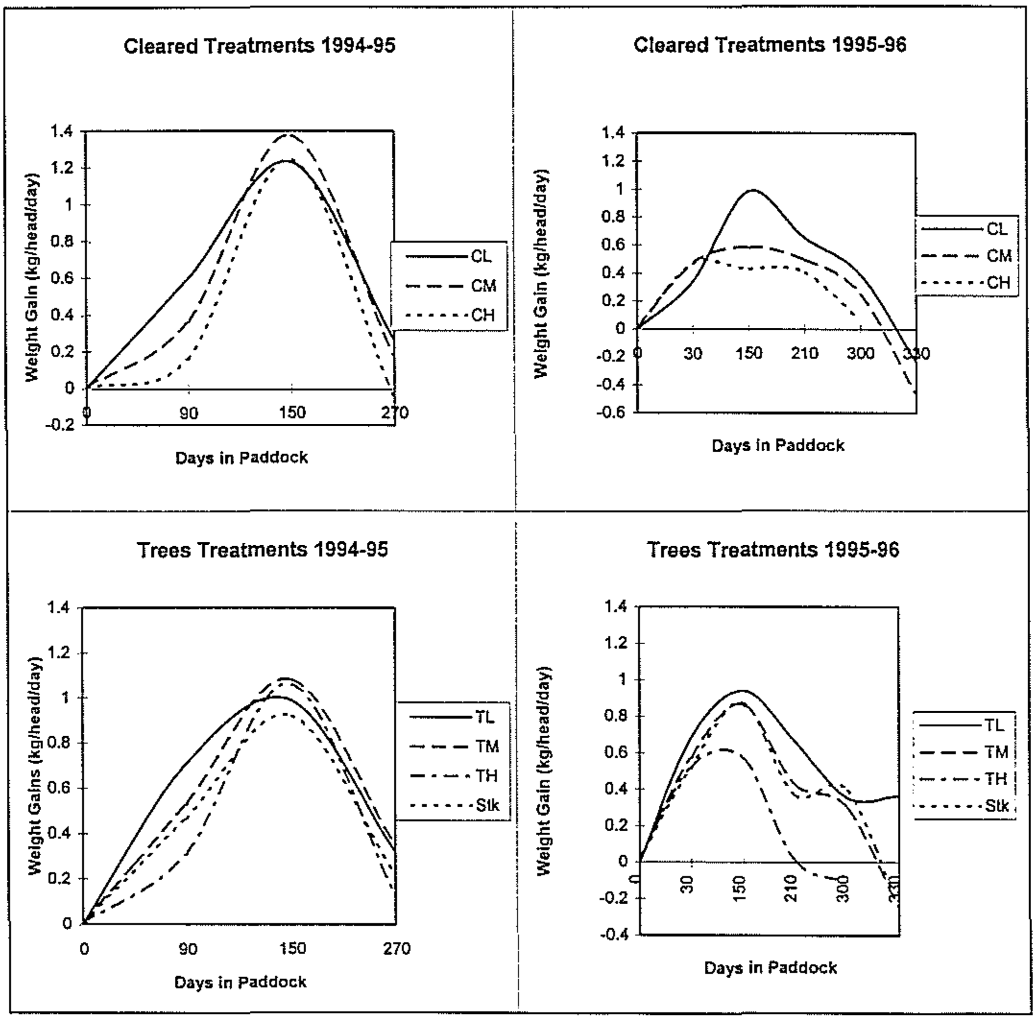


Figure 12 Daily growth rates (kg/head/day) of stock in all treatments during 1994/95 and 1995/96.

Grazing during the first year of treatments (1994/95) saw similar rates of growth for the stock of all treatments (Figure 12). This can be associated with the buffering affects of previous conservative grazing management in the area and average rainfall conditions. However the most important consideration was the inability of any the stock to be restricted by intake in any significant way during the majority of the season. A short period where contrasts were apparent was between November 1994 and February 1995, a period when no rain fell. During this period limitations appear to have been most severe for stock in the high grazing pressure treatments and least in the low grazing pressure treatments. During the subsequent period all stock achieved similar peak growth rates (1.0 to 1.4 kg/hd/day), except in the Stock paddock where a number of stock suffered 3 day sickness.

Grazing during the second year of treatments saw greater contrasts between treatments than observed in the first year. The stock of the cleared medium and heavy grazing pressure treatments was a group whose growth rates were much lower than those of all other treatments. This difference is due to pasture growth responses in the cleared treatments being much lower than initially anticipated (400 kg DM/ha recorded vs 1,000 kg DM/ha anticipated) and consequently utilisation pressure in the medium and high cleared treatments were heavier compared to those in the trees set. In 1994/95 this was not a major problem, except that carry over residual into 1995/96 in these cleared treatments was low. This together with minimal growth response by pasture in the cleared treatments has meant that intake restrictions occurred. In the cleared low grazing pressure treatment pasture on offer was much greater than in the medium and high grazing pressure treatments and daily growth rates were similar to that of the trees low grazing pressure treatment.

11.2 Cumulative yearly performance

The performance of stock over a complete season provides a more simplistic measure of the effects of all treatments. The most consistent result was the lower performance of stock (Total gain per head and Average Daily Gain per head) in the high grazing pressure treatments compared to the other treatments in both years (Table 20). This is not a surprising outcome, but it does again demonstrate the need for a conservative approach in balancing animal numbers with pasture on hand.

Table 20 Annual cattle performance (kg) in 1994/95 and 1995/96.

	1994/95			1995/96		
	Total Gain per head	Average Daily Gain per head	Total Gain per ha	Total Gain per head	Average Daily Gain per head	Total Gain per ha
(a) All Treatments						
CL	174 a	0.62 a	50 a	183 a	0.61 a	53 a
CM	163 a	0.58 a	88 a	134 a	0.44 a	72 a
CH	109 a	0.39 a	90 a	98 a	0.32 a	65 a
TL	180 a	0.64 a	27 a	198 a	0.65 a	29 a
TM	175 a	0.62 a	53 a	164 a	0.54 a	50 a
TH	128 a	0.45 a	56 a	72 a	0.24 a	31 a
(b) Averaged across similar grazing pressures						
Low	177 a	0.63 a	38 a	190 a	0.63 a	41 a
Medium	167 a	0.60 a	70 b	148 a	0.49 a	61 a
High	118 b	0.42 b	73 b	85 b	0.28 b	48 a
(c) Averaged across similar timber developments						
Cleared	148 a	0.53 a	76 a	138 a	0.46 a	63 a
Trees	160 a	0.57 a	45 b	145 a	0.48 a	36 b

Within columns in each section, means followed by different letters differ significantly ($P<0.05$)

In the 1994/95 season the production per hectare may appear to have been maximised in the heavy grazing pressure treatments, however condition scores of all stock saw the stock of the heavy grazing pressure treatments downgraded in comparison to stock of all other treatments. In the 1995/96 season the heavy grazing pressure treatments provided no benefits in terms of production per hectare. However the severity of this grazing treatment resulted in pasture yields severely reduced by April /May 1996 and as a result both cleared and trees heavy grazing pressure treatments were not able to be restocked at the start of the 1996/97 grazing year. Once growing season rains are received stock will be reintroduced, but in the interim these treatments are penalised as stock need to be agisted elsewhere. On restocking only 2 animals per paddock will return as there is a shared belief between the project team and the local co-operator that these two treatments have lost the capacity to carry 3 animals at a 70% utilisation rate.

Comparisons between cleared and trees treatments show no significant benefit to either treatment on a per head basis. However given the higher stocking rates in the cleared treatments, production per hectare was significantly greater from the cleared than the trees treatments.

Rainfall contrasts between the first 2 years of grazing resulted in lower production averages in all treatments in the drier 1995/96 than in 1994/95. Slightly at odds with this deduction were the stock of the cleared and trees low grazing pressure treatments. They were able to maintain a similar average daily weight gain over both seasons, irrespective of rainfall differences.

This grazing trial does not set out to recommend any particular stocking rate practice, however it is evident that sound management practices in the local district appear to be achieving a level of utilisation somewhere between the low and medium grazing pressure treatments. The similarity of the site to all other properties in the Peak Vale land system will allow a comparison of pasture utilisation from this site to other properties, in an attempt to validate animal performance of a larger herd size. In the interim the Stock paddock grazed at a trees medium grazing pressure does validate the result derived from the trial treatments (1995/96 performance was identical to that of the TM treatment - Figure 12).

11.3 Future issues

- as contrasts in feed supply become greater between treatments, then the need for adjustment in stock numbers will become more frequent. As mentioned earlier in the report, paddock yield assessment on a 10 to 12 week sampling interval may be required to have confidence that the appropriate utilisation rate is being achieved.
- a measure of grazing capacity not presented is number of grazing days for each treatment. Given the need to destock some paddocks at certain times the penalty of lost grazing can be easily presented through grazing day figures.
- an economic analysis is required to evaluate the financial worth of the various treatments. Such an analysis can accommodate financial differences due condition differences of stock at the end of a season. This analysis is critical to determining the feasibility of timber clearing on this land type and is an analysis which can determine the number of years required to break even.

12. RUN OFF AND SOIL LOSS

12.1 Preliminary trends

Installations for the measurement of runoff and soil loss were established in both replicates of CH and CM treatments by January 1994. Installation in trees treatments is not yet complete as a suitable site in a TH treatment has been hard to find. Resolution of this matter is required immediately. Preliminary data is presented in Table 21 of events recorded until April 1995. The absence of a project hydrologist for the last 10 months has not enabled any further data development.

Table 21 Run-off (mm/ha) and soil loss (tonnes oven dry soil/ha) summary from cleared treatments, January 1994 to March 1995.

Event date	Treatment GP= grazing pressure	Run off (mm)	Suspended soil load(t/ha)	Bed soil load (t/ha)	Total soil loss (t/ha)
9-17/3/94	Zero GP	26.7	not rec.	not rec	not rec.
	Medium GP	42.2	not rec.	not rec.	not rec.
	High GP	21.7	not rec.	not rec.	not rec.
	rain				
31/10/94	Zero GP	1.7	0.08	0.24	0.32
	Medium GP	0.5	0.03	0.14	0.17
	High GP	1.4	0.07	0.14	0.21
	rain	21.5			
14/12/94	Zero GP	0.0	0.0	0.0	0.0
	Medium GP	0.0	0.0	0.0	0.0
	High GP	0.0	0.0	0.0	0.0
	rain	22.5			
4/1/95	Zero GP	12.9	0.24	0.60	0.84
	Medium GP	10.6	0.27	0.79	1.05
	High GP	21.6	0.48	1.29	1.76
	rain	45.5			
31/1/95	Zero GP	5.9	0.02	0.36	0.38
	Medium GP	21.3	0.08	0.29	0.36
	High GP	19.4	0.10	0.43	0.52
	rain	41.0			
21/2/95	Zero GP	53.1	0.48	0.60	1.07
	Medium GP	8.5	0.08	0.93	1.01
	High GP	39.4	0.79	1.36	2.15
	rain	197.0			
23/2/95	Zero GP	2.3	0.0	0.0	0.0
	Medium GP	4.5	0.0	0.0	0.0
	High GP	5.3	0.0	0.0	0.0
	rain	44.5			
7/4/95	Zero GP	14.1	not proc.	not proc.	not proc.
	Medium GP	13.1	not proc.	not proc.	not proc.
	High GP	21.8	not proc.	not proc.	not proc.
	rain	44.5			

not proc.= not processed

Early indications highlight a higher proportion of run-off and soil loss in the heavy grazing pressure treatment than in the medium grazing pressure treatment (Table 21). If such trends continue, contrasts in pasture growth between treatments are also likely to emerge, particularly if less moisture is entering the soil profile of the heavy grazing pressure treatment. The role of the exclosure runoff site is critical for determining the natural run-off and soil loss characteristics for this site. The similarity of the exclosure with the medium grazing pressure treatment at times would suggest no effects of grazing on run-off and soil loss on those occasions, but a greater number of event comparisons and seasonal totals are required to elucidate this issue.

12.2 Pasture cover

The amount of run off and soil loss is associated with the level of pasture cover. As a result of cover class estimates observed during the Botanal survey, cover is described as a cover class frequency distribution (Figure 13). A frequency distribution description provides some insight into the variability of cover that can occur across a landscape, as well as contrasting the effects of the different treatments.

A cover level of at least 30% is considered to minimise the amount of runoff and soil loss. Consequently treatments in which high proportions of the lower classes are recorded are at risk. This is particularly the case in both the cleared and trees high grazing pressure treatments where in 1995 and 1996, 51 and 85% (values are the average of both treatments) respectively of their paddock areas recorded 35% or less in cover (Figure 13). In 1996 the proportions of area in cover classes 0-5% and 5-15% in the high grazing pressure treatment were significantly greater ($P<.05$) than in the medium and low grazing pressure treatments. Such a level of low cover and a trend of increasing low cover will have a major effect on increasing run-off and soil loss in the heavy grazing pressure treatments.

The measurement of cover is only a "snapshot perspective" as changes within a season are highly likely depending on the timing of rainfall. In 1996, conditions were dry prior to sampling (no rain from end of January to early April) and it was evident in the low grazing pressure treatments that the proportion of high cover levels had declined and low cover levels had increased. However at this level of grazing pressure, the low grazing pressure treatments maintained significantly higher proportions of the 50-90 and 90-100% cover classes, than the medium and low grazing pressure treatments (LSD $P<.05$: 90-100% -3.2 and 50-90% - 6.6).

12.3 Future issues

- a review of all run-off and soil loss results is required
- the flume catchments in the trees treatments need to be in place as soon as possible
- the Keilambete grazing trial site has been considered as a co-operative site in a Fitzroy catchment monitoring project and there has been discussion of installing an additional monitoring site to the east of the trial site

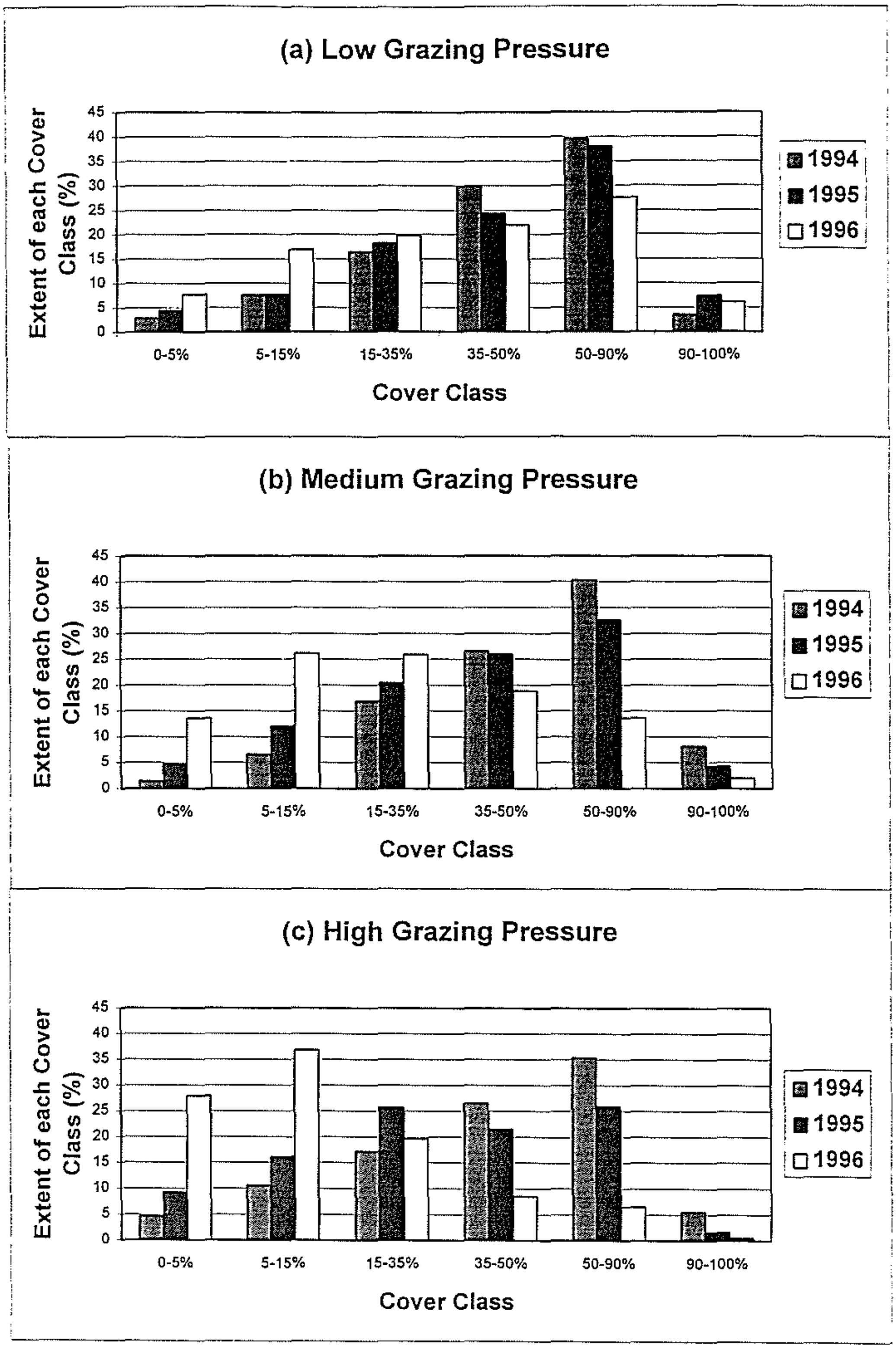


Figure 13 Cover class proportions averaged for similar grazing pressures in April 1994, 1995 and 1996.

13. CONCLUDING COMMENTS

13.1 Experimental approach

The approach in this grazing trial is to examine a number of ecological processes, which together describe the ecological functioning of a grazed woodland. Processes which are sensitive to the imposed treatments or climatic conditions will only be evident after undergoing change. Subsequently, the impact of any process that causes change is evaluated in terms of change to other processes in the system. This technique of "retrospective identification" necessitates a routine approach of maintaining all key sampling activities and of managing the data and interpreting the results in a consistent manner.

Identification of early warning indicator features will require at least 4 to 10 years of committed monitoring and it is paramount that the approach used so far is maintained. The benefits of this approach is that a comprehensive data set that will be collected, which will provide an invaluable insight into this community. The data can be used for comparative analysis of treatment effects during the duration of the trial. Just as important, the data can also be used to derive process relationships, which will enable simulation models to extrapolate the results of this trial across any combination of climatic sequences.

This study is based on a systems approach and as such any analysis of data and interpretations requires consideration of the magnitude and trends of all processes and components. For example, comparing the results of the annual botanical surveys, needs to be considered in conjunction with the results of the key species population dynamics, which in turn is considered with trends in the soil seed reserves. Likewise trends in pasture basal area need to be linked with pasture growth measures in Swiftsynd sites, which in turn may be modified by soil moisture relationship changes as pasture cover and run-off magnitude alter under contrasting grazing pressures. These are but a few of the inter-relationships that exist in this study and that need to be considered when presenting the outcomes from this study.

13.2 Treatment contrasts after 2 years of grazing

Change in grazed native pastures is often considered to occur slowly, but when it does occur the change can be dramatic. This view is applicable to the contrasts observed to date. No major change has occurred in terms of the floristics and growth of the pasture, which may be expected after only 2 years of imposed treatments. A number of system components are showing some response to treatments (Table 22) and they may be pre-empting some of the major changes that will occur in time.

The analysis of the results has identified a series of significant contrasts due to different grazing pressure or to clearing (Table 22). The number of significant interactions due to the combined effects of grazing pressure and clearing are negligible and of little impact.

