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PROCEEDINGS
MITCHELL GRASS MANAGEMENT AND OTHER ASPECTS OF WESTERN QUEENSLAND RANGELANDS
FIELD MEETING—CHARLEVILLE—MARCH 26 and 27, 1982

This two days in the Charleville area, in conjunction with the Queensland Department of Primary Industries (QDPI) and the Australian Rangeland Society, was the first field meeting for 1982. It involved participation in the first of a series of QDPI field days on the theme "Mitchell Grass Management—More Stock Gives More Production, or does it". The "Burenda" concept, setting stocking rates each autumn for the following twelve months on the basis of forage produced over the previous summer, was explained.

This was followed by inspections of CSIRO forage species adaptation trials in the Augathella district and of a property located on mulga (*Acacia aneura*) country. Some of the QDPI research work at Charleville was also seen.

INTRODUCTION TO THE "BURENDA" CONCEPT OF MITCHELL GRASS MANAGEMENT

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If your out-go exceeds your income then your upkeep becomes your downfall. This applies to money but it also applies to animals and plants and land as well. If you've got more animals than feed the results are fairly obvious. Unfortunately for plants the results are not obvious immediately.

Plants harvest the energy of sunlight and use it to convert carbon dioxide to starch for plant growth. The plant in turn can be used as animal fodder. But plant growth is like a bank account. Starting growth after rain depletes the plants savings account of starch i.e. puts it in the red. Leaves have to be relatively large (maybe 100+ mm long) before they can contribute back to the reserves. Grazing at a level that doesn't allow restoration of reserves has out-go exceeding income with downfall of the plant a result. And the downfall of an edible plant species all too often results in the rise of woody or inedible plants e.g. wiregrasses, (*Aristida* spp.) and the downfall of animal production.

Thus we need to aim for a level of stocking which maximises production from the area while maintaining its stability.

Production is tied firstly to rainfall. If we had a regular rainfall we could run a set number of animals and achieve a desirable, even level of grazing on plant species. Unfortunately we don't have a regular rainfall. The result is that running constant numbers of stock results in uneven utilization. In wet years forage is underutilized, in dry ones it is over utilized. Inspection of rainfall figures for Charleville show that there are about 1/3 of years above and 2/3 below the average rainfall.

On the other hand grazing at a level of use desirable for the plant will result in fluctuating stock numbers. Inherent in this is potential marketing conflict—either stock plentiful and cheap when selling or scarce and expensive when buying. Despite this problem, flexible climatic conditions are best handled by flexible management methods.

One way of looking at pasture management is the idea of moving stock when the forage remaining falls to a predefined level. Work from Colorado, USA found that for short grass prairie the optimum production and use was to graze until 200 kg ha^{-1} was left and then move the animals. More could be used in drought times but this use reduced animal production in the next year. A guide to this level of utilization was when a small cactus became visible in these grasslands. We haven't got as easy a guide.

Experimental work in Western Queensland has shown that most plant growth occurs on summer rain—about 10 times as much as in winter. Thus around April we are looking at about 90% of what will be produced until the next summer rainfall. Or the one after that if next year is a drought. Winter rain encourages the growth of broadleaf species (herbage). This is high in nutritive value but low in yield and summer tolerance.

Thus autumn provides a time for looking at stock numbers in relation to feed supply. The "Burenda" trial was established to look at using this information in conjunction with different forage use levels (or stocking rates). From this we aimed to find the reaction of the species present to different use levels. This ultimately affects animal growth rate and production which were also monitored.

Each autumn the weight of feed in the paddocks is estimated. It takes from 400 to 450 kg of forage to maintain a sheep for a year. We work out the number of sheep required to eat off 80, 50, 30, 20 and 10% of the forage in a year if no further rain is received. This means that forage remaining at the next autumn should be 20, 50, 70, 80 or 90%.

The trial was set up in 1975 by fencing-off an area of a large paddock. Each treatment started with 12 sheep. Treatments now show large differences and one is carrying only 2 sheep.

EFFECTS OF STOCKING INTENSITY ON THE VEGETATION

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Stocking rates used to achieve the required utilization levels in each paddock at the commencement of this trial range from 3 to 0.3 sheep per hectare (i.e. 1 sheep per 0.8 acre to 1 sheep per 8.2 acres) for the 80% to 10% respectively. Stocking rates to achieve 10, 20 and 30% utilization levels have been least variable (1 sheep to 1.0 ha) while the stocking rate used to achieve 80% utilization has fallen from 3 sheep per hectare in 1975 to 0.25 sheep per hectare in 1981 (i.e. from 1 sheep per 0.8 acre to 1 sheep per 9.8 acres).

Forage yields have declined from 1975 in all paddocks in line with seasonal rainfall conditions. Forage yields have been reduced substantially in the paddock

grazed at the 80% utilization level and to a lesser extent in the 50% level paddock. Yields have been similar in each of the 10, 20 and 30% utilization level paddocks.

Basal area of the plants, a measure of the stability of the pasture, has fallen in all paddocks in line with seasonal rainfall. As with forage yields, the greatest reduction has been in the 80% utilization paddock. Changes in basal area at the 10, 20 and 30% utilization levels have been similar while at the 50% level, basal area has been intermediate between the 30 and 80% levels.

WHAT SHEEP PREFER TO EAT

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You may question why we need to know what sheep prefer to eat. After all its either there to be eaten to it isn't and it may seem that there's not much we can do about it anyway.

The first thing we need to know is which species are preferred by the animals as these are the ones that tend to be overgrazed. Overgrazing in turn reduces competition to unpalatable and woody species. The management and production implications are obvious.

Secondly, where two or more animal species are run together we need to know which plants each species eats. Animals do not necessarily compete for the same plant species. In Texas it is possible to run cattle, sheep, Angora goats or deer (and to sell hunting rights) on the same land area because their diets don't overlap.

Direct observation of grazing is not a satisfactory method for determining which species are being eaten. We use oesophageally fistulated (hole in the neck) animals to obtain samples of material eaten by the animals.

Plants were identified by studying the outer surface patterns of the leaf under a microscope. The pattern are characteristic of each species—a bit like fingerprints. In the mitchell grass area we identified about 24 species in the diet. In mulga areas there were more than 50 species.

Details of the diets consumed by animals in the 30 and 50% utilization treatments can be summarized by noting that herbage species were preferred when they were present. As the herbage species were reduced, grasses in the diet increased, the major grasses utilized being mitchell grass and blue