Parameters that showed a high sensitivity to grazing pressure increases, and changed significantly in this initial period, were pasture basal area and pasture cover. Potentially, declining pasture basal area can initiate a whole sequence of process changes which would be detrimental to the grazed pasture. Reduced basal areas means a reduction in pasture growth. If stocking rates are not adjusted accordingly the decline will be accelerated. If stocking rates are adjusted the interesting question is: does the pasture recover and how long does it take? If pasture basal area remains low, the capacity of the pasture to compete for moisture from woody species becomes less. This poses a significant "threshold crossing" threat, for if climatic conditions (eg wet winters) were to favour

Table 22 A summary of significant contrasts due to the main treatment effects.

Grazing Pressure	Cleared vs Trees
Key group frequency (Table 12) • *T. triandra* declines with increasing GP • *Aristida* spp. increases under low GP	**Pasture growth** (Section 6) • pasture growth benefited from clearing by 400 kg DM/ha in 1994/95 and was similar to uncleared areas in 1995/96
Key group and total yield (Section 7.2 and Table 9) • all major perennial grasses and a few others decline with increasing GP • total pasture yield declines with increasing GP	**Key group frequency** (Table 12) • *T. triandra, D. serecium* and *Panicum* spp. declined in cleared treatments • *Aristida* spp. and *Chloris* spp increased in cleared treatments
Percent total yield (Section 7.3) • *C. fallax, Enneapogon* spp., *T. australianus* and *T. loliiformis* increase with increasing GP • *T. triandra* declines with increasing GP	**Cattle performance** (Table 20) • total gain per ha increased in cleared treatments
Pasture basal area (Section 8.1) • increasing GP reduces basal area	
Cattle performance (Table 20) • total gain per head and average daily gain per head decline with increasing GP	
Run-off and soil loss (Table 21) • run-off and soil loss was highest under the cleared heavy GP treatment	
Pasture cover (Section 12.2) • increasing GP increased the proportion of low cover classes and reduced the proportion of high cover classes	

woody species germination or improved growing conditions for the large density of low height tree species (Figure 6), then the pasture would offer no competition and a significant increase in timber density and basal area would occur. Once the new tree population was established, the grazing productivity would be markedly reduced. Further monitoring will clarify the validity of these forecasts.

The rapid decline in pasture cover levels across the landscape of the heavy grazing pressure treatments is of major concern. The association of cover decline with the measured increase in run-off and soil loss was documented previously in this community (Ciesolka 1987). It is not known how long it takes for this change to impact on pasture growth. This grazing trial has the capacity to answer the question.

The decline in cattle performance (LWG/head) as grazing pressure increases is a relationship typical of grazed pastures. The selection competition between animals that occurs as the availability of desirable pasture components declines is also associated with a marked reduction in pasture yield. Unless the pasture yields can recover to levels that overcome intake restrictions, lower animal productivity is maintained under high grazing pressure. Other parameter responses, show high grazing pressure is also detrimental to the pasture.

The small number of changes in key group floristic behaviour highlights the stability of the botanical composition after only 2 years of treatments. *T. triandra* is one consistent species that declines with increasing grazing pressure, but it will be interesting to see what the effects are on key species such as *B. ewartiana* and *H. contortus*. The plant population studies will provide an early indication of any changes in paddock floristic descriptions of these species.

Although the number of contrasts between cleared and trees treatments have been minimal, the small increase in pasture growth that has occurred after clearing is an important result. If this difference does not increase in subsequent years, then the benefits to production of clearing on this land type to will be questionable. Further evaluation is required and a cost-benefit analysis will also clarify the financial feasibility of clearing on this land type. There is a concern that the Swiftsynd sampling sites may be too small to confidently measure pasture growth (due to low plant density and high spatial heterogeneity of plant distribution at this site), hence there is a need to determine pasture growth rates using indirect means (Section 6). Given the importance of an objective and reliable pasture growth measurement in discussions on tree clearing, some further consideration needs to be given to ensure that an adequate pasture growth sampling technique is in place.

13.3 Key species behaviour

Close examination of the behaviour of *B. ewartiana, H. contortus* and *C. fallax* has been possible by the consideration of plant behaviour at various scales of sampling. Integration of all these results has allowed a comprehensive profile of these plants to be established. Major treatment differences have not been a feature of any of these species in the initial 2 years, however contrasts in the behaviour of the plants are evident.

Essentially it appears that *H. contortus* is a short lived perennial grass in comparison to *B. ewartiana* and *C. fallax*. Estimates of plant life spans can not be determined at this early stage and it will be interesting to compare the persistence of *B. ewartiana* plants with *C. fallax* plants. The below ground "rhizomatous" structures of *C. fallax* suggests that it is a plant that is highly persistent and will need to endure significant stress to die. In contrast, *B. ewartiana* is a tufted grass species and will eventually succumb to mortality if uprooted.

The contrasts between species in soil seed reserves further supports the above views. The lack of any seed reserves of *C. fallax* highlights the need of the plant to be highly persistent and long lived. *B. ewartiana* also has a reliance on some vegetative propagation, which has been observed as stolons that grow out from a mature plant and root down at some distance (10 to 20cm) from the "mother plant". In some instances the above ground stems have disappeared and the distant rooted component has established into a mature plant. The proportion of plants that exhibited this behaviour was very low.

13.4 Management implications

The majority of significant contrasts to date have all occurred due to increasing grazing pressure. Achieving a sustainable balance between cattle numbers and pasture on offer appears to be the most critical management requirement, regardless of wheter the pasture is cleared or uncleared. This view is central to the local best bet management practices of the Mt Mica area (Various 1992) and has been regularly endorsed by the grazing trial advisory group. Comparisons between the trial site and to neighbouring properties would suggest that a stocking rate that achieves pasture utilisation of between 30 and 40% would be an optimal goal.

A preliminary management package prepared from experiences from the grazing trial and discussions with grazing trial advisory group are presented in Appendix 12. As the trial proceeds and further casebook studies are undertaken at a commercial scale, recommended management practices can be further developed.

A particular issue requiring significant investigation is the need and role of opportunistic fire in this community. This aspect was include as an additional study to this grazing trial, but to date insufficient pasture has accumulated to allow burning comparisons to be made. The low density of pasture plants and highly variable spatial distribution of plants restricts the ability of experimental investigations to be made at this site. The small plot sizes (1 ha) and their location on the shallow soil parts of the trial site are further hindrances to any success in achieving a realistic fire event. Perseverance will be required to achieve the burn events at this site. In the interim an alternative consideration is to work in conjunction with a grazier who is planning a commercial paddock fire and monitoring parameters at this location (an adjacent unburnt reference area will also be required). In addition, a number of Qgraze sites in the district have been positioned in locations where fire has been practiced and they also can be used to make comparisons.

14. ACKNOWLEDGMENTS

Jacqui and Charlie Hawkins of "Keilambete", Rubyvale have been extremely generous in agreeing to QDPI establishing the grazing trial on their property. The guidance and advice provided by Jacqui and Charlie has been invaluable to the development of the trial and their many practical suggestions have been highly appreciated. The regular maintenance and checking of waters is undertaken by Charlie and his employees. All stock grazing the trial are provided by the Keilambete Pastoral Company. All mustering activities by Clint, Bill, Dan and Charlie Hawkins are highly appreciated. The project is very fortunate to have such a generous cooperator Family and we acknowledge the operational success of the trial to date to the Hawkin's Family.

The Meat Research Corporation has a high commitment to obtaining biological information to assist in formulating sound grazing management practices for this native pasture community. We commend the MRC for their financial support. Inparticular, we thank Dr Barry Walker for his interest, encouragement and support in the development of the project.

The Keilambete Advisory group have regularly provided guidance and feedback on the grazing trial. Thanks go to Charlie Hawkins, Laurie Walker, Bill Acton, Jim Purvis, Rob Donaldson, John Graham and Bill and Mavis Horne.

Piet Filet has been the grazing trial project leader during the design, establishment and early interpretation period until October 1996. Invaluable assistance in establishment and maintenance of trial infrastructure, data collection and management and various other project activities has been willingly provide by David Osten. Regular assistance in botanical surveys and other sampling activities was provided by Lachlan Pegler and Jacqui Willcocks. Evan Thomas was responsible for the installation of the runoff equipment and Brett Kuskopf has regularly serviced runoff events. Greg Botrolussi assisted in cattle management.

Given the many tasks undertaken at the trial many staff from Emerald DPI and DNR have provided assistance on occasions. Thanks go to Karen Rutherfurd, Peter Donaghy, Ben Fleming, Vikki Osten, Richard Sequeria, George Bourne, Ken Dixon, Nina Lyster, Bill Wilkinson and Les Merton.

The project team also acknowledge the support and technical guidance provided by Dr Bill Burrows and Mr Eric Anderson in the development of the trial.

15. REFERENCES

15.1 Report references

Ciesiolka, C. (1987). Catchment management in the Nogoa watershed. AWRC Research Project 80/128. QDPI.

Filet, P.G. (1995). *Aristida/Bothriochloa* Project Methodology Manual. Project Report, QDPI, Emerald.

Foran, B.D., Bastin, G. and Shaw, K.A. (1986). Range assessment and monitoring in arid lands: the use of classification and ordination in range survey. *Journal of Environmental Management* **22**: 67-84.

Hall, T.J., Filet, P.G., Banks, B. and Silcock, R.G. (1994). State and transition models for rangelands. 11. A state and transition model of the *Aristida-Bothriochloa* pasture community of central and southern Queensland. *Tropical Grasslands* **28**: 270-273.

Preesland, A.J. (1990). Notification of proposed application for funding 1990/91 to AMLRDC. ENHANCE: Extensive native pasture husbandry to advance northern cattle enterprises. Application by Pasture Management Branch, QDPI.

Tothill, J.C. and Gillies, C. (1992). The pasture lands of northern Australia: their condition, productivity and sustainability. *Tropical Grassland Society of Australia, Occasional Publication No. 5.*

Various, (1992). Beef property management in the Mount Mica area; based on producer experience. MRC sponsored report, QDPI Emerald.

Weston, E.J., Harbison, J., Leslie, J.K., Rosenthal, K.M. and Mayer, R.J. (1981). Assessment of the agricultural potential of Queensland. *Technical Report No. 27, Agriculture Branch, QDPI, Brisbane.*

15.2 Additional recommended reading

Anderson, E.R. (1993). Plants of central Queensland, their identification and uses. QDPI.

Filet, P.G. (1994). State and transition models for rangelands. 3. The impact of the state and transition model on grazing lands research, management and extension: A review. *Tropical Grasslands* **28**: 214-222.

Filet, P.G. and Hall, T.J. (1994). Developing grazing management strategies for the *Aristida/Bothriochloa* grasslands of Queensland. *In Proceedings, 8th Australian Rangeland Society Conference*, Katherine, 1994. pp211-212.

Filet, P.G., McCosker, J.C. and Osten, D. (1996). Management indicators for production and conservation in grazed woodlands of Queensland: A case study. *In Proceedings, Conservation Outside of Nature Reserves*, St Lucia, February 1996 (in press).

Henry, D.R., Hall, T.J., Jordan, D.J., Milson, J.A., Schefe, C.M. and Silcock, R.G. (1995). Pasture plants of southern inland Queensland. Information Series QI95016, QDPI.

Kelly, A.M. (1996). Multivariate analysis of ecological data. Master of Agricultural Science Thesis, University of Queensland.

McIntyre, S. and Filet, P.G. (in press). Choosing appropriate taxonomic units for botanical surveys: *Aristida* a case study.

Osten, D. and Schefe, C. (1994). The native pastures of the eucalypt woodlands of inland central and southern Queensland. *In Proceedings, 8th Australian Rangeland Society Conference*, Katherine, 1994. pp161-162.

Scanlan, J.C., McKeon, G.M., Day, K.A., Mott, J.J. and Hinton, A.W. (1994). Estimating safe carrying capacities of extensive cattle-grazing properties within tropical, semi-arid woodlands of north-eastern Australia. *The Rangeland Journal* 16:64-76.

Schefe, C.M., Graham, T.W.G, and Hall,T.J. (1993). A floristic description of the pasture land types of the Maranoa. Project Report Series Q093003. QDPI.

Willcocks, J. and Filet, P. (1993). Assessing the productivity of pastures in the Central Highlands region of Queensland, Australia. *In Proceedings, XVII International Grassland Congress* pp 367-368.

APPENDIX CONTENTS

Appendix 1 Species list of all pasture and woody species occurring at the Keilambete site.

Appendix 2 Soil survey details for 10 profiles at Keilambete site.

Appendix 3 Monthly weather data

Appendix 4 Tree and shrub densities (plants/ha)

Appendix 5 Tree and shrub basal areas (m^2/ha)

Appendix 6 Pasture growth, phenology and moisture levels at Swiftsynd sites

Appendix 7 Gravimetric soil moisture (%) at Swiftsynd sites

Appendix 8 Frequency (%) of key groups

Appendix 9 Pasture yield (kg DM/ha) of key groups

Appendix 10 Percent of total pasture yield (%) of key groups

Appendix 11 Soil seed reserves (germinated seed/m^2)

Appendix 12 Management packages

****

The file names of all spreadsheet data presented in the appendices are detailed in each appendix. The file name is listed on the bottom right hand of the page and the sheet name is on the top of the page. All files are stored on the Emerald server under the following directory:

O:\R_CEN\L_EMR\P_INDER\S_BEEF\AB\KEILAMBT\

The specific directory for each file is listed on the Appendix cover page.

APPENDIX 1

SPECIES LIST OF ALL PASTURE AND WOODY SPECIES OCCURRING AT THE KEILAMBETE SITE.

LOCATION: MISC\PLANTLST

Pasture and woody species list, Keilambete.

Code	Scientific Name	Common Name	Code	Scientific Name	Common Name
GRASSES			GRASSES (continued)		
Ari arm	*Aristida calycina var praealta*	branched wiregrass	Fim ova	*Fimbristylis ovata*	
Ari cal	*Aristida calycina var calycina*	dark wiregrass	Het con	*Heteropogon contortus*	black speargrass
Ari gra	*Aristida gracilipes*	fine wiregrass	Ise vag	*Iseilema vaginiflorum*	Flinders grass
Ari hol	*Aristida holathera var holathera*	erect kerosine grass	Lep dec	*Leptochloa decipiens*	slender canegrass
Ari ing	*Aristida ingrata*		Mel rep	*Melenis repens*	red Natal grass
Ari lat	*Aristida latifolia*	feathertop wiregrass	Oxy sca	*Oxychloris scariosa*	winged chloris
Ari lep	*Aristida leptopoda*	white speargrass	Pan dec	*Panicum decompositum*	native millet
Ari sch	*Aristida schultzii*		Pan eff	*Panicum effusum*	hairy panic
Bot bla	*Bothriochloa bladhii*	forest bluegrass	Pas cae	*Paspalidium caespitosum*	brigalow grass
Bot ewa	*Bothriochloa ewartiana*	desert mitchell	Pas con	*Paspalidium constrictum*	knottybutt grass
Bra whi	*Brachiaria whiteana*		Pas jub	*Paspalidium jubiflorum*	Warrego grass
Cap spp	*Capillipedium parviflorum*	scentedtops	Per rar	*Perotis rara*	comet grass
Cen cil	*Cenchrus ciliaris*	buffel	Seh ner	*Sehima nervosum*	rats tail grass
Chl div	*Chloris divaricata*	slender chloris	Spo act	*Sporobolus actinocladus*	Katoora ray grass
Chl inf	*Chloris inflata*	purple topped chloris	Spo aus	*Sporobolus australasicus*	Australian dropseed
Chl pec	*Chloris pectinata*	short armed chloris	Spo car	*Sporobolus caroli*	fairy grass
Chl tru	*Chloris truncatus*	windmill grass	Spo elo	*Sporobolus elongatus var creber*	slender rat's tail
Chl vir	*Chloris virgata*	wooly top chloris	The ave	*Themeda avenacea*	native oatgrass
Chr fal	*Chrysopogon fallax*	golden beard grass	The tri	*Themeda triandra*	kangaroo grass
Cym bom	*Cymbopogon bombycinus*	silky oilheads	Tra aus	*Tragus australianus*	small burr grass
Cym ref	*Cymbopogon refractus*	barbwire grass	Tri lol	*Tripogon loliiformis*	five minute grass
Cyp bif	*Cyperus bifax*	downs nutgrass	Tri mol	*Triraphis mollis*	purple plumegrass
Cyp con	*Cyperus concinnus*				
Cyp ful	*Cyperus fulvus*	sticky sedge	FORBS		
Cyp iri	*Cyperus iria*	rice flatsedge	Abu oxy	*Abutilon oxycarpum*	flannel
Cyp jav	*Cyperus javanicus*		Acr asp	*Achyranthes aspera*	chaff flower
Cyp pol	*Cyperus polystachyos*		Alt den	*Alternanthera denticulata*	lesser joyweed
Dac egy	*Dactyloctenium egyptii*	long arm button grass	Alt mic	*Alternanthera micrantha*	
Dac rad	*Dactyloctenium radulans*	button grass	Alt nan	*Alternanthera nana*	hairy joyweed
Dic ser	*Dichanthium sericeum*	Qld bluegrass	Ama vir	*Amaranthus viridus*	green amaranthus
Dic ten	*Dichanthium tenue*	small bluegrass	Bid bip	*Bidens bipinnata*	beggars-ticks
Dig amm	*Digitaria ammophila*	silky umbrella	Boe pal	*Boerhavia paludosa*	tarvine
Dig bro	*Digitaria brownii*	cotton panic grass	Bru aus	*Brunoniella australis*	blue trumpet flower
Dig cil	*Digitaria ciliaris*	summer grass	Cal lap	*Calotis lappulacea*	yellow burr daisy
Dig dyd	*Digitaria didactyla*	Qld blue couch	Cal squ	*Calotis squamigera*	
Dig lon	*Digitaria longiflora*		Cam bar	*Camptacra barbata*	
Dig par	*Digitaria parviflora*	small-flowered finger grass	Cha mim	*Chaemachrista mimosoides*	
Ech col	*Echinochloa colona*	awnless barnyard grass	Che car	*Chenopodium carinatum*	Boggabri weed
Ele ind	*Eleusine indica*	crowsfoot grass	Che sie	*Cheilanthes sieberi*	fern
Emp min	*Empodisma minus*	rope rush	Chr api	*Chrysocephalum apiculatum*	yellow buttons
Enn cle	*Enneapogon clelandii*		Con alb	*Conyza albinda*	tall fleabane
Enn gra	*Enneapogon gracilis*	slender nineawn	Dia spp	*Dianella spp*	blue flax lily
Enn pol	*Enneapogon polyphyllus*	leafy nineawn	Ein pol	*Einadia polygonoides*	knotted goosefoot
Enn tru	*Enneapogon truncatus*	nine awn bottlewasher	Epa aus	*Epaltes australis*	
Enn vir	*Enneapogon virens*		Eup pro	*Euphorbia prostrata*	red creeping spurge
Era bro	*Eragrostis brownii*	Brown's lovegrass	Eup tan	*Euphorbia tannensis*	desert spurge
Era cil	*Eragrostis cilianensis*	stinkgrass	Eup whe	*Euphorbia wheeleri*	
Era elo	*Eragrostis elongata*	clustered lovegrass	Evo als	*Evolvulus alsinoides*	speedwell
Era lac	*Eragrostis lacunaria*	purple lovegrass	Gom cel	*Gomphrena celsioides*	gomphrena weed
Era lep	*Eragrostis leptocarpa*		Goo gla	*Goodenia glabra*	fanflower
Era mol	*Eragrostis parviflora*	weeping lovegrass	Gre ret	*Grewia retusifolia*	dognuts
Era sor	*Eragrostis sororia*	woodland lovegrass	Hel str	*Heliotropum strigosum*	
Era ste	*Eragrostis sterilis*		Hib stu	*Hibiscus sturtii*	hill hibiscus
Era ten	*Eragrostis tenuifolia*	elastic grass	Hyb enn	*Hybanthus enneaspermum*	spade flower
Ere bim	*Eremochloa bimaculata*	poverty grass	Hyp geo	*Hypoxis geometrica*	nut lily
Eri muc	*Eriachne mucronata*	Wanderrie grass	Mal ame	*Malvastrum americanum*	spiked malvastrum
Erio pro	*Eriochloa procera*	spring grass	Mal cor	*Malvastrum coromandelianum*	prickly malvastrum
Erio pse	*Eriochloa pseudoacrotricha*	spring grass	Mel obl	*Melhania oblongifolia*	velvet hibiscus
Eul aur	*Eulalia aurea*	browntop	Oxa con	*Oxalis coniculata*	creeping oxalis
Fim dic	*Fimbristylis dichotoma*	common fringerush	Phy mad	*Phyllanthus maderaspatanus*	

Code	*Scientific Name*	Common Name		Code	*Scientific Name*	Common Name
FORBS (continued)				SHRUBS AND TREES (continued)		
Pol cor	*Polycarpaea corymbosa*			Ma cun	*Maytenus cunninghami*	
Pol lin	*Polygala linariifolia*	milkwort		Pe pub	*Petalostigma pubescens*	quinine berry
Pso aus	*Psoralea australasica*	tall verbine				
Ros ads	*Rostellularia adscendens*	pinktongues				
Sal kal	*Salsola kali*	soft roly poly				
Scl bic	*Sclerolaena bicornis*	goat head burr				
Scl bir	*Sclerolaena birchii*	galvanized burr				
Scl mur	*Sclerolaena muricata var villosa*	black roly poly				
Sen occ	*Senna occidentalis*	coffee senna				
Sid ath	*Sida atherophora*					
Sid fib	*Sida fibulifera*	pin sida				
Sid ple	*Sida pleiantha*					
Sid spi	*Sida spinosa*	spiny sida				
Sid sub	*Sida subspicata*	spiked sida				
Sid tri	*Sida trichopoda*	high sida				
Sol ell	*Solanum ellipticum*	potato weed				
Spe spp	*Spermacoce spp*					
Tri ter	*Tribulus terrestris*	caltrop				
Ver cin	*Vernonia cineria*	vernonia				
Vit pus	*Vittadinia pustulata*	fuzzweed				
Wed spi	*Wedelia spilanthoides*	sunflower daisy				
Wha gra	*Whalenbergia granitica*	Australian bluebell				
LEGUMES						
Aes bre	*Aeschenomene brevifolia*	joint vetch				
Cas con	*Cassia concinna*	dwarf cassia				
Cro med	*Crotolaria medicaginea*	trefoil rattlepod				
Cro mon	*Crotolaria montana*	rattlepod				
Des bra	*Desmodium brachypodum*	large tick trefoil				
Des cam	*Desmodium campylocaulon*	creeping tick trefoil				
Des var	*Desmodium varians*	slender tick trefoil				
Gly cla	*Glycine clandestina*	twining glycine				
Gly tab	*Glycine tabacina*	variable glycine				
Ind bre	*Indigofera brevidens*	desert indigo				
Ind col	*Indigofera colutea*	sticky indigo				
Ind hir	*Indigofera hirsuta*	hairy indigo				
Ind lin	*Indigofera linifolia*	narrow-leaf indigo				
Ind lnn	*Indigofera linneai*	Birdsville indigo				
Ind pol	*Indigofera polygaloides*					
Ind pra	*Indigofera pratensis*	forest indigo				
Rhy min	*Rhynchosia minima*	rhynchosia				
Tep fil	*Tephrosia filipes*					
Tep pur	*Tephrosia purpurea*					
Zor mur	*Zornia muriculata var angustata*					
SHRUBS AND TREES						
Ac har	*Acacia harpophylla*	brigalow				
Ac lon	*Acacia longispicata*					
Al lue	*Allocasuarina luehmannii*	bull oak				
Al exc	*Alphitonia excelsa*	red ash				
Ar bas	*Archidendropsis basaltica*	dead finish				
Br obl	*Breynia oblongifolia*	coffee bush				
Bu inc	*Bursaria incana*	prickly pine				
Ca ova	*Carissa ovata*	currant bush				
Er mit	*Eremophila mitchellii*	false sandalwood				
Eu ery	*Eucalyptus erythrophloia*	variable barked bloodwood				
Eu mel	*Eucalyptus melanophloia*	silver-leaved ironbark				
Eu pap	*Eucalyptus papuana*	ghost gum				
Fl dis	*Flindersia dissosperma*					
Ha cor	*Hakea cordophylla*	bootlace				

APPENDIX 2

SOIL SURVEY DETAILS FOR 10 PROFILES AT THE KEILAMBETE SITE

LOCATION: MISC\SOILS\SOILSURVEY.DOC

SOIL TYPE:
SUBSTRATE MATERIAL: granite
SITE NO: 1
CONFIDENCE SUBSTRATE IS PARENT MATERIAL:
A.M.G. REFERENCE: 559 880 mE 7 414 850 mN ZONE 55
SLOPE: 1 %
GREAT SOIL GROUP: Non-calcic brown soil
LANDFORM ELEMENT TYPE: hillcrest
PRINCIPAL PROFILE FORM: Dr2.12
LANDFORM PATTERN TYPE: undulating rises 9-30m 3-10%
SOIL TAXONOMY UNIT:
FAO UNESCO UNIT:
AUSTRALIAN SOIL CLASSIFICATION: HAPLIC, EUTROPHIC, RED, CHROMOSOL; Thin, Non Gravelly, Sandy, Clayey, Shallow. (Confidence level 3).
STRUCTURAL FORM: Mid-high woodland
DOMINANT VEGETATION SPECIES: Eucalyptus melanophloia, Eucalyptus erythrophloia, Bursaria incana, Eucalyptus melanophloia, Bursaria incana, Bothriochloa ewartiana, Heteropogon contortus, Enneapogon species, Chrysopogon fallax, Themeda triandra

PROFILE MORPHOLOGY:
CONDITION OF SURFACE SOIL WHEN DRY: hard setting

HORIZON	DEPTH	DESCRIPTION
A1	0 to .05 m	Brownish black (7.5YR3/2) moist; loamy sand; massive. clear to-
B1	.05 to .10 m	Dark reddish brown (5YR3/2) moist; sandy light clay; massive. clear to-
B2	.10 to .40 m	Reddish brown (2.5YR4/6) moist; light medium clay; strong 20-50mm angular blocky. gradual to-
B3	.40 to .45 m	Reddish brown (2.5YR4/6) moist; medium clay; moderate 20-50mm angular blocky parting to moderate 10-20mm lenticular; common distinct slickenside. gradual to-
BC	.45 to .60 m	Weathering granite
C	.60 m	Hard granite

SOIL TYPE:
SUBSTRATE MATERIAL: granite
SITE NO: 2
CONFIDENCE SUBSTRATE IS PARENT MATERIAL:
A.M.G. REFERENCE: 559 930 mE 7 414 900 mN ZONE 55
SLOPE: 4 %
GREAT SOIL GROUP: Non-calcic brown soil
LANDFORM ELEMENT TYPE: hillslope
PRINCIPAL PROFILE FORM: Dr2.12
LANDFORM PATTERN TYPE: undulating rises 9-30m 3-10%
SOIL TAXONOMY UNIT:
FAO UNESCO UNIT:
AUSTRALIAN SOIL CLASSIFICATION: HAPLIC, EUTROPHIC, RED, CHROMOSOL; Thin, Non Gravelly, Sandy, Clayey, Shallow. (Confidence level 3).
STRUCTURAL FORM: Mid-high woodland
DOMINANT VEGETATION SPECIES: Eucalyptus melanophloia, Eucalyptus erythrophloia, Bothriochloa ewartiana, Heteropogon contortus, Themeda triandra, Chrysopogon fallax, Panicum effusum, Enneapogon species

PROFILE MORPHOLOGY:
CONDITION OF SURFACE SOIL WHEN DRY: hard setting

HORIZON	DEPTH	DESCRIPTION
A1	0 to .03 m	Brownish black (7.5YR3/2) moist; loamy sand; massive. clear to-
A3	.03 to .08 m	Dark reddish brown (5YR3/4) moist; sandy loam; massive. clear to-
B1	.08 to .12 m	Dark reddish brown (5YR3/2) moist; sandy light clay; massive. clear to-
B2	.12 to .35 m	Dark reddish brown (2.5YR3/4) moist; medium clay; strong 10-20mm angular blocky. gradual to-
B3	.35 to .50 m	Reddish brown (5YR4/6) moist; light medium clay; strong prismatic; few distinct slickenside. Gradual to-
BC	.50to .70 m	Weathering granite

SOIL TYPE:
SUBSTRATE MATERIAL: granite
SITE NO: 3
CONFIDENCE SUBSTRATE IS PARENT MATERIAL:
A.M.G. REFERENCE: 560 030 mE 7 414 950 mN ZONE 55
SLOPE: 4 %
GREAT SOIL GROUP: Non-calcic brown soil
LANDFORM ELEMENT TYPE: hillslope
PRINCIPAL PROFILE FORM: Dr2.12
LANDFORM PATTERN TYPE: undulating rises 9-30m 3-10%

HORIZON	DEPTH	DESCRIPTION
A1	0 to .08 m	Brownish black (7.5YR3/2) moist; sandy clay loam; massive. gradual to-
A3	.08 to .12 m	Reddish brown (5YR4/6) moist; sandy clay loam; massive. clear to-
B2	.12 to .45 m	Dark reddish brown (2.5YR3/6) moist; light medium clay; strong 10-20mm angular blocky.
BC	.45to .60 m	Weathering granite
C	.60 m	Hard granite

SOIL TYPE:
SUBSTRATE MATERIAL: igneous rock (unidentified)
SITE NO: 6
CONFIDENCE SUBSTRATE IS PARENT MATERIAL:
A.M.G. REFERENCE: 559 200 mE 7 414 580 mN ZONE 55
SLOPE: 1 %
GREAT SOIL GROUP: No suitable group
LANDFORM ELEMENT TYPE: hillcrest
PRINCIPAL PROFILE FORM: Dd1.12
LANDFORM PATTERN TYPE: undulating rises 9-30m 3-10%
SOIL TAXONOMY UNIT:
FAO UNESCO UNIT:
AUSTRALIAN SOIL CLASSIFICATION: VERTIC, EUTROPHIC, BLACK, CHROMOSOL; Medium, Non Gravelly, Clay Loamy, Clayey, Moderately deep. (Confidence level 3).
STRUCTURAL FORM: Mid-high woodland
DOMINANT VEGETATION SPECIES: Eucalyptus melanophloia, Heteropogon contortus
SURFACE COARSE FRAGMENTS: Common cobbles, angular igneous rock (unidentified)

PROFILE MORPHOLOGY:
CONDITION OF SURFACE SOIL WHEN DRY: hard setting

HORIZON	DEPTH	DESCRIPTION
A11	0 to .07 m	Black (10YR2/1); sandy clay loam; massive; moderately moist;. gradual to-
A12	.07 to .15 m	Black (10YR2/1); clay loam, sandy; massive; moderately moist;. clear to-
B21	.15 to .30 m	Brownish black (10YR3/2); few medium distinct dark mottles; sandy medium clay; strong subangular blocky; dry; very strong. gradual to-
B22	.30 to .50 m	Brownish black (10YR3/1); sandy medium heavy clay; strong lenticular; common prominent slickenside; dry; very strong.
BC	.50	Weathering rock

SOIL TYPE:
SUBSTRATE MATERIAL: granite
SITE NO: 7
CONFIDENCE SUBSTRATE IS PARENT MATERIAL:
A.M.G. REFERENCE: 560 320 mE 7 414 680 mN ZONE 55
SLOPE: 4 %
GREAT SOIL GROUP: Non-calcic brown soil
LANDFORM ELEMENT TYPE: hillslope
PRINCIPAL PROFILE FORM: Dr2.12
LANDFORM PATTERN TYPE: undulating rises 9-30m 3-10%
SOIL TAXONOMY UNIT:
FAO UNESCO UNIT:
AUSTRALIAN SOIL CLASSIFICATION: HAPLIC, EUTROPHIC, RED, CHROMOSOL; Medium, Non Gravelly, Loamy, Clayey, Shallow. (Confidence level 3).
STRUCTURAL FORM: Mid-high woodland
DOMINANT VEGETATION SPECIES: Eucalyptus melanophloia, Eucalyptus erythrophloia, Bothriochloa ewartiana, Heteropogon contortus, Themeda triandra, Chrysopogon fallax

PROFILE MORPHOLOGY:
CONDITION OF SURFACE SOIL WHEN DRY: hard setting

HORIZON	DEPTH	DESCRIPTION
A1	0 to .07 m	Dark reddish brown (2.5YR3/2) moist; sandy loam; massive. clear to-
A3	.07 to .13 m	Dark reddish brown (5YR3/3) moist; coarse sandy clay loam; very few small pebbles, angular granite; massive. clear to-
B21	.13 to .35 m	Dark reddish brown (2.5YR3/6) moist; light medium clay; strong 10-20mm angular blocky. grading to-
B22	.35 to .45 m	Dark reddish brown (2.5YR3/4) moist; sandy light medium clay; strong 10-20mm lenticular; common distinct slickenside. gradual to-
BC	.45	Weathering granite

SOIL TAXONOMY UNIT:
FAO UNESCO UNIT:
AUSTRALIAN SOIL CLASSIFICATION: HAPLIC, EUTROPHIC,
STRUCTURAL FORM: RED, CHROMOSOL; Thin, Non Gravelly, Loamy, Clayey, Moderately deep. (Confidence level 3).
DOMINANT VEGETATION SPECIES: Eucalyptus melanophloia, Eucalyptus erythrophloia, Bothriochloa ewartiana, Heteropogon contortus, Themeda triandra, Chrysopogon fallax, Panicum effusum, Enneapogon species

PROFILE MORPHOLOGY:
CONDITION OF SURFACE SOIL WHEN DRY: hard setting

HORIZON	DEPTH	DESCRIPTION
A11	0 to .05 m	Brownish black (10YR2/2) moist; sandy loam; massive. gradual to-
A12	.05 to .08 m	Brownish black (7.5YR3/2) moist; sandy clay loam; massive. clear to-
B1	.08 to .12 m	Dark reddish brown (5YR3/4) moist; sandy light clay; massive. clear to-
B2	.12 to .45 m	Reddish brown (5YR4/6) moist; medium clay; moderate 20-50mm angular blocky; few distinct slickenside. gradual to-
B3	.45 to .60 m	Dark brown (7.5YR3/4) moist; light medium clay; moderate 10-20mm angular blocky; few distinct slickenside. gradual to-
BC	.60to .75 m	Weathering granite

SOIL TYPE:
SUBSTRATE MATERIAL: Altered substrate material
SITE NO: 4
CONFIDENCE SUBSTRATE IS PARENT MATERIAL:
A.M.G. REFERENCE: 560 080 mE 7 414 900 mN ZONE 55
SLOPE: 0.8 %
GREAT SOIL GROUP: No suitable group
LANDFORM ELEMENT TYPE: valley-flat
PRINCIPAL PROFILE FORM: Um5.51
LANDFORM PATTERN TYPE: undulating rises 9-30m 3-10%
SOIL TAXONOMY UNIT:
FAO UNESCO UNIT:
AUSTRALIAN SOIL CLASSIFICATION: BASIC, STRATIC, RUDOSOL; Non Gravelly, Clay Loamy. (Confidence level 3).
STRUCTURAL FORM: Tall isolated clump of trees
DOMINANT VEGETATION SPECIES: Eucalyptus melanophloia, Eucalyptus papuana, Eucalyptus erythrophloia, Sida species, Archidendropsis basaltica, Enneapogon species, Chrysopogon fallax, Aristida species, Tripogon loliiformis

PROFILE MORPHOLOGY:
CONDITION OF SURFACE SOIL WHEN DRY: hard setting

HORIZON	DEPTH	DESCRIPTION
A1	0 to .20 m	Brownish black (10YR2/2) moist; sandy clay loam; massive; dry; moderately firm. gradual to -
2D	.20 to .40 m	Dull yellowish brown (10YR4/3) moist, dull yellowish brown (10YR5/3) dry; loamy sand; massive; dry; moderately weak. clear to-
3D	.40 to .85 m	Brown (10YR4/4) moist; clayey sand; massive parting to single grain; dry; loose. diffuse to-
4D	.85 to 1.00 m	Brown (10YR4/4) moist; coarse sand; single grain; dry; loose. abrupt to-
5D1e	1.00 to 1.00 m	Dull yellowish orange (10YR7/2) dry.
5D2	1.00 to 1.15 m	Brownish grey (10YR4/1) moist; sandy light clay; moderate subangular blocky; moist; very firm.

SOIL TYPE:
SUBSTRATE MATERIAL: granite
SITE NO: 5
CONFIDENCE SUBSTRATE IS PARENT MATERIAL:
A.M.G. REFERENCE: 559 890 mE 7 414 670 mN ZONE 55
SLOPE: 1 %
GREAT SOIL GROUP: Non-calcic brown soil
LANDFORM ELEMENT TYPE: hillcrest
PRINCIPAL PROFILE FORM: Dr2.12
LANDFORM PATTERN TYPE: undulating rises 9-30m 3-10%
SOIL TAXONOMY UNIT:
FAO UNESCO UNIT:
AUSTRALIAN SOIL CLASSIFICATION: HAPLIC, EUTROPHIC, RED, CHROMOSOL; Medium, Non Gravelly, Clay Loamy, Clayey, Shallow. (Confidence level 3).
STRUCTURAL FORM: Mid-high woodland
DOMINANT VEGETATION SPECIES: Eucalyptus melanophloia, Eucalyptus erythrophloia, Bursaria incana, Heteropogon contortus, Bothriochloa ewartiana, Chrysopogon fallax, Enneapogon species

PROFILE MORPHOLOGY:
CONDITION OF SURFACE SOIL WHEN DRY: hard setting

GREAT SOIL GROUP: Solodized solonetz
LANDFORM ELEMENT TYPE: hillslope
PRINCIPAL PROFILE FORM: Dy3.43
LANDFORM PATTERN TYPE: undulating rises 9-30m 3-10%
SOIL TAXONOMY UNIT:
FAO UNESCO UNIT:
AUSTRALIAN SOIL CLASSIFICATION: EUTROPHIC, MOTTLED-MESONATRIC, GREY, SODOSOL; Medium, Non-Gravelly, Sandy, Clayey, Deep. (Confidence level 3).
STRUCTURAL FORM: Mid-high woodland
DOMINANT VEGETATION SPECIES: Eucalyptus melanophloia, Eucalyptus papuana,Archidendropsis basaltica, Carissa ovata, Bursaria incana, Bothriochloa ewartiana, Chrysopogon fallax, Aristida species

PROFILE MORPHOLOGY:
CONDITION OF SURFACE SOIL WHEN DRY: hard setting

HORIZON	DEPTH	DESCRIPTION
A1	0 to .12 m	Brownish black (10YR3/2) moist; loamy sand; massive. gradual to-
A2e	.12 to .22 m	Dull yellowish brown (10YR4/3) moist, dull yellowish orange (10YR7/2) dry; clayey coarse sand; massive. abrupt to-
B21	.22 to .40 m	Greyish yellow-brown (10YR4/2) moist; many medium prominent brown mottles; sandy medium clay; strong 50-100mm columnar. diffuse to-
B22	.40 to .70 m	Dull yellowish brown (10YR5/4) moist; many medium prominent grey mottles; medium heavy clay; strong angular blocky parting to moderate lenticular; common coarse manganiferous soft segregations. gradual to-
B23	.70 to .90 m	Yellowish brown (10YR5/6) moist; common fine faint dark mottles; light medium clay; moderate subangular blocky; few medium manganiferous soft segregations.

SOIL TYPE:
SUBSTRATE MATERIAL: granite
SITE NO: 11
CONFIDENCE SUBSTRATE IS PARENT MATERIAL:
A.M.G. REFERENCE: 559 600 mE 7 414 670 mN ZONE 55
SLOPE: 3 %
GREAT SOIL GROUP: Yellow podzolic soil
LANDFORM ELEMENT TYPE: hillslope
PRINCIPAL PROFILE FORM: Db2.23
LANDFORM PATTERN TYPE: undulating rises 9-30m 3-10%
SOIL TAXONOMY UNIT:
FAO UNESCO UNIT:
AUSTRALIAN SOIL CLASSIFICATION: VERTIC, EUTROPHIC, BROWN, CHROMOSOL; Medium, Non Gravelly, Sandy, Clayey, Deep. (Confidence level 3).
STRUCTURAL FORM: Mid-high woodland
DOMINANT VEGETATION SPECIES: Eucalyptus melanophloia, Eucalyptus erythrophloia, Bursaria incana, Bothriochloa ewartiana, Heteropogon contortus, Chrysopogon fallax, Bursaria incana, Enneapogon species

PROFILE MORPHOLOGY:
CONDITION OF SURFACE SOIL WHEN DRY: hard setting

HORIZON	DEPTH	DESCRIPTION
A1	0 to .07 m	Brownish black (10YR2/2) moist; loamy sand; massive. gradual to-
A2	.07 to .25 m	Dark brown (7.5YR3/4) moist; loamy sand; massive. gradual to-
A3	.25 to .35 m	Dull reddish brown (5YR4/3) moist; coarse sandy clay loam; massive. clear to-
B21	.35 to .50 m	Brown (7.5YR4/4) moist; common medium distinct red mottles, very few medium distinct dark mottles; sandy light clay; moderate 20-50mm subangular blocky parting to moderate 5-10mm lenticular; very few fine manganiferous soft segregations. gradual to-
B22	.50 to .75 m	Dull yellowish brown (10YR5/4) moist; light clay; strong 10-20mm angular blocky parting to moderate 5-10mm lenticular; few distinct slickenside; few medium manganiferous soft segregation gradual to-
B23	.75 to 1.05 m	Greyish yellow-brown (10YR4/2) moist; light clay; very few small pebbles, angular granite; strong 10-20mm lenticular; many prominent slickenside; few coarse manganiferous soft segregations.

SOIL TYPE:
SUBSTRATE MATERIAL: granite
SITE NO: 8
CONFIDENCE SUBSTRATE IS PARENT MATERIAL:
A.M.G. REFERENCE: 560 270 mE 7 414 870 mN ZONE 55
SLOPE: 5 %
GREAT SOIL GROUP: Non-calcic brown soil
LANDFORM ELEMENT TYPE: hillslope
PRINCIPAL PROFILE FORM: Dr2.12
LANDFORM PATTERN TYPE: undulating rises 9-30m 3-10%
SOIL TAXONOMY UNIT:
FAO UNESCO UNIT:
AUSTRALIAN SOIL CLASSIFICATION: HAPLIC, EUTROPHIC, RED, CHROMOSOL; Medium, Non Gravelly, Loamy, Clayey, Shallow. (Confidence level 3).
STRUCTURAL FORM: Mid-high woodland
DOMINANT VEGETATION SPECIES: Eucalyptus melanophloia, Eucalyptus erythrophloia, Bothriochloa ewartiana, Heteropogon contortus, Chrysopogon fallax, Themeda triandra

PROFILE MORPHOLOGY:
CONDITION OF SURFACE SOIL WHEN DRY: hard setting

HORIZON	DEPTH	DESCRIPTION
A1	0 to .06 m	Brownish black (10YR2/2); sandy loam; massive. clear to-
A3	.06 to .12 m	Dark reddish brown (5YR3/3); sandy clay loam; massive. clear to-
B1	.12 to .18 m	Dark reddish brown (5YR3/4); sandy light clay; moderate subangular blocky. gradual to-
B21	.18 to .35 m	Reddish brown (2.5YR4/6); light medium clay; strong angular blocky. gradual to-
B22	.35 to .50 m	Dark reddish brown (2.5YR3/6); light clay; strong angular blocky; few faint slickenside. gradual to-
BC	.50 to .65 m	Weathering granite. gradual to-
C	.65	Hard granite

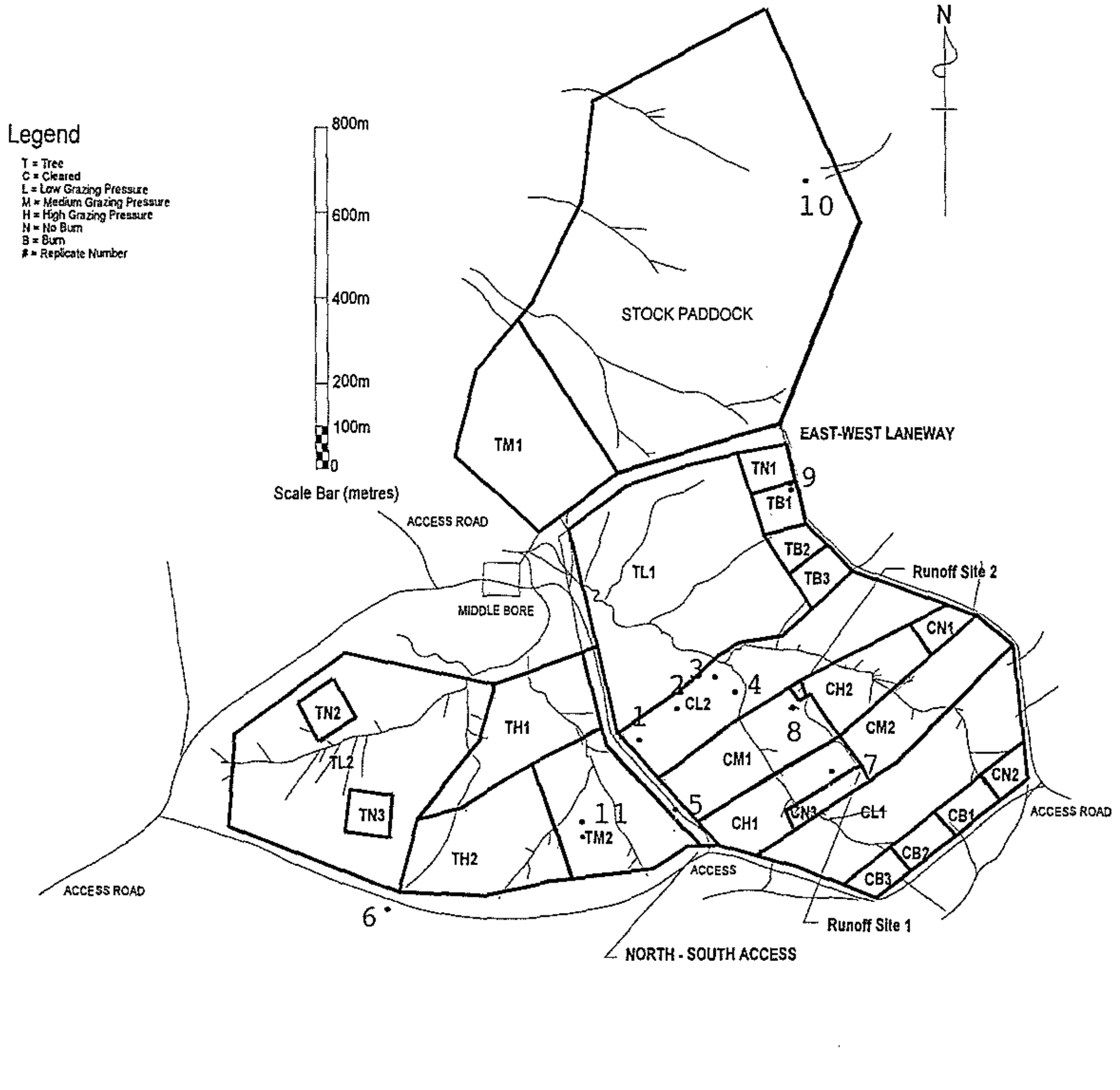
SOIL TYPE:
SUBSTRATE MATERIAL: granite
SITE NO: 9
CONFIDENCE SUBSTRATE IS PARENT MATERIAL:
A.M.G. REFERENCE: 560 270 mE 7 515 470 mN ZONE 55
SLOPE: 1 %
GREAT SOIL GROUP: Yellow podzolic soil
LANDFORM ELEMENT TYPE: hillcrest
PRINCIPAL PROFILE FORM: Dy2.22
LANDFORM PATTERN TYPE: undulating rises 9-30m 3-10%
SOIL TAXONOMY UNIT:
FAO UNESCO UNIT:
AUSTRALIAN SOIL CLASSIFICATION: HAPLIC, EUTROPHIC, BROWN, Clayey, Moderately deep. (Confidence level 3).
CHROMOSOL; Medium, Non Gravelly, Sandy,
STRUCTURAL FORM: Mid-high woodland
DOMINANT VEGETATION SPECIES: Eucalyptus melanophloia, Eucalyptus erythrophloia, Bursaria incana, Bothriochloa ewartiana, Heteropogon contortus, Enneapogon species, Themeda avenacea

PROFILE MORPHOLOGY:
CONDITION OF SURFACE SOIL WHEN DRY: hard setting

HORIZON	DEPTH	DESCRIPTION
A1	0 to .05 m	Brownish black (10YR2/2) moist; loamy sand; massive. clear to-
A2	.05 to .15 m	Dark brown (10YR3/3) moist; coarse sandy loam; massive. clear to-
B21	.15 to .30 m	Yellowish brown (10YR5/6) moist; medium clay; weak subangular blocky parting to massive. gradual to-
B22	.30 to .50 m	Yellowish brown (10YR5/6) moist; few coarse distinct dark mottles; light medium clay; moderate 20-50mm subangular blocky; few distinct slickenside.
B23	.50 to .65 m	Yellowish brown (10YR5/6) moist; few coarse distinct dark mottles; medium clay; strong 10-20mm subangular blocky.
BC	.65 to .70 m	Weathering granite.

SOIL TYPE:
SUBSTRATE MATERIAL: colluvium
SITE NO: 10
CONFIDENCE SUBSTRATE IS PARENT MATERIAL:
A.M.G. REFERENCE: 560 360 mE 7 416 270 mN ZONE 55
SLOPE: 3 %

DPI - MRC KEILAMBETE GRAZING TRIAL



. = Site Number.

APPENDIX 3

MONTHLY WEATHER DATA

LOCATION: *ROSL\METDATA*

Monthly Weather Data

(a) Temperatures (°C)						
	Air min	Air max	Air 0900	Soil min	Soil max	Grass min
1994						
January	21.9	34.5	26.9	29	44	22
February	21.7	32.4	25.5	29	40	21
March	18	28.6	22.7	25	34	17
April	16.7	29.6	23.2	26	36	15
May	7.5	24.6	17.9	-	-	6
June	5.9	22.5	14.9	-	-	4
July	5.3	21.6	13.9	-	-	3
August	6.3	23	15.7	-	-	5
September	10.1	28	20.2	22	40	8
October	15.5	31.1	23.8	22	41	14
November	18.9	33.9	26.3	26	46	18
December	20.2	33.8	26.4	27	46	19
Annual						
1995						
January	21.8	34	26.5	28	45	21
February	21	31.1	24.5	25	38	20
March	19.6	33.5	25.8	27	45	19
(b) Moisture Parameters						
Month	Total Rain (mm)	Rel. Humidity min (%)	Rel. Humidity max (%)	Rel. Humidity 0900 (%)	Total Evaporation (mm)	
1992						
S	12					
O	12					
N	54					
D	71					
1993						
J	58					
F	27					
M	0					
A	0					
M	8					
J	0					
J	19					
A	90					
Sep-Aug Total	351					
S	60					
O	20					
N	136					
D	5					
Annual Total	423					
1994						
J	19.5	30.8	81.2	60	117.9	
F	24.5	40	85.1	69	158.1	
M	146.5	47.7	93.2	72	157.4	
A	0	39	91.3	68	10.3 (?)	
M	0	30.9	84	50	89.4	
J	4.5	35.5	85.9	60	86.5	
J	0	31.9	75.5	54	89	
A	0	28.2	72.9	54	105.4	
Sep-Aug Total	416					
S	0	19.5	64.7	42	150.3	
O	21.5	24.4	70.8	47	163.9	
N	9.5	24.3	69.4	46	219.1	
D	25	29	81.3	56	221.9	
Annual Total	246.5					
1995						

J	103.5	34.6	83.3	63	211.9	
F	185	50.1	93.9	77	149.7	
M	21.5	34.3	85.1	62	187.8	
A	16					
M	36					
J	0					
J	0					
A	20					
Sep-Aug Total	438					
S	0					
O	65					
N	29					
D	33					
Annual Total	509					
1996						
J	113					
F	0					
M	0					
A	94					
M	0					
J	0					
J	0					
A	16					
Sep-Aug Total	350					
Rainfall data January 1994 to March 1995 was collected at the site. The remining rainfall is that received at the Keilambete homestead						
(c) Other parameters						
	Wind run (km)	Sunshine daily hours	Radiation daily (MJ/m2)			
1994						
January	117	11.6	24			
February	115	11.1	21			
March	98	10.1	20			
April	60	10.2	21			
May	57	9.7	17			
June	56	9.1	15			
July	74	9.4	16			
August	66	9.5	18			
September	79	10.2	23			
October	87	11	22			
November	105	11.7	26			
December	108	12	25			
Annual						
1995						
January	107	11.8	24			
February	84	10.8	20			
March	67	10.5	22			

APPENDIX 4

TREE AND SHRUB DENSITIES (plants/ha)

LOCATION: *TREES\SUMMARY*

Density (stems-ha) Summary

	Tree Height Class (m)									
Species	<0.5	0.5-1.5	1.5-4.0	4.0-7.0	7.0-10.0	10.0-15.0	>15.0	Total	se - note	% of total
aclon	6	6	2	3	1	1	0	***18***	8.0	**1**
arbas	182	52	10	0	0	0	0	***244***	176.6	**11**
buinc	111	20	13	0	5	0	0	***149***	57.7	**7**
caova	6	1	0	0	0	0	0	***7***	2.2	**0**
caspp	3	0	0	0	0	0	0	***3***	2.8	**0**
erlon	4	0	0	0	0	0	0	***4***	3.7	**0**
euery	40	18	8	18	11	5	1	***99***	27.0	**5**
eumel	1017	241	160	67	52	40	5	***1580***	143.0	**73**
eupap	10	1	0	0	0	2	0	***13***	5.9	**1**
fldis	1	0	0	0	0	0	0	***1***	1.0	**0**
halor	0	0	0	1	0	0	0	***1***	1.0	**0**
jadid	1	4	0	0	0	0	0	***5***	2.7	**0**
jatri	20	2	0	0	0	0	0	***22***	14.4	**1**
macun	9	1	0	1	0	0	0	***11***	7.3	**1**
opspp	1	0	0	0	0	0	0	***1***	1.0	**0**
pepub	7	2	0	1	0	0	0	***9***	6.0	**0**
TOTAL	**1416**	**347**	**193**	**90**	**68**	**48**	**6**	**2167**		
se	179	54	22	10	10	14	3			
% of Total	**65**	**16**	**9**	**4**	**3**	**2**	**0**	**100**		

note - standard errors are also calculated for each species per height class. These results are listed under species sheet names in sum95.xls

APPENDIX 5

TREE AND SHRUB BASAL AREA (m^2/ha)

LOCATION: TREES\SUMMARY

Basal Area (sq. m-ha) Summary

	Tree Height Class (m)									
Species	<0.5	0.5-1.5	1.5-4.0	4.0-7.0	7.0-10.0	10.0-15.0	>15.0	Total	se - note	% of total
aclon	0.00	0.00	0.00	0.01	0.01	0.00	0.00	**0.02**	.016	**0.3**
arbas	0.01	0.01	0.01	0.00	0.00	0.00	0.00	**0.03**	.016	**0.4**
buinc	0.00	0.03	0.02	0.00	0.08	0.00	0.00	**0.14**	.045	**1.8**
caova	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**	.000	**0.0**
caspp	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**	.000	**0.0**
erlon	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**	.000	**0.0**
euery	0.09	0.00	0.02	0.16	0.26	0.29	0.02	**0.83**	.176	**10.8**
eumel	0.07	0.27	0.57	0.62	1.88	2.63	0.50	**6.53**	.975	**85.1**
eupap	0.00	0.00	0.00	0.00	0.00	0.08	0.00	**0.08**	.077	**1.0**
fldis	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**	.000	**0.0**
halor	0.00	0.00	0.00	0.01	0.01	0.00	0.00	**0.02**	.004	**0.3**
jadid	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**	.000	**0.0**
jatri	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**	.000	**0.0**
macun	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**	.000	**0.0**
opspp	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**	.000	**0.0**
pepub	0.00	0.00	0.00	0.01	0.00	0.00	0.00	**0.01**	.011	**0.1**
TOTAL	**0.17**	**0.32**	**0.63**	**0.81**	**2.24**	**2.99**	**0.51**	**7.67**		
se	0.081	0.092	0.237	0.192	0.233	0.760	0.339			
% of Total	**2.3**	**4.1**	**8.2**	**10.5**	**29.2**	**39.0**	**6.7**	**100**		
note - standard errors are also calculated for each species per height class. These results are listed under species sheet names in sum95.xls										

APPENDIX 6

PASTURE GROWTH, PHENOLOGY AND SUMMARY MOISTURE LEVELS AT SWIFTSYND SITES

LOCATION: PAGROWTH\SSYN\SUMMARY

Pasture growth 94-95-Cleared

Date	19-Sep-94	18-Jan-95	3-Mar-95	24-Apr-95	27-Jul-95
Rain prior	start date	97	247	148	0
Soil Moisture - gravimetric (%)					
0-10cm	4.5	3.1	8.2	5.6	4.8
10-30cm	10.1	9.6	17.1	11.9	11.9
30-100cm	10.3	9.4	12.3	11.3	10.6
Total yield (kg DM/ha)		71	1350	1680	533
Bot ewa		18	197	652	194
Het con		14	418	449	200
Chr fal		3	44	73	20
Other grasses		21	166	359	64
Forbs		16	525	147	55
Plant Parts (%)	Bot ewa				
Green leaf		100	56	25	
Dead leaf			3	36	
Green stem			36	32	
Dead stem				6	
Seed head			5	1	
	Het con				
Green leaf		100	74	50	
Dead leaf			2	15	
Green stem			23	32	
Dead stem				1	
Seed head			2	3	
	Chr fal				
Green leaf		100	65	insufficient	
Dead leaf			12	material	
Green stem			15		
Dead stem					
Seed head			9		

Pasture growth 94-95 Trees

Date	19-Sep-94	18-Jan-95	3-Mar-95	24-Apr-95	27-Jul-95
Rain prior	start date	96.5	247	148	0
Soil Moisture - gravimetric (%)					
0-10cm	3.7	1.6	10.5	5.9	5.3
10-30cm	9.8	8.1	15.9	10.3	11.2
30-100cm	7.4	7.2	8.8	5.8	7.8
Total yield		41	1804	2002	831
Bot ewa		7	303	565	199
Het con		1	584	779	388
Chr fal		13	401	354	116
Other grasses		12	272	252	104
Forbs		8	245	52	24
Plant Parts (%)	Bot ewa				
Green leaf		100	40	15	
Dead leaf			4	35	
Green stem			47	31	
Dead stem				19	
Seed head			9		
	Het con				
Green leaf		100	62	53	
Dead leaf			1	26	
Green stem			37	16	
Dead stem				trace	
Seed head			1	5	
	Chr fal				
Green leaf		100	55	43	
Dead leaf			2	48	
Green stem			29	2	
Dead stem				4	
Seed head			14	3	

Pasture growth 95-96 Cleared

Date	6.09.95	16.11.95	1.02.96	9.04.96	13.06.96
Rain to:	start date	26.5	144.5	7	75
Soil Moisture - gravimetric(%)					
0-10 cm	7.78	3.47	1.91	4.18	4.45
10-30 cm	11.93	9.80	11.85	11.33	10.35
30-70 cm	13.88	13.12	12.27	11.58	8.22
Total Yield (kg DM/ha)		250	1235	1180	1889
Bot ewa		32	368	538	789
Het con		60	258	271	501
Chr fal		33	76	72	207
Other grasses		101	440	276	340
Forbs		23	93	22	52
Plant Parts					
(%)	Bot ewa				
Green leaf		100	58	0	26
Dead leaf			11	53	32
Green stem			29	47	27
Dead stem			0	0	3
Seed head			2	0	3
	Het con				
Green leaf		100	79	0	20
Dead leaf			14	95	59
Green stem			7	4	11
Dead stem			0	0	4
Seed head			0	1	12
	Chr fal				
Green leaf		100	75	0	48
Dead leaf			15	90	53
Green stem			7	0	5
Dead stem			0	9	0
Seed head			2	0	0

Pasture growth 95-96 Trees

Date	6.09.95	18.11.95	1.02.96	9.04.96	13.06.96
Rain to:	start date	26.5	144.5	7	75
Soil Moisture - gravimetric(%)					
0-10 cm	5.75	5.90	6.65	4.65	7.19
10-30 cm	11.45	10.95	13.37	10.42	11.42
30-70 cm	10.99	8.68	9.52	9.80	9.59
Total Yield (kg DM/ha		152	977	1181	1851
Bot ewa		7	84	500	433
Het con		58	374	440	799
Chr fal		24	136	146	205
Other grasses		45	346	81	346
Forbs		19	37	15	68
Plant Parts					
(%)	Bot ewa				
Green leaf		100	66	0	11
Dead leaf			15	46	10
Green stem			17	54	19
Dead stem			0	0	1
Seed head			2	0	2
	Het con				
Green leaf		100	85	0	25
Dead leaf			7	95	29
Green stem			9	0	13
Dead stem			0	5	0
Seed head			0	0	11
	Chr fal				
Green leaf		100	67	0	38
Dead leaf			19	95	20
Green stem			13	0	5
Dead stem			0	5	7
Seed head			1	0	3

APPENDIX 7

GRAVIMETRIC SOIL MOISTURE (%) AT SWIFTSYND SITE

LOCATION: *PAGROWTH\SSYN\9495 and 9596*

KEILAMBETE SWIFTSYND SITE CLEARED AVERAGE GRAVIMETRIC SOIL MOISTURE PERCENTAGE							
	9/12/94	10/01/95	18/01/95	14/02/95	3/03/95	29/03/95	24/04/95
DEPTH							
0-10cm	3.92	5.62	3.06	14.20	8.22	6.25	5.56
10-20cm	5.64	10.22	7.43	16.58	15.84	10.06	10.17
20-30cm	10.35	12.37	11.79	21.93	18.34	11.42	13.55
30-40cm	11.60	12.22	11.44	19.30	16.55	11.21	15.56
40-50cm	11.80	11.32	10.32	13.60	14.70	11.32	12.37
50-60cm	11.09	10.81	9.57	12.44	12.44	10.79	11.51
60-70cm	10.23	8.76	9.88	11.12	11.18	9.96	11.39
70-80cm	8.01	4.83	9.23	10.05	10.11	9.72	9.90
80-90cm	2.12	0	8.63	4.96	2.94	2.67	4.57
90-100cm	0.00	0	2.53	0.00	0.00	3.09	0.00
100-110c	0.00	0	2.84	0.00	0.00	0.00	0.00
110-120c	0.00	0	0.00	0.00	0.00	0.00	0.00

KEILAMBETE SWIFTSYND SITE TREES AVERAGE GRAVIMETRIC SOIL MOISTURE PERCENTAGE							
	9/12/94	10/01/95	18/01/95	14/02/95	3/03/95	29/03/95	24/04/95
DEPTH							
0-10cm							
10-20cm							
20-30cm							
30-40cm							
40-50cm							
50-60cm							
60-70cm							
70-80cm							
80-90cm							
90-100cm							
100-110cm							
110-120cm							

KEILAMBETE SWIFTSYND SITE CLEARED AVERAGE GRAVIMETRIC SOIL MOISTURE PERCENTAGE

DEPTH	27.07.95	ST ERR	06.09.95	ST ERR	16.11.95	ST ERR	01.02.96	ST ERR	09.04.96	ST ERR
0-10cm	**4.8**	0.62	**7.8**	2.52	**3.5**	1.51	**1.9**	0.08	**4.2**	0.47
10-20cm	**10.4**	0.96	**10.5**	4.13	**7.4**	2.67	**10.0**	0.34	**9.8**	0.63
20-30cm	**13.4**	0.55	**13.4**	1.48	**12.2**	1.05	**13.7**	0.90	**12.9**	1.02
30-40cm	**13.3**	0.77	**15.2**	1.33	**14.2**	1.37	**13.8**	1.31	**12.6**	0.49
40-50cm	**12.7**	0.92	**14.8**	1.78	**14.1**	1.82	**12.8**	1.47	**12.2**	0.09
50-60cm	**10.7**	0.85	**13.6**	2.48	**12.9**	1.54	**11.8**	0.57	**11.0**	0.93
60-70cm	**9.2**	2.08	**11.9**	1.88	**11.3**	2.77	**10.7**	1.85	**10.5**	1.86
70-80cm	**10.0**	1.18	**11.4**	1.36	**11.2**	2.62	**9.5**	2.19	**8.5**	2.25
80-90cm					**11.5**	1.28	**6.6**	2.49	**7.4**	2.47
90-100cm										

KEILAMBETE SWIFTSYND SITE WITH TREES AVERAGE GRAVIMETRIC SOIL MOISTURE PERCENTAGE

DEPTH	27.07.95	ST ERR	06.09.95	ST ERR	16.11.95	ST ERR	01.02.96	ST ERR	09.04.96	ST ERR
0-10cm	**5.3**	0.82	**5.8**	0.32	**5.9**	1.11	**6.7**	2.25	**4.7**	1.75
10-20cm	**10.3**	1.07	**10.6**	0.53	**10.2**	1.43	**12.7**	3.15	**9.0**	1.30
20-30cm	**12.0**	0.77	**12.3**	0.53	**11.7**	1.62	**14.0**	1.66	**11.8**	1.13
30-40cm	**10.4**	1.10	**12.0**	0.82	**10.5**	1.84	**12.7**	1.02	**11.4**	0.94
40-50cm	**9.0**	0.99	**11.4**	0.77	**8.7**	1.28	**10.4**	1.41	**9.9**	0.64
50-60cm	**6.6**	1.06	**10.6**	0.53	**7.6**	0.77	**8.4**	1.26	**8.5**	1.82
60-70cm	**5.7**	0.85	**10.0**	1.03	**7.8**	1.57	**6.6**	1.08	**9.3**	2.00
70-80cm					**6.7**	3.58	**6.3**	0.60		
80-90cm							**6.1**	1.79		
90-100cm							**6.9**	0.35		

APPENDIX 8

FREQUENCY (%) OF KEY GROUPS

LOCATION: BOTANAL\1994, 1995, 1996 and 1994-96\SUMMARY

Frequency Summary 1994

Key group frequency (%) of each treatment

Plant Category	Plant Group	Cleared Low	Cleared Medium	Cleared High	Trees Low	Trees Medium	Trees High	LSD P=.05
Major Perennial Grasses	*Bot ewa*	35.3	35.2	33.7	29.3	39.0	31.8	ns
	Chr fal	36.7	44.8	38.4	46.0	42.2	39.0	ns
	Het con	26.1	27.3	20.1	22.8	23.1	25.6	ns
	The tri	20.4	20.9	22.5	12.3	17.1	11.9	ns
Minor Perennial Grasses	*Dic ser*	3.8	5.9	3.1	4.4	7.0	7.3	ns
	Dig spp	2.1	0.8	2.9	5.1	3.1	2.9	ns
	Eul aur	14.9	14.1	14.0	13.6	11.8	13.7	ns
	Pan spp	18.0	20.1	27.3	18.5	20.7	21.4	ns
Undesirable Perennial Grasses	*Ari spp*	22.3	25.8	15.0	18.9	14.4	16.9	ns
Mixed types grass group	*Chl spp*	1.8	1.9	2.0	3.0	5.1	1.6	ns
	Enn spp	15.7	19.4	21.8	13.7	14.3	17.0	ns
	Era spp	7.5	10.6	11.1	10.1	6.4	8.9	ns
	Eri spp	1.7	1.5	1.0	1.3	2.3	3.6	ns
	Other grasses	1.3	0.8	2.0	2.3	0.8	1.3	ns
	Pas spp	2.9	1.4	1.4	5.0	3.6	4.3	ns
	Spo spp	0.7	0.8	1.6	0.6	2.3	1.1	ns
Low height grasses	*Dac rad*	0.7	0.4	0.5	1.5	0.2	0.7	ns
	Tra aus	0.9	0.0	0.5	1.3	0.5	0.8	ns
	Tri lol	14.8	9.4	14.5	13.5	11.2	9.7	ns
Non grasses	Forbs	75.6	73.4	75.8	73.3	73.6	66.4	ns
	Nat legume	64.6	62.1	60.2	56.6	75.8	54.4	ns
	Sedges	27.0	16.6	14.6	35.0	32.7	24.2	ns

Key group frequency averaged across similar grazing pressures

Plant Category	Plant Group	Low	Medium	High	LSD P=.05
Major Perennial Grasses	*Bot ewa*	32.3	37.1	32.7	ns
	Chr fal	41.3	43.5	38.7	ns
	Het con	24.4	25.2	22.8	ns
	The tri	16.3	19.0	17.2	ns
Minor Perennial Grasses	*Dic ser*	4.1	6.4	5.2	ns
	Dig spp	3.6	1.9	2.9	ns
	Eul aur	14.2	12.9	13.8	ns
	Pan spp	18.2	20.4	24.3	ns
Undesirable Perennial Grasses	*Ari spp*	20.6	20.1	15.9	ns
Mixed types grass group	*Chl spp*	2.4	3.5	1.8	ns
	Enn spp	14.7	16.9	19.4	ns
	Era spp	8.8	8.5	10.0	ns
	Eri spp	1.5	1.9	2.3	ns
	Other grasses	1.8	0.8	1.6	ns
	Pas spp	3.9	2.5	2.8	ns
	Spo spp	0.7	1.5	1.3	ns
Low height grasses	*Dac rad*	1.1	0.3	0.6	ns
	Tra aus	1.1	0.2	0.6	ns
	Tri lol	14.1	10.3	12.1	ns
Non grasses	Forbs	74.4	73.5	71.1	ns
	Nat legume	60.6	68.9	57.3	ns
	Sedges	31.0	24.6	19.4	ns

Key group frequency averaged across timber treatments

Plant Category	Plant Group	Cleared	Trees	LSD P=.05
Major Perennial Grasses	*Bot ewa*	34.7	33.3	ns
	Chr fal	40.0	42.4	ns
	Het con	24.5	23.8	ns
	The tri	21.2	13.7	7.0
Minor Perennial Grasses	*Dic ser*	4.2	6.2	ns
	Dig spp	1.9	3.7	1.3
	Eul aur	14.3	13.0	ns
	Pan spp	21.8	20.2	ns
Undesirable Perennial Grasses	*Ari spp*	21.0	16.7	ns
Mixed types grass group	*Chl spp*	1.9	3.2	ns
	Enn spp	19.0	15.0	ns
	Era spp	9.7	8.5	ns
	Eri spp	1.4	2.4	ns
	Other grasses	1.3	1.4	ns
	Pas spp	1.9	4.3	2.1
	Spo spp	1.0	1.3	ns
Low height grasses	*Dac rad*	0.5	0.8	ns
	Tra aus	0.5	0.8	ns
	Tri lol	12.9	11.4	ns
Non grasses	Forbs	74.9	71.1	ns
	Nat legume	62.3	62.2	ns
	Sedges	19.4	30.6	ns

Key group frequency averaged across all treatments

Plant Grp	All
Bot ewa	34.0
Chr fal	41.2
Het con	24.1
The tri	17.5
Dic ser	5.2
Dig spp	2.8
Eul aur	13.7
Pan spp	21.0
Ari spp	18.9
Chl spp	2.5
Enn spp	17.0
Era spp	9.1
Eri spp	1.9
O. grasses	1.4
Pas spp	3.1
Spo spp	1.2
Dac rad	0.6
Tra aus	0.6
Tri lol	12.2
Forbs	73.0
Nat leg.	62.3
Sedges	25.0

Frequency Summary 1995

Key group frequency (%) yield of each treatment

Plant Category	Plant Group	Cleared Low	Cleared Medium	Cleared High	Trees Low	Trees Medium	Trees High	LSD P=.05
Major Perennial Grasses	*Bot ewa*	36.5	42.1	39.3	36.8	45.3	39.6	ns
	Chr fal	43.1	39.5	33.7	48.9	45.7	39.1	ns
	Het con	40.3	40.0	43.9	36.5	35.3	36.4	ns
	The tri	22.3	22.6	16.3	12.6	14.2	10.2	ns
Minor Perennial Grasses	*Dic ser*	3.5	4.9	5.6	3.1	4.9	2.8	ns
	Dig spp	4.6	3.6	8.5	3.1	1.7	3.4	ns
	Eul aur	12.2	12.3	9.6	14.8	12.2	7.9	ns
	Pan spp	17.2	19.7	19.7	11.5	13.9	7.6	ns
Undesirable Perennial Grasses	*Ari spp*	18.4	18.7	16.3	20.2	15.7	12.4	ns
Mixed types grass group	*Chl spp*	1.9	1.9	3.4	2.2	3.1	1.9	ns
	Enn spp	21.1	16.8	24.8	15.4	21.7	19.6	ns
	Era spp	5.7	6.7	7.3	5.4	2.4	3.4	ns
	Eri spp	1.1	1.2	3.4	1.8	1.8	4.3	ns
	Other grasses	1.6	0.4	1.1	4.0	1.9	1.9	ns
	Pas spp	4.2	3.8	2.2	2.9	2.7	1.3	ns
	Spo spp	2.2	2.7	5.1	1.1	9.3	5.6	ns
Low height grasses	*Dac rad*	0.6	2.9	2.8	2.3	0.4	3.9	ns
	Tra aus	1.0	1.1	1.1	1.6	0.9	3.9	ns
	Tri lol	12.7	12.1	12.9	12.4	10.9	12.3	ns
Non grasses	Forbs	56.4	62.1	63.0	62.2	68.1	44.3	ns
	Nat legume	48.4	56.3	53.4	34.0	54.2	37.4	ns
	Sedges	30.3	16.9	23.1	33.0	13.3	33.9	ns

Key group frequency averaged across similar grazing pressures

Plant Category	Plant Group	Low	Medium	High	LSD P=.05
Major Perennial Grasses	*Bot ewa*	36.7	43.7	39.5	ns
	Chr fal	46.0	42.6	36.4	ns
	Het con	38.4	37.6	40.1	ns
	The tri	17.4	18.4	13.3	ns
Minor Perennial Grasses	*Dic ser*	3.3	4.9	4.2	ns
	Dig spp	3.8	2.7	5.9	ns
	Eul aur	13.5	12.3	8.7	ns
	Pan spp	14.3	16.8	13.6	ns
Undesirable Perennial Grasses	*Ari spp*	19.3	17.2	14.3	ns
Mixed types grass group	*Chl spp*	2.0	2.5	2.6	ns
	Enn spp	18.2	19.2	22.2	ns
	Era spp	5.5	4.5	5.4	ns
	Eri spp	1.5	1.5	3.8	ns
	Other grasses	2.8	1.2	1.5	ns
	Pas spp	3.5	3.2	1.7	ns
	Spo spp	1.6	6.0	5.3	ns
Low height grasses	*Dac rad*	1.4	1.6	3.4	ns
	Tra aus	1.3	1.0	2.5	ns
	Tri lol	12.5	11.5	12.6	ns
Non grasses	Forbs	59.3	65.1	53.6	ns
	Nat legume	41.2	55.2	45.4	ns
	Sedges	31.7	15.1	28.5	1.0

Key group frequency averaged across timber treatments

Plant Category	Plant Group	Cleared	Trees	LSD P=.05
Major Perennial Grasses	*Bot ewa*	39.3	40.6	ns
	Chr fal	38.8	44.5	ns
	Het con	41.4	36.0	ns
	The tri	20.4	12.3	ns
Minor Perennial Grasses	*Dic ser*	4.7	3.6	ns
	Dig spp	5.5	2.7	ns
	Eul aur	11.3	11.6	ns
	Pan spp	18.9	11.0	7.5
Undesirable Perennial Grasses	*Ari spp*	17.8	16.1	ns
Mixed types grass group	*Chl spp*	2.4	2.4	ns
	Enn spp	20.9	18.9	ns
	Era spp	6.6	3.7	ns
	Eri spp	1.9	2.6	ns
	Other grasses	1.0	2.6	1.3
	Pas spp	3.4	2.3	ns
	Spo spp	3.3	5.3	ns
Low height grasses	*Dac rad*	2.1	2.2	ns
	Tra aus	1.0	2.1	ns
	Tri lol	12.6	11.8	ns
Non grasses	Forbs	60.5	58.2	ns
	Nat legume	52.7	41.8	ns
	Sedges	23.4	26.7	ns

Key group frequency averaged across all treatments

Plant Grp.	All
Bot ewa	39.9
Chr fal	41.6
Het con	38.7
The tri	16.4
Dic ser	4.1
Dig spp	4.1
Eul aur	11.5
Pan spp	14.9
Ari spp	16.9
Chl spp	2.4
Enn spp	19.9
Era spp	5.1
Eri spp	2.3
O. grasses	1.8
Pas spp	2.8
Spo spp	4.3
Dac rad	2.1
Tra aus	1.6
Tri lol	12.2
Forbs	59.3
Nat leg.	47.2
Sedges	25.1

Key group frequency (%) of each treatment

Plant Category	Plant Group	Cleared Low	Cleared Medium	Cleared High	Trees Low	Trees Medium	Trees High	LSD P=.05
Major Perennial Grasses	*Bot ewa*	41.5	51.3	42.4	40.9	52.3	34.3	ns
	Chr fal	35.7	39.5	39.1	43.4	40.9	33.7	ns
	Het con	40.9	41.0	34.5	31.9	38.6	27.5	ns
	The tri	15.9	5.7	7.7	12.7	8.4	3.7	ns
Minor Perennial Grasses	*Dic ser*	2.1	0.0	0.0	2.3	5.9	0.9	significant
	Dig spp	2.4	1.5	2.8	1.6	0.2	0.6	ns
	Eul aur	11.4	12.1	11.5	13.0	11.6	8.0	ns
	Pan spp	11.0	8.2	8.8	8.0	7.7	2.9	ns
Undesirable Perennial Grasses	*Ari spp*	27.8	16.7	19.7	25.0	13.9	6.8	ns
Mixed types grass group	*Chl spp*	4.7	9.9	6.0	3.0	4.7	3.1	ns
	Enn spp	25.2	25.0	22.4	19.0	22.8	24.7	ns
	Era spp	4.2	3.9	4.5	3.2	1.3	0.9	ns
	Eri spp	2.1	2.3	2.2	1.3	0.9	0.9	ns
	Other grasses	0.6	0.4	0.6	2.1	0.6	1.2	ns
	Pas spp	3.2	3.7	4.4	6.1	3.2	2.6	ns
	Spo spp	1.0	1.8	2.7	0.1	0.7	2.8	ns
Low height grasses	*Dac rad*	0.0	0.0	0.0	0.1	0.0	0.0	ns
	Tra aus	2.5	3.0	4.4	1.4	2.0	7.7	ns
	Tri lol	14.5	13.7	14.0	15.8	11.5	16.8	ns
Non grasses	Forbs	36.4	40.6	35.6	38.7	41.5	29.2	ns
	Nat legume	11.1	14.1	11.9	4.6	7.3	4.0	ns
	Sedges	27.6	19.2	18.7	27.3	9.8	26.7	ns

Key group frequency averaged across similar grazing pressures

Plant Category	Plant Group	Low	Medium	High	LSD P=.05
Major Perennial Grasses	*Bot ewa*	41.2	51.8	38.3	ns
	Chr fal	39.5	40.2	36.4	ns
	Het con	36.4	39.8	31.0	ns
	The tri	14.3	7.0	5.7	4.6
Minor Perennial Grasses	*Dic ser*	2.2	3.0	0.4	1.2
	Dig spp	2.0	0.8	1.7	ns
	Eul aur	12.2	11.9	9.7	ns
	Pan spp	9.5	7.9	5.8	ns
Undesirable Perennial Grasses	*Ari spp*	26.4	15.3	13.3	9.9
Mixed types grass group	*Chl spp*	3.9	7.3	4.5	ns
	Enn spp	22.1	23.9	23.5	ns
	Era spp	3.7	2.6	2.7	ns
	Eri spp	1.7	1.6	1.5	ns
	Other grasses	1.3	0.5	0.9	ns
	Pas spp	4.6	3.4	3.5	ns
	Spo spp	0.5	1.2	2.8	ns
Low height grasses	*Dac rad*	0.1	0.0	0.0	ns
	Tra aus	1.9	2.5	6.0	2.7
	Tri lol	15.1	12.6	15.4	ns
Non grasses	Forbs	37.5	41.0	32.4	ns
	Nat legume	7.8	10.7	7.9	ns
	Sedges	27.4	14.5	22.7	1.0

Key group frequency averaged across timber treatments

Plant Category	Plant Group	Cleared	Trees	LSD P=.05
Major Perennial Grasses	*Bot ewa*	45.1	42.5	ns
	Chr fal	38.1	39.3	ns
	Het con	38.8	32.7	ns
	The tri	9.8	8.2	ns
Minor Perennial Grasses	*Dic ser*	0.7	3.0	1.0
	Dig spp	2.2	0.8	ns
	Eul aur	11.7	10.9	ns
	Pan spp	9.3	6.2	ns
Undesirable Perennial Grasses	*Ari spp*	21.4	15.2	ns
Mixed types grass group	*Chl spp*	6.8	3.6	2.9
	Enn spp	24.2	22.2	ns
	Era spp	4.2	1.8	ns
	Eri spp	2.2	1.0	ns
	Other grasses	0.5	1.3	ns
	Pas spp	3.8	3.9	ns
	Spo spp	1.8	1.2	ns
Low height grasses	*Dac rad*	0.0	0.0	ns
	Tra aus	3.3	3.7	ns
	Tri lol	14.0	14.7	ns
Non grasses	Forbs	37.5	36.5	ns
	Nat legume	12.4	5.3	2.6
	Sedges	21.8	21.3	ns

Key group frequency averaged across all treatments

Plant Grp.	All
Bot ewa	43.8
Chr fal	38.7
Het con	35.7
The tri	9.0
Dic ser	1.9
Dig spp	1.5
Eul aur	11.3
Pan spp	7.7
Ari spp	18.3
Chl spp	5.2
Enn spp	23.2
Era spp	3.0
Eri spp	1.6
O. grasses	0.9
Pas spp	3.8
Spo spp	1.5
Dac rad	0.0
Tra aus	3.5
Tri lol	14.4
Forbs	37.0
Nat leg.	8.8
Sedges	21.5

Key group frequency (%) yield of each treatment

Plant Category	Plant Group	Cleared Low	Cleared Medium	Cleared High	Trees Low	Trees Medium	Trees High	LSD P=05
Major Perennial Grasses	*Bot ewa*	1.2	6.9	5.7	7.6	6.3	7.8	ns
	Chr fal	6.5	-5.4	-4.7	2.9	3.5	0.1	ns
	Het con	14.3	12.8	23.8	13.8	12.2	10.8	ns
	The tri	1.9	1.7	-6.2	0.4	-2.9	-1.7	ns
Minor Perennial Grasses	*Dic ser*	-0.3	-1.0	2.6	-1.3	-2.1	-4.6	ns
	Dig spp	2.5	2.9	5.6	-2.0	-1.4	0.5	ns
	Eul aur	-2.8	-1.8	-4.5	1.3	0.5	-5.8	ns
	Pan spp	-0.8	-0.4	-7.6	-7.1	-6.8	-13.8	ns
Undesirable Perennial Grasses	*Ari spp*	-4.0	-7.1	1.4	1.3	1.3	-4.5	ns
Mixed types grass group	*Chl spp*	0.2	0.1	1.4	-0.9	-2.0	0.3	ns
	Enn spp	5.4	-2.7	3.0	1.7	7.4	2.7	ns
	Era spp	-1.8	-4.0	-3.8	-4.8	-4.0	-5.5	ns
	Eri spp	-0.6	-0.4	2.4	0.5	-0.5	0.8	ns
	Other grasses	0.3	-0.4	-0.9	1.7	1.2	0.6	ns
	Pas spp	1.3	2.4	0.9	-2.1	-0.9	-3.0	ns
	Spo spp	1.5	2.0	3.5	0.5	7.1	4.5	ns
Low height grasses	*Dac rad*	-0.1	2.5	2.4	0.8	0.2	3.3	ns
	Tra aus	0.1	1.1	0.7	0.4	0.4	3.1	ns
	Tri lol	-2.1	2.8	-1.6	-1.1	-0.4	2.6	ns
Non grasses	Forbs	-19.2	-11.3	-12.9	-11.1	-5.5	-22.2	ns
	Nat legume	-16.3	-5.8	-6.8	-22.7	-21.6	-17.0	ns
	Sedges	3.3	0.4	8.5	-2.0	-19.5	9.7	ns

Key group frequency averaged across similar grazing pressures

Plant Category	Plant Group	Low	Medium	High	LSD P=05
Major Perennial Grasses	*Bot ewa*	4.4	6.6	6.7	ns
	Chr fal	4.7	-1.0	-2.3	ns
	Het con	14.0	12.5	17.3	ns
	The tri	1.1	-0.6	-3.9	ns
Minor Perennial Grasses	*Dic ser*	-0.8	-1.6	-1.0	ns
	Dig spp	0.3	0.8	3.0	ns
	Eul aur	-0.8	-0.7	-5.1	ns
	Pan spp	-3.9	-3.6	-10.7	ns
Undesirable Perennial Grasses	*Ari spp*	-1.3	-2.9	-1.6	ns
Mixed types grass group	*Chl spp*	-0.4	-1.0	0.8	ns
	Enn spp	3.6	2.4	2.8	ns
	Era spp	-3.3	-4.0	-4.7	ns
	Eri spp	0.0	-0.4	1.6	ns
	Other grasses	1.0	0.4	-0.1	ns
	Pas spp	-0.4	0.7	-1.1	ns
	Spo spp	1.0	4.5	4.0	ns
Low height grasses	*Dac rad*	0.4	1.3	2.8	ns
	Tra aus	0.2	0.7	1.9	ns
	Tri lol	-1.6	1.2	0.5	ns
Non grasses	Forbs	-15.2	-8.4	-17.5	ns
	Nat legume	-19.5	-13.7	-11.9	6.1
	Sedges	0.7	-9.6	9.1	ns

Key group frequency averaged across timber treatments

Plant Category	Plant Group	Cleared	Trees	LSD P=05
Major Perennial Grasses	*Bot ewa*	4.6	7.2	ns
	Chr fal	-1.2	2.1	ns
	Het con	16.9	12.3	ns
	The tri	-0.9	-1.4	ns
Minor Perennial Grasses	*Dic ser*	0.4	-2.7	ns
	Dig spp	3.6	-0.9	ns
	Eul aur	-3.0	-1.4	ns
	Pan spp	-2.9	-9.2	ns
Undesirable Perennial Grasses	*Ari spp*	-3.2	-0.7	ns
Mixed types grass group	*Chl spp*	0.5	-0.9	ns
	Enn spp	1.9	3.9	ns
	Era spp	-3.2	-4.8	ns
	Eri spp	0.5	0.3	ns
	Other grasses	-0.3	1.2	0.7
	Pas spp	1.5	-2.0	2.6
	Spo spp	2.3	4.0	ns
Low height grasses	*Dac rad*	1.6	1.4	ns
	Tra aus	0.6	1.3	ns
	Tri lol	-0.3	0.4	ns
Non grasses	Forbs	-14.4	-12.9	ns
	Nat legume	-9.6	-20.4	4.9
	Sedges	4.1	-3.9	ns

Key group frequency averaged across all treatments

Plant Grp.	All
Bot ewa	5.9
Chr fal	0.5
Het con	14.6
The tri	-1.1
Dic ser	-1.1
Dig spp	1.4
Eul aur	-2.2
Pan spp	-6.1
Ari spp	-1.9
Chl spp	-0.2
Enn spp	2.9
Era spp	-4.0
Eri spp	0.4
O. grasses	0.4
Pas spp	-0.3
Spo spp	3.2
Dac rad	1.5
Tra aus	0.9
Tri lol	0.0
Forbs	-13.7
Nat leg.	-15.0
Sedges	0.1

Frequency Summary 1996 - 1995

Key group frequency (%) of each treatment

Plant Category	Plant Group	Cleared Low	Cleared Medium	Cleared High	Trees Low	Trees Medium	Trees High	LSD P=.05
Major Perennial Grasses	*Bot ewa*	5.0	9.2	3.1	4.1	7.0	-5.4	ns
	Chr fal	-7.5	0.0	5.4	-5.5	-4.8	-5.4	ns
	Het con	0.6	1.0	-9.4	-4.6	3.3	-8.9	ns
	The tri	-6.4	-16.9	-8.7	0.1	-5.9	-6.6	significant
Minor Perennial Grasses	*Dic ser*	-1.4	-4.9	-5.6	-0.9	1.0	-1.9	ns
	Dig spp	-2.2	-2.2	-5.7	-1.6	-1.5	-2.8	ns
	Eul aur	-0.8	-0.2	2.0	-1.8	-0.6	0.1	ns
	Pan spp	-6.2	-11.6	-11.0	-3.5	-6.2	-4.7	ns
Undesirable Perennial Grasses	*Ari spp*	9.5	-2.0	3.4	4.8	-1.8	-5.6	significant
Mixed types grass group	*Chl spp*	2.8	8.0	2.6	0.9	1.6	1.3	ns
	Enn spp	4.1	8.2	-2.4	3.7	1.1	5.1	ns
	Era spp	-1.6	-2.8	-2.9	-2.2	-1.1	-2.6	ns
	Eri spp	1.0	1.1	-1.2	-0.6	-1.0	-3.5	ns
	Other grasses	-1.0	0.0	-0.6	-1.9	-1.3	-0.7	ns
	Pas spp	-1.0	-0.1	2.2	3.2	0.5	1.3	ns
	Spo spp	-1.2	-0.9	-2.4	-1.0	-8.7	-2.8	ns
Low height grasses	*Dac rad*	-0.6	-2.9	-2.8	-2.2	-0.4	-3.9	ns
	Tra aus	1.5	1.9	3.3	-0.3	1.1	3.8	ns
	Tri lol	1.8	1.6	1.1	3.5	0.7	4.5	ns
Non grasses	Forbs	-20.1	-21.6	-27.4	-23.5	-26.7	-15.1	ns
	Nat legume	-37.3	-42.2	-41.5	-29.4	-46.9	-33.4	ns
	Sedges	-2.8	2.3	-4.4	-5.7	-3.5	-7.2	ns

Key group frequency averaged across similar grazing pressures

Plant Category	Plant Group	Low	Medium	High	LSD P=.05
Major Perennial Grasses	*Bot ewa*	4.5	8.1	-1.1	ns
	Chr fal	-6.5	-2.4	0.0	ns
	Het con	-2.0	2.2	-9.1	ns
	The tri	-3.2	-11.4	-7.6	5.9
Minor Perennial Grasses	*Dic ser*	-1.1	-1.9	-3.8	ns
	Dig spp	-1.9	-1.8	-4.2	ns
	Eul aur	-1.3	-0.4	1.0	ns
	Pan spp	-4.8	-8.9	-7.8	ns
Undesirable Perennial Grasses	*Ari spp*	7.1	-1.9	-1.1	3.1
Mixed types grass group	*Chl spp*	1.8	4.8	1.9	ns
	Enn spp	3.9	4.7	1.3	ns
	Era spp	-1.9	-1.9	-2.7	ns
	Eri spp	0.2	0.1	-2.3	ns
	Other grasses	-1.5	-0.7	-0.6	ns
	Pas spp	1.1	0.2	1.8	ns
	Spo spp	-1.1	-4.8	-2.6	ns
Low height grasses	*Dac rad*	-1.4	-1.6	-3.4	ns
	Tra aus	0.6	1.5	3.5	ns
	Tri lol	2.6	1.1	2.8	ns
Non grasses	Forbs	-21.8	-24.1	-21.2	ns
	Nat legume	-33.3	-44.5	-37.5	ns
	Sedges	-4.2	-0.6	-5.8	ns

Key group frequency averaged across timber treatments

Plant Category	Plant Group	Cleared	Trees	LSD P=.05
Major Perennial Grasses	*Bot ewa*	5.8	1.9	ns
	Chr fal	-0.7	-5.2	ns
	Het con	-2.6	-3.4	ns
	The tri	-10.6	-4.1	4.8
Minor Perennial Grasses	*Dic ser*	-4.0	-0.6	3.1
	Dig spp	-3.3	-2.0	ns
	Eul aur	0.3	-0.8	ns
	Pan spp	-9.6	-4.8	4.1
Undesirable Perennial Grasses	*Ari spp*	3.6	-0.9	2.5
Mixed types grass group	*Chl spp*	4.5	1.2	2.3
	Enn spp	3.3	3.3	ns
	Era spp	-2.4	-1.9	ns
	Eri spp	0.3	-1.7	ns
	Other grasses	-0.5	-1.3	ns
	Pas spp	0.4	1.7	ns
	Spo spp	-1.5	-4.1	ns
Low height grasses	*Dac rad*	-2.1	-2.2	ns
	Tra aus	2.2	1.5	ns
	Tri lol	1.5	2.9	ns
Non grasses	Forbs	-23.0	-21.7	ns
	Nat legume	-40.3	-36.6	ns
	Sedges	-1.6	-5.5	ns

Key group frequency averaged across all treatments

Plant Grp.	All
Bot ewa	3.8
Chr fal	-3.0
Het con	-3.0
The tri	-7.4
Dic ser	-2.3
Dig spp	-2.6
Eul aur	-0.2
Pan spp	-7.2
Ari spp	1.4
Chl spp	2.8
Enn spp	3.3
Era spp	-2.2
Eri spp	-0.7
O. grasses	-0.9
Pas spp	1.0
Spo spp	-2.8
Dac rad	-2.1
Tra aus	1.9
Tri lol	2.2
Forbs	-22.4
Nat leg.	-38.4
Sedges	-3.5

APPENDIX 9

PASTURE YIELD (kg DM/ha) OF KEY GROUPS

LOCATION: BOTANAL\1994, 1995, 1996 and 1994-96\SUMMARY

Species Yield Summary 1994

Key group yields (kg DM/ha) of each treatment

Plant Category	Plant Group	Cleared Low	Cleared Medium	Cleared High	Trees Low	Trees Medium	Trees High	LSD P=.05
Major Perennial Grasses	*Bot ewa*	178	228	149	212	294	279	ns
	Chr fal	77	100	93	130	110	100	ns
	Het con	127	108	100	164	148	175	ns
	The tri	30	32	56	24	29	29	ns
Minor Perennial Grasses	*Dic ser*	9	8	10	13	16	21	ns
	Dig spp	3	1	4	8	6	4	ns
	Eul aur	56	46	34	55	50	63	ns
	Pan spp	26	25	46	35	37	47	ns
Undesirable Perennial Grasses	*Ari spp*	37	41	14	33	28	28	ns
Mixed types grass group	*Chl spp*	6	4	1	9	17	2	ns
	Enn spp	26	25	32	25	30	35	ns
	Era spp	8	16	8	12	10	19	ns
	Eri spp	5	3	2	5	5	21	ns
	Other grasses	2	1	4	11	3	6	ns
	Pas spp	2	1	2	9	6	3	ns
	Spo spp	0	1	1	0	1	0	ns
Low height grasses	*Dac rad*	0	0	0	2	0	1	ns
	Tra aus	1	0	0	2	1	2	ns
	Tri lol	3	3	3	2	2	3	ns
Non grasses	Forbs	29	22	18	38	24	26	ns
	Nat legume	14	10	14	19	22	10	ns
	Sedges	15	9	6	21	22	12	ns

Key group yields averaged across similar grazing pressures

Plant Category	Plant Group	Low	Medium	High	LSD P=.05
Major Perennial Grasses	*Bot ewa*	195	261	214	ns
	Chr fal	104	105	97	ns
	Het con	145	128	138	ns
	The tri	27	31	42	ns
Minor Perennial Grasses	*Dic ser*	11	12	15	ns
	Dig spp	5	4	4	ns
	Eul aur	56	48	49	ns
	Pan spp	31	31	46	12
Undesirable Perennial Grasses	*Ari spp*	35	34	21	ns
Mixed types grass group	*Chl spp*	7	10	2	ns
	Enn spp	25	27	33	ns
	Era spp	10	13	13	ns
	Eri spp	5	4	11	ns
	Other grasses	7	2	5	3
	Pas spp	6	4	2	ns
	Spo spp	0	1	0	ns
Low height grasses	*Dac rad*	1	0	0	ns
	Tra aus	2	0	1	ns
	Tri lol	3	2	3	ns
Non grasses	Forbs	33	23	22	7
	Nat legume	17	16	12	ns
	Sedges	18	15	9	ns

Key group yields averaged across timber treatments

Plant Category	Plant Group	Cleared	Trees	LSD P=.05
Major Perennial Grasses	*Bot ewa*	185	262	74
	Chr fal	90	113	ns
	Het con	112	162	ns
	The tri	39	28	ns
Minor Perennial Grasses	*Dic ser*	9	16	ns
	Dig spp	3	6	3
	Eul aur	45	56	ns
	Pan spp	32	40	ns
Undesirable Perennial Grasses	*Ari spp*	30	30	ns
Mixed types grass group	*Chl spp*	4	9	ns
	Enn spp	27	30	ns
	Era spp	11	13	ns
	Eri spp	3	10	ns
	Other grasses	2	7	3
	Pas spp	2	6	4
	Spo spp	0	0	ns
Low height grasses	*Dac rad*	0	1	ns
	Tra aus	0	2	ns
	Tri lol	3	2	ns
Non grasses	Forbs	23	29	6
	Nat legume	13	17	3
	Sedges	10	18	ns

Key group yields averaged across all treatments

Plant Grp.	All
Bot ewa	223
Chr fal	102
Het con	137
The tri	33
Dic ser	13
Dig spp	4
Eul aur	51
Pan spp	36
Ari spp	30
Chl spp	6
Enn spp	29
Era spp	12
Eri spp	7
O. grasses	4
Pas spp	4
Spo spp	0
Dac rad	0
Tra aus	1
Tri lol	3
Forbs	26
Nat leg.	15
Sedges	14

Key group yields (kg DM/ha) of each treatment

Plant Category	Plant Group	Cleared Low	Cleared Medium	Cleared High	Trees Low	Trees Medium	Trees High	LSD P=.05
Major Perennial Grasses	*Bot ewa*	450	386	208	478	496	370	ns
	Chr fal	189	122	49	202	136	111	ns
	Het con	467	400	230	424	379	283	ns
	The tri	106	85	50	79	40	24	ns
Minor Perennial Grasses	*Dic ser*	20	14	12	9	24	9	ns
	Dig spp	19	8	16	6	4	6	ns
	Eul aur	82	65	24	84	60	27	ns
	Pan spp	52	57	36	39	31	14	ns
Undesirable Perennial Grasses	*Ari spp*	74	44	35	67	47	29	ns
Mixed types grass group	*Chl spp*	7	5	5	6	6	4	ns
	Enn spp	51	51	34	40	43	36	ns
	Era spp	18	14	8	12	3	4	ns
	Eri spp	5	3	15	3	4	9	ns
	Other grasses	5	0	1	16	5	5	ns
	Pas spp	3	4	2	6	4	1	ns
	Spo spp	1	2	1	2	5	3	ns
Low height grasses	*Dac rad*	0	1	1	2	0	5	ns
	Tra aus	1	0	1	1	0	5	ns
	Tri lol	2	2	6	5	5	3	ns
Non grasses	Forbs	28	25	17	31	28	20	ns
	Nat legume	13	17	15	9	27	11	ns
	Sedges	27	8	11	27	7	29	ns

Key group yields averaged across similar grazing pressures

Plant Category	Plant Group	Low	Medium	High	LSD P=.05
Major Perennial Grasses	*Bot ewa*	464	441	289	142
	Chr fal	196	129	80	54
	Het con	446	390	256	149
	The tri	92	63	37	27
Minor Perennial Grasses	*Dic ser*	15	19	11	ns
	Dig spp	12	6	11	ns
	Eul aur	83	63	26	39
	Pan spp	46	44	25	ns
Undesirable Perennial Grasses	*Ari spp*	70	46	32	22
Mixed types grass group	*Chl spp*	6	5	5	ns
	Enn spp	46	47	35	ns
	Era spp	15	8	6	ns
	Eri spp	4	4	12	ns
	Other grasses	11	3	3	ns
	Pas spp	5	4	2	ns
	Spo spp	2	3	2	ns
Low height grasses	*Dac rad*	1	0	3	ns
	Tra aus	1	0	3	ns
	Tri lol	4	3	5	ns
Non grasses	Forbs	29	27	18	ns
	Nat legume	11	22	13	ns
	Sedges	27	7	20	ns

Key group yields averaged across timber treatments

Plant Category	Plant Group	Cleared	Trees	LSD P=.05
Major Perennial Grasses	*Bot ewa*	348	448	ns
	Chr fal	120	150	ns
	Het con	366	362	ns
	The tri	81	48	24
Minor Perennial Grasses	*Dic ser*	15	14	ns
	Dig spp	14	5	ns
	Eul aur	57	57	ns
	Pan spp	49	28	ns
Undesirable Perennial Grasses	*Ari spp*	51	48	ns
Mixed types grass group	*Chl spp*	6	5	ns
	Enn spp	45	40	ns
	Era spp	13	6	ns
	Eri spp	8	6	ns
	Other grasses	2	9	6
	Pas spp	3	4	ns
	Spo spp	1	3	ns
Low height grasses	*Dac rad*	1	2	ns
	Tra aus	1	2	ns
	Tri lol	4	4	ns
Non grasses	Forbs	23	26	ns
	Nat legume	15	16	ns
	Sedges	15	21	ns

Key group yields averaged across all treatments

Plant Grp.	All
Bot ewa	398
Chr fal	135
Het con	364
The tri	64
Dic ser	15
Dig spp	10
Eul aur	57
Pan spp	38
Ari spp	49
Chl spp	5
Enn spp	43
Era spp	10
Eri spp	7
O. grasses	5
Pas spp	3
Spo spp	2
Dac rad	1
Tra aus	1
Tri lol	4
Forbs	25
Nat leg.	16
Sedges	18

Species Yield Summary 1996

Key group yields (kg DM/ha) of each treatment

Plant Category	Plant Group	Cleared Low	Cleared Medium	Cleared High	Trees Low	Trees Medium	Trees High	LSD P=.05
Major Perennial Grasses	*Bot ewa*	852	386	98	1084	864	78	ns
	Chr fal	38	19	28	65	23	15	ns
	Het con	417	68	54	425	259	26	ns
	The tri	39	5	3	46	4	1	ns
Minor Perennial Grasses	*Dic ser*	11	0	0	5	8	0	ns
	Dig spp	4	0	2	1	0	0	ns
	Eul aur	52	11	5	44	30	4	ns
	Pan spp	16	3	3	12	4	0	ns
Undesirable Perennial Grasses	*Ari spp*	137	13	16	142	42	3	ns
Mixed types grass group	*Chl spp*	4	3	2	7	2	2	ns
	Enn spp	29	7	8	29	10	10	ns
	Era spp	3	2	1	6	0	0	ns
	Eri spp	5	1	0	1	0	1	ns
	Other grasses	3	0	0	19	18	0	ns
	Pas spp	2	1	1	11	1	1	ns
	Spo spp	1	0	0	0	0	1	ns
Low height grasses	*Dac rad*	0	0	0	1	0	0	ns
	Tra aus	1	0	0	0	0	2	ns
	Tri lol	3	1	2	5	2	3	ns
Non grasses	Forbs	10	7	4	13	15	7	ns
	Nat legume	3	0	1	1	1	0	ns
	Sedges	4	2	1	5	1	7	ns

Key group yields averaged across similar grazing pressures

Plant Category	Plant Group	Low	Medium	High	LSD P=.05
Major Perennial Grasses	*Bot ewa*	968	625	88	496
	Chr fal	52	21	22	24
	Het con	421	163	40	118
	The tri	42	5	2	16
Minor Perennial Grasses	*Dic ser*	8	4	0	ns
	Dig spp	3	0	1	ns
	Eul aur	48	21	5	19
	Pan spp	14	3	2	5
Undesirable Perennial Grasses	*Ari spp*	139	28	9	43
Mixed types grass group	*Chl spp*	6	3	2	ns
	Enn spp	29	8	9	11
	Era spp	5	1	1	3
	Eri spp	3	1	1	1
	Other grasses	11	9	0	ns
	Pas spp	7	1	1	ns
	Spo spp	0	0	1	ns
Low height grasses	*Dac rad*	0	0	0	ns
	Tra aus	1	0	1	0.5
	Tri lol	4	2	3	ns
Non grasses	Forbs	11	11	6	ns
	Nat legume	2	1	0	1
	Sedges	5	2	4	ns

Key group yields averaged across timber treatments

Plant Category	Plant Group	Cleared	Trees	LSD P=.05
Major Perennial Grasses	*Bot ewa*	445	676	ns
	Chr fal	28	35	ns
	Het con	180	237	ns
	The tri	16	17	ns
Minor Perennial Grasses	*Dic ser*	4	5	ns
	Dig spp	2	0	ns
	Eul aur	23	26	ns
	Pan spp	7	5	ns
Undesirable Perennial Grasses	*Ari spp*	55	62	ns
Mixed types grass group	*Chl spp*	3	4	ns
	Enn spp	14	16	ns
	Era spp	2	2	ns
	Eri spp	2	1	1
	Other grasses	1	12	ns
	Pas spp	1	4	ns
	Spo spp	1	0	ns
Low height grasses	*Dac rad*	0	0	ns
	Tra aus	0	1	0.5
	Tri lol	2	3	ns
Non grasses	Forbs	7	12	ns
	Nat legume	1	1	ns
	Sedges	2	5	ns

Key group yields averaged across all treatments

Plant Grp.	All
Bot ewa	561
Chr fal	31
Het con	208
The tri	16
Dic ser	4
Dig spp	1
Eul aur	24
Pan spp	6
Ari spp	59
Chl spp	3
Enn spp	15
Era spp	2
Eri spp	1
O. grasses	7
Pas spp	3
Spo spp	0
Dac rad	0
Tra aus	1
Tri lol	3
Forbs	9
Nat leg.	1
Sedges	3

APPENDIX 10

PERCENT OF TOTAL PASTURE YIELD (%) OF KEY GROUPS

LOCATION: BOTANAL\1994, 1995, 1996 and 1994-96\SUMMARY

Species Percentage Summary 1994

Key group percent of total yield of each treatment

Plant Category	*Plant Group*	Cleared Low	Cleared Medium	Cleared High	Trees Low	Trees Medium	Trees High	LSD P=.05
Major Perennial Grasses	*Bot ewa*	27.4	33.4	25.0	24.7	34.4	31.4	ns
	Chr fal	11.8	14.6	15.6	15.6	12.4	11.2	ns
	Het con	19.3	15.9	16.9	18.7	17.4	19.7	ns
	The tri	4.6	4.9	9.2	3.1	3.4	3.3	ns
Minor Perennial Grasses	*Dic ser*	1.3	1.1	1.7	1.8	1.9	2.3	ns
	Dig spp	0.4	0.2	0.6	0.9	0.7	0.5	ns
	Eul aur	3.9	3.7	7.6	4.3	4.2	5.3	ns
	Pan spp	5.6	6.1	2.3	4.3	3.2	3.1	ns
Undesirable Perennial Grasses	*Ari spp*	8.5	6.5	5.6	7.2	5.5	7.1	ns
Mixed types grass group	*Chl spp*	0.9	0.5	0.2	1.1	2.1	0.3	ns
	Enn spp	3.9	3.6	5.3	3.0	3.4	3.9	ns
	Era spp	1.2	2.2	1.3	1.4	1.3	2.2	ns
	Eri spp	0.8	0.5	0.3	0.6	0.7	2.4	ns
	Other grasses	0.4	0.1	0.6	1.3	0.3	0.7	ns
	Pas spp	0.3	0.2	0.4	1.3	0.8	0.3	ns
	Spo spp	0.0	0.1	0.1	0.1	0.3	0.2	ns
Low height grasses	*Dac rad*	0.1	0.0	0.1	0.2	0.0	0.1	ns
	Tra aus	0.2	0.0	0.0	0.3	0.1	0.2	ns
	Tri lol	0.5	0.5	0.5	0.3	0.2	0.3	ns
Non grasses	Forbs	4.3	3.3	2.9	4.7	2.8	2.9	ns
	Nat legume	2.2	1.5	2.4	2.4	2.6	1.1	ns
	Sedges	2.3	1.3	1.0	2.4	2.4	1.3	ns

Key group percent of total yield averaged across similar grazing pressures

Plant Category	*Plant Group*	Low	Medium	High	LSD P=.05
Major Perennial Grasses	*Bot ewa*	26.0	33.9	28.2	ns
	Chr fal	13.7	13.5	13.4	ns
	Het con	19.0	16.6	18.3	ns
	The tri	3.8	4.1	6.2	ns
Minor Perennial Grasses	*Dic ser*	1.6	1.5	2.0	ns
	Dig spp	0.7	0.4	0.5	ns
	Eul aur	4.1	4.0	6.5	1.6
	Pan spp	4.9	4.6	2.7	ns
Undesirable Perennial Grasses	*Ari spp*	7.9	6.0	6.4	ns
Mixed types grass group	*Chl spp*	1.0	1.3	0.2	ns
	Enn spp	3.5	3.5	4.6	ns
	Era spp	1.3	1.7	1.7	ns
	Eri spp	0.7	0.6	1.4	ns
	Other grasses	0.8	0.2	0.7	0.4
	Pas spp	0.8	0.5	0.3	ns
	Spo spp	0.1	0.2	0.1	ns
Low height grasses	*Dac rad*	0.1	0.0	0.1	ns
	Tra aus	0.2	0.0	0.1	ns
	Tri lol	0.4	0.3	0.4	ns
Non grasses	Forbs	4.5	3.0	2.9	1.2
	Nat legume	2.3	2.0	1.7	ns
	Sedges	2.4	1.9	1.2	ns

Key group percent of total yield averaged across timber treatments

Plant Category	*Plant Group*	Cleared	Trees	LSD P=.05
Major Perennial Grasses	*Bot ewa*	28.6	30.2	ns
	Chr fal	14.0	13.1	ns
	Het con	17.3	18.6	ns
	The tri	6.2	3.3	ns
Minor Perennial Grasses	*Dic ser*	1.4	2.0	ns
	Dig spp	0.4	0.7	ns
	Eul aur	5.1	4.6	ns
	Pan spp	4.6	3.5	ns
Undesirable Perennial Grasses	*Ari spp*	6.9	6.6	ns
Mixed types grass group	*Chl spp*	0.5	1.2	ns
	Enn spp	4.3	3.4	ns
	Era spp	1.6	1.6	ns
	Eri spp	0.5	1.2	ns
	Other grasses	0.4	0.8	ns
	Pas spp	0.3	0.8	ns
	Spo spp	0.1	0.2	ns
Low height grasses	*Dac rad*	0.0	0.1	ns
	Tra aus	0.1	0.2	ns
	Tri lol	0.5	0.3	ns
Non grasses	Forbs	3.5	3.5	ns
	Nat legume	2.0	2.0	ns
	Sedges	1.6	2.1	ns

Key group percent of total yield averaged across all treatments

Plant Grp.	All
Bot ewa	29.4
Chr fal	13.5
Het con	18.0
The tri	4.7
Dic ser	1.7
Dig spp	0.5
Eul aur	4.9
Pan spp	4.1
Ari spp	6.7
Chl spp	0.9
Enn spp	3.9
Era spp	1.6
Eri spp	0.9
O. grasses	0.6
Pas spp	0.5
Spo spp	0.1
Dac rad	0.1
Tra aus	0.1
Tri lol	0.4
Forbs	3.5
Nat leg.	2.0
Sedges	1.8

Species Percentage Summary 1995

Key group percent of total yield of each treatment

Plant Category	Plant Group	Cleared Low	Cleared Medium	Cleared High	Trees Low	Trees Medium	Trees High	LSD P=.05
Major Perennial Grasses	*Bot ewa*	27.4	29.3	26.0	30.8	36.5	36.6	ns
	Chr fal	11.6	9.3	6.7	13.1	10.1	10.8	ns
	Het con	28.7	30.3	27.8	27.3	28.0	28.2	ns
	The tri	6.6	6.4	6.8	5.1	3.0	2.4	ns
Minor Perennial Grasses	*Dic ser*	1.3	1.0	1.3	0.0	1.8	0.9	ns
	Dig spp	1.2	0.7	2.3	0.4	0.3	0.3	ns
	Eul aur	5.0	5.0	3.4	5.5	4.5	2.6	ns
	Pan spp	3.3	4.4	5.2	2.5	2.3	1.4	ns
Undesirable Perennial Grasses	*Ari spp*	4.6	3.4	4.8	4.3	3.5	2.8	ns
Mixed types grass group	*Chl spp*	0.4	0.4	0.7	0.4	0.4	0.4	ns
	Enn spp	3.2	3.9	4.5	2.6	3.2	3.6	ns
	Era spp	1.1	1.1	1.2	0.8	0.2	0.4	ns
	Eri spp	0.3	0.2	1.7	0.2	0.3	1.0	ns
	Other grasses	0.4	0.0	0.1	1.6	0.4	0.8	ns
	Pas spp	0.2	0.3	0.3	0.4	0.3	0.1	ns
	Spo spp	0.1	0.1	0.1	0.1	0.4	0.3	ns
Low height grasses	*Dac rad*	0.0	0.1	0.1	0.1	0.0	0.4	ns
	Tra aus	0.1	0.0	0.1	0.1	0.0	0.5	ns
	Tri lol	0.1	0.2	0.9	0.3	0.4	0.3	ns
Non grasses	Forbs	1.7	1.9	2.0	2.0	2.1	2.0	ns
	Nat legume	0.8	1.3	1.8	0.6	2.0	1.1	ns
	Sedges	1.7	0.6	1.6	1.7	0.5	2.9	ns

Key group percent of total yield averaged across similar grazing pressures

Plant Category	Plant Group	Low	Medium	High	LSD P=.05
Major Perennial Grasses	*Bot ewa*	29.1	32.9	31.3	ns
	Chr fal	12.4	9.7	8.7	ns
	Het con	28.0	29.1	28.0	ns
	The tri	5.8	4.7	4.6	ns
Minor Perennial Grasses	*Dic ser*	0.6	1.4	1.1	ns
	Dig spp	0.8	0.5	1.3	ns
	Eul aur	5.2	4.8	3.0	ns
	Pan spp	2.9	3.4	3.3	ns
Undesirable Perennial Grasses	*Ari spp*	4.5	3.4	3.8	ns
Mixed types grass group	*Chl spp*	0.4	0.4	0.6	ns
	Enn spp	2.9	3.5	4.0	ns
	Era spp	0.9	0.6	0.8	ns
	Eri spp	0.3	0.3	1.3	ns
	Other grasses	1.0	0.2	0.4	ns
	Pas spp	0.3	0.3	0.2	ns
	Spo spp	0.1	0.2	0.2	ns
Low height grasses	*Dac rad*	0.1	0.0	0.3	ns
	Tra aus	0.1	0.0	0.3	ns
	Tri lol	0.2	0.3	0.6	ns
Non grasses	Forbs	1.9	2.0	2.0	ns
	Nat legume	0.7	1.6	1.5	ns
	Sedges	1.7	0.6	2.2	ns

Key group percent of total yield averaged across timber treatments

Plant Category	Plant Group	Cleared	Trees	LSD P=.05
Major Perennial Grasses	*Bot ewa*	27.6	34.6	5.5
	Chr fal	9.2	11.3	ns
	Het con	28.9	27.8	ns
	The tri	6.6	3.5	2.5
Minor Perennial Grasses	*Dic ser*	1.2	0.9	ns
	Dig spp	1.4	0.3	ns
	Eul aur	4.5	4.2	ns
	Pan spp	4.3	2.1	ns
Undesirable Perennial Grasses	*Ari spp*	4.2	3.5	ns
Mixed types grass group	*Chl spp*	0.5	0.4	ns
	Enn spp	3.8	3.1	ns
	Era spp	1.1	0.5	ns
	Eri spp	0.7	0.5	ns
	Other grasses	0.2	0.9	0.5
	Pas spp	0.3	0.3	ns
	Spo spp	0.1	0.3	ns
Low height grasses	*Dac rad*	0.1	0.2	ns
	Tra aus	0.1	0.2	ns
	Tri lol	0.4	0.3	ns
Non grasses	Forbs	1.9	2.0	ns
	Nat legume	1.3	1.2	ns
	Sedges	1.3	1.7	ns

Key group percent of total yield averaged across all treatments

Plant Grp.	All
Bot ewa	31.1
Chr fal	10.3
Het con	28.4
The tri	5.0
Dic ser	1.1
Dig spp	0.8
Eul aur	4.3
Pan spp	3.2
Ari spp	3.9
Chl spp	0.5
Enn spp	3.5
Era spp	0.8
Eri spp	0.6
O. grasses	0.6
Pas spp	0.3
Spo spp	0.2
Dac rad	0.1
Tra aus	0.1
Tri lol	0.4
Forbs	2.0
Nat leg.	1.3
Sedges	1.5

Species Percentage Summary 1996

Key group percent of total yield of each treatment

Plant Category	Plant Group	Cleared Low	Cleared Medium	Cleared High	Trees Low	Trees Medium	Trees High	LSD P=.05
Major Perennial Grasses	*Bot ewa*	51.8	71.2	47.4	57.0	63.5	44.3	ns
	Chr fal	2.3	4.0	11.6	3.3	2.0	9.9	ns
	Het con	25.7	13.3	21.8	21.9	21.3	15.7	ns
	The tri	2.3	0.9	1.0	2.4	0.3	0.6	ns
Minor Perennial Grasses	*Dic ser*	0.7	0.0	0.0	0.3	0.9	0.2	ns
	Dig spp	0.3	0.0	0.6	0.1	0.0	0.0	ns
	Eul aur	3.2	2.2	2.0	2.2	3.3	2.7	ns
	Pan spp	1.0	0.5	1.1	0.6	0.3	0.2	ns
Undesirable Perennial Grasses	*Ari spp*	8.5	2.6	5.5	7.3	3.9	2.1	ns
Mixed types grass group	*Chl spp*	0.3	0.7	1.0	0.3	0.2	1.5	ns
	Enn spp	1.7	1.4	3.1	1.6	1.0	6.6	ns
	Era spp	0.2	0.3	0.3	0.3	0.0	0.4	ns
	Eri spp	0.3	0.3	0.1	0.0	0.1	0.9	ns
	Other grasses	0.2	0.1	0.0	0.9	1.6	0.0	ns
	Pas spp	0.1	0.2	0.5	0.5	0.1	0.8	ns
	Spo spp	0.1	0.0	0.2	0.0	0.0	0.7	ns
Low height grasses	*Dac rad*	0.0	0.0	0.0	0.0	0.0	0.0	ns
	Tra aus	0.0	0.0	0.0	0.0	0.0	1.7	significant
	Tri lol	0.2	0.2	1.4	0.3	0.2	2.0	ns
Non grasses	Forbs	0.6	1.5	1.7	0.6	1.1	5.6	ns
	Nat legume	0.2	0.1	0.3	0.1	0.1	0.1	ns
	Sedges	0.3	0.3	0.4	0.3	0.1	3.9	significant

Key group percent of total yield averaged across similar grazing pressures

Plant Category	Plant Group	Low	Medium	High	LSD P=.05
Major Perennial Grasses	*Bot ewa*	54.4	67.3	45.8	ns
	Chr fal	2.8	3.0	10.8	3.5
	Het con	23.8	17.3	18.8	ns
	The tri	2.3	0.6	0.8	1.0
Minor Perennial Grasses	*Dic ser*	0.5	0.4	0.1	ns
	Dig spp	0.2	0.0	0.3	ns
	Eul aur	2.7	2.7	2.3	ns
	Pan spp	0.8	0.4	0.7	ns
Undesirable Perennial Grasses	*Ari spp*	7.9	3.3	3.8	ns
Mixed types grass group	*Chl spp*	0.3	0.4	1.3	ns
	Enn spp	1.7	1.2	4.8	1.8
	Era spp	0.3	0.2	0.3	ns
	Eri spp	0.2	0.2	0.5	ns
	Other grasses	0.5	0.9	0.0	ns
	Pas spp	0.3	0.1	0.7	ns
	Spo spp	0.0	0.0	0.4	ns
Low height grasses	*Dac rad*	0.0	0.0	0.0	ns
	Tra aus	0.03	0.04	0.85	0.55
	Tri lol	0.2	0.2	1.7	1.2
Non grasses	Forbs	0.6	1.3	3.6	ns
	Nat legume	0.1	0.1	0.2	ns
	Sedges	0.3	0.2	2.2	1.2

Key group percent of total yield averaged across timber treatments

Plant Category	Plant Group	Cleared	Trees	LSD P=.05
Major Perennial Grasses	*Bot ewa*	56.8	54.9	ns
	Chr fal	6.0	5.1	ns
	Het con	20.3	19.6	ns
	The tri	1.4	1.1	ns
Minor Perennial Grasses	*Dic ser*	0.2	0.5	ns
	Dig spp	0.3	0.0	ns
	Eul aur	2.4	2.7	ns
	Pan spp	0.9	0.4	ns
Undesirable Perennial Grasses	*Ari spp*	5.5	4.4	ns
Mixed types grass group	*Chl spp*	0.7	0.7	ns
	Enn spp	2.1	3.1	ns
	Era spp	0.3	0.2	ns
	Eri spp	0.2	0.3	ns
	Other grasses	0.1	0.9	0.7
	Pas spp	0.3	0.5	ns
	Spo spp	0.1	0.2	ns
Low height grasses	*Dac rad*	0.0	0.0	ns
	Tra aus	0.0	0.6	0.5
	Tri lol	0.6	0.8	ns
Non grasses	Forbs	1.3	2.5	ns
	Nat legume	0.2	0.1	ns
	Sedges	0.4	1.5	1.0

Key group percent of total yield averaged across all treatments

Plant Grp.	All
Bot ewa	55.9
Chr fal	5.5
Het con	20.0
The tri	1.3
Dic ser	0.3
Dig spp	0.2
Eul aur	2.6
Pan spp	0.6
Ari spp	5.0
Chl spp	0.7
Enn spp	2.6
Era spp	0.3
Eri spp	0.3
O. grasses	0.5
Pas spp	0.4
Spo spp	0.2
Dac rad	0.0
Tra aus	0.3
Tri lol	0.7
Forbs	1.9
Nat leg.	0.1
Sedges	0.9

APPENDIX 11

SOIL SEED RESERVES (germinated seeds/m^2)

LOCATION: *SOILSEED\SUMMARY*

Grazing Treatments - 1994

GRASSES	TL1	TL2	TM1	TM2	TH1	TH2	CL1	CL2	CM1	CM2	CH1	CH2	Average	Std Error
BOTEWA	76	47.5	19	19	28.5	19	57	28.5	0	76	19	76	38.8	7.71
CHRFAL	9.5	0	0	0	0	0	19	0	0	0	0	28.5	4.8	2.74
HETCON	142.5	142.5	47.5	38	285	133	19	142.5	133	57	57	95	107.7	20.96
DICSER	9.5	0	0	38	0	9.5	0	0	0	9.5	9.5	19	7.9	3.27
DIGBRO	0	9.5	0	0	19	0	28.5	0	0	0	19	9.5	7.1	2.89
PANEFF	0	0	0	0	0	9.5	0	0	19	0	0	0	2.4	1.70
ARILEP	9.5	0	9.5	0	0	0	0	0	19	0	0	19	4.8	2.19
ARISCH	0	0	0	0	9.5	0	9.5	0	0	19	0	0	3.2	1.79
ARISPP	0	0	0	0	0	0	0	9.5	0	0	0	0	0.8	0.79
CHLDIV	0	0	0	0	19	9.5	0	19	0	0	19	0	5.5	2.47
ENNSPP	9.5	57	76	0	0	9.5	19	28.5	19	9.5	28.5	9.5	22.2	6.65
ERASPP	0	0	9.5	0	0	19	0	19	0	0	0	0	4.0	2.17
ERABRO	0	0	0	28.5	0	0	19	0	0	0	0	0	4.0	2.73
ERIPSE	9.5	0	9.5	0	38	19	0	0	0	0	0	0	6.3	3.38
NO I.D.	38	104.5	38	57	152	66.5	104.5	114	19	66.5	47.5	123.5	77.6	11.86
PASJUB	0	0	0	0	0	9.5	0	0	0	0	0	0	0.8	0.79
SPOAUS	0	0	19	0	28.5	9.5	0	9.5	0	9.5	0	0	6.3	2.70
DACEGY	0	0	0	0	0	0	0	0	9.5	0	0	0	0.8	0.79
TRILOL	0	0	0	0	0	0	0	0	0	0	0	28.5	2.4	2.38
CYPSPP	9.5	0	38	0	0	9.5	0	9.5	0	28.5	0	19	9.5	3.70
FIMDIC	0	47.5	19	9.5	0	0	0	0	0	28.5	0	9.5	9.5	4.38
FORBS														
ALTSPP	0	0	0	0	19	9.5	0	0	0	0	0	0	2.4	1.70
BRUAUS	19	9.5	0	38	47.5	47.5	0	19	0	0	9.5	9.5	16.6	5.25
DESVAR	19	0	9.5	0	0	0	0	0	0	0	0	0	2.4	1.70
EUPSPP	0	9.5	9.5	0	9.5	0	0	0	0	0	0	28.5	4.8	2.48
GLYSPP	0	19	0	0	19	0	0	0	0	0	0	9.5	4.0	2.17
GNASPP	0	0	0	0	9.5	19	0	28.5	0	0	0	38	7.9	3.85
GOOGLA	0	0	0	19	19	0	9.5	9.5	0	0	0	0	4.8	2.19
HYBENN	57	9.5	38	285	28.5	85.5	9.5	57	0	47.5	0	807.5	118.8	66.43
INDSPP	19	0	0	19	0	9.5	0	0	19	9.5	9.5	28.5	9.5	2.86
NO I.D.	9.5	19	76	47.5	28.5	38	9.5	256.5	123.5	38	28.5	513	99.0	42.62
PHYSPP	38	9.5	0	0	0	38	0	0	9.5	0	28.5	9.5	11.1	4.35
PORLIN	9.5	57	28.5	9.5	9.5	28.5	0	0	9.5	0	0	0	12.7	5.01
POROLE	0	0	38	9.5	38	28.5	0	0	0	0	66.5	0	15.0	6.45
SENLAU	0	0	9.5	0	0	0	0	0	0	0	0	0	0.8	0.79
SESBANIA	0	0	0	0	0	0	0	0	0	0	0	19	1.6	1.58
SPESPP	0	9.5	28.5	28.5	19	38	9.5	0	9.5	19	19	76	21.4	5.98
WHASPP	0	0	9.5	19	9.5	0	0	0	0	9.5	0	28.5	6.3	2.70
ZORMUR	0	28.5	0	0	9.5	0	0	0	0	0	0	0	3.2	2.43

GRASSES (seeds/m^2)	TL1	TL2	TM1	TM2	TH1	TH2	CL1	CL2	CM1	CM2	CH1	CH2	Avearge	Std Error
Bothriochloa ewartiana	57	66.5	28.5	9.5	19	0	19	9.5	19	66.5	0	19	26.1	6.9
Chrysopogon fallax	0	0	9.5	0	9.5	0	0	0	0	9.5	0	0	2.4	1.2
Heteropogon contortus	28.5	9.5	9.5	95	0	0	47.5	28.5	0	95	9.5	9.5	27.7	10.0
Themeda triandra	0	0	0	0	0	9.5	0	0	0	0	0	0	0.8	0.8
Dicanthium serecium	0	0	0	19	0	9.5	0	0	0	0	0	0	2.4	1.7
Digitaria brownii	0	0	0	9.5	0	0	9.5	0	0	0	9.5	9.5	3.2	1.4
Eulalia aurea	0	9.5	0	0	0	0	0	0	0	0	0	0	0.8	0.8
Panicum effusum	0	0	9.5	0	9.5	0	9.5	0	0	9.5	38	0	6.3	3.2
Aristida ingrata	9.5	0	0	0	0	0	0	0	0	0	0	0	0.8	0.8
Aristida leptopoda	9.5	9.5	0	0	0	0	0	9.5	0	9.5	0	9.5	4.0	1.4
Aristida schultzii	9.5	0	0	0	0	0	0	19	0	9.5	0	0	3.2	1.8
Chloris divaricata	0	0	9.5	9.5	19	0	0	0	0	0	38	9.5	7.1	3.3
Enneapogon species	28.5	19	66.5	9.5	19	9.5	38	38	9.5	0	38	0	23.0	5.7
Eragrostis brownii	9.5	9.5	0	0	0	9.5	9.5	9.5	0	9.5	9.5	0	5.5	1.4
Eragrostis species	9.5	0	0	0	0	0	9.5	9.5	0	0	0	0	2.4	1.2
Eriochloa pseudoacrotricha	0	0	9.5	0	9.5	9.5	0	0	0	9.5	0	0	3.2	1.4
Cenchrus ciliaris	0	0	0	19	0	0	0	0	0	0	0	0	1.6	1.6
Not Known Grass	9.5	0	0	0	0	0	76	0	0	9.5	0	0	7.9	6.3
Sporobolus australasicus	0	0	19	0	9.5	0	0	0	47.5	0	19	0	7.9	4.2
Dactyloctenium egyptii	0	0	9.5	0	0	0	0	0	9.5	0	9.5	9.5	3.2	1.4
Tragus australasicus	0	0	0	0	19	0	0	0	0	0	0	0	1.6	1.6
Tripogon lolliformis	9.5	38	0	0	9.5	9.5	0	0	38	9.5	28.5	38	15.0	4.6
Cyperus species	38	57	0	57	19	38	76	0	0	19	28.5	38	30.9	7.1
Fimbristylus species	0	0	0	0	9.5	0	9.5	9.5	0	9.5	0	0	3.2	1.4
Total per treatment	218.5	219	171	228	152	95	304	133	123.5	266	228	142.5	190.0	18.3
FORBS (seeds/m^2)														
Acacia species	0	9.5	0	9.5	0	0	0	0	0	0	0	0	1.6	1.1
Euphorbia species	9.5	47.5	104.5	47.5	95	57	0	38	0	9.5	38	19	38.8	10.0
Evolvulus species	9.5	0	0	0	0	0	0	0	0	0	0	0	0.8	0.8
Glycine species	0	0	9.5	0	0	0	0	0	0	0	9.5	9.5	2.4	1.2
Gnaphalium species	9.5	9.5	19	0	9.5	9.5	19	9.5	0	9.5	0	19	9.5	2.0
Goodenia species	0	0	9.5	0	0	0	9.5	9.5	0	9.5	0	0	3.2	1.4
Hybanthus species	199.5	9.5	9.5	19	76	85.5	38	47.5	47.5	57	19	0	50.7	15.6
Indigofera species	9.5	0	9.5	28.5	9.5	19	19	28.5	19	9.5	19	0	14.3	2.7
Lillium species	0	9.5	0	0	0	0	0	0	19	9.5	0	0	3.2	1.8
Not Known Forb	28.5	171	19	9.5	19	95	142.5	142.5	104.5	123.5	85.5	114	87.9	16.1
Oxalis species	0	0	0	0	0	0	9.5	9.5	0	0	0	0	1.6	1.1
Phyllanthus species	38	28.5	9.5	9.5	19	9.5	28.5	47.5	0	9.5	0	38	19.8	4.6
Portulacca species	0	0	9.5	28.5	28.5	0	0	0	0	9.5	47.5	28.5	12.7	4.7
Pterocaulon species	0	0	19	0	0	9.5	19	0	9.5	0	28.5	28.5	9.5	3.3
Ruellia species	0	0	9.5	0	9.5	0	0	9.5	19	19	9.5	0	6.3	2.1
Sclerolaena species	0	0	0	0	0	0	0	0	0	9.5	0	0	0.8	0.8
Sida species	0	0	0	0	0	0	9.5	9.5	0	0	0	0	1.6	1.1
Sonchus species	0	0	9.5	9.5	0	0	0	0	0	0	9.5	0	2.4	1.2
Spermacoce species	19	19	28.5	9.5	9.5	9.5	9.5	0	0	28.5	0	28.5	13.5	3.2
Tephrosia species	0	0	0	0	0	0	9.5	0	0	0	0	0	0.8	0.8
Whalenbergia species	104.5	304	28.5	19	38	57	228	199.5	85.5	237.5	9.5	256.5	130.6	30.9
Zornia species	9.5	0	0	0	0	0	9.5	0	9.5	9.5	0	0	3.2	1.4
Total per treatment	437	599	294.5	180.5	313.5	351.5	551	551	313.5	551	275.5	541.5	413.3	40.8

APPENDIX 12

MANAGEMENT PACKAGES

LOCATION: AB\MILESTON\NO26\MILE26.DOC

MANAGEMENT PACKAGES FOR SUSTAINABLE USE OF GRAZED PASTURES IN SILVER-LEAVED IRONBARK COUNTRY

INTRODUCTION

Grazing management of the native pastures in eucalypt woodlands in the Central Highlands is dependant on simple and reliable management practices. Large property sizes, minimal manpower and a need for low input management to maintain viability precludes any practice, other than uncomplicated practices.

Given the short history of the current investigation of the inland forest community, a management package is presented that is based on preliminary technical perspectives and local best practices of graziers in the area.

Associated with each management practice are outcomes that will enhance the sustainability of the resource and viability of the enterprise. To best undertake the suggested management practices particular skills are needed and they are also presented.

KEY MANAGEMENT PRACTICES

1. Moderate level of grazing

Why: The stability of the resource and beef production derived from grazing the resource is optimised under a moderate level of grazing.

How is it done: The grazing pressure that achieves moderate use is one which utilises between 30 and 40% of the annual pasture growth. Under an average annual rainfall of 660mm, the equivalent local stocking rate that achieves moderate grazing is approximately 9ha per breeder unit or 13ha per 400kg steer. Given the regular variability of rainfall in the district, regular downward and upward adjustments to stock numbers are required to achieve moderate grazing levels.

An adequate distribution of stock waters within a paddock also plays an important part of achieving the desired level of grazing across the landscape. Paddocks in which significant proportions are underutilised whilst in other parts overutilisation is occurring is symptomatic of a low density and/or poor distribution of waters.

Benefits of practice:
- Animal growth per head and per hectare are optimised
- Adequate reserves of pasture are maintained for any subsequent drought conditions
- Cover levels are adequate to maximise infiltration and minimise runoff and soil loss
- Desirable levels of forest mitchell (the dominant perennial species) are maintained

Skills required:
- ability to assess pasture yield
- ability to determine how many and which stock types are to be added or removed from a paddock
- ability to assess the quality of the pasture, based on key pasture species identification

2. Opportunistic burning

Why: Fire is required to maintain an open woodland structure by suppression or death of small seedling or suckering trees and as a result pasture production is optimised.

How is it done: Fire can only occur with an adequate fuel load (at least 1000 kg DM/ha). Fuel loads are regulated by the amount of previous summer rainfall and it is only in the years of average to above rainfall, 1 in every 5 to 7 years (Anakie long term rainfall data), that an adequate fuel load will accumulate.

Ensuring that the fuel load is available for a late spring/summer burn is also dependant on maintaining at least a moderate grazing pressure (after above average rainfall years), if not a light grazing pressure (after average rainfall years) in the period subsequent to the burn. A strategic spell or reduction in stock numbers may be necessary if there is an urgency to undertake a fire.

Benefits of practice:
- balanced proportions of tree size classes
- minimised competition between pasture and tree species for soil moisture
- avoidance of any need for costly timber control measures

Skills required:
- ability to assess timber density and timber basal area
- ability to assess pasture yield
- ability to manipulate stock numbers to ensure adequate fuel load is present

OTHER MANAGEMENT CONSIDERATIONS

Additional options for sustainable management in silver-leaved ironbark country are only feasible if the previous 2 key management practices are already in place. The other options that can be considered are:
- timber clearing - The only viable long term clearing method is by stem injection. Subsequent fire management will be critical for suppressing significant seedling and/or sucker increases. The financial feasibility of the development will only be realised if the initial treatment costs and subsequent maintenance costs are less than the cumulative production benefits in the subsequent 10 years. Currently, local producers believe there is little benefit of timber development of this land type because of high costs and limited production benefits.
- augmentation with legumes, namely seca stylo - A potential for stylo augmentation is feasible as long as expectations of increased carrying capacity are not assumed. The ability of stylo to improve pasture quality toward the end of the growing season would benefit animal production. Extensive developments are yet to occur and there is a need for any preliminary developments to be fully evaluated.

Management options for rehabilitation of degraded land types also needs to be considered. However at this point of the investigation little substantive recommendations can be provided for this need.

1. In cases of extreme and continuous overgrazing, a period of destocking may initially alleviate some of the problem and subsequent action may be required, such as reseeding if there was little increase of desirable species.
2. The other problem scenario that can be found is shrubland conditions that have resulted after pulling of timber. The cost of this type of rehabilitation will be expensive, however if some form of stability and productivity is to be achieved, then a cost will not be avoidable. Rechaining the shrubland followed by a period of destocking is an option that may allow fire to be introduced and so diminish the number of small trees. A subsequent fire may also be necessary to fully effective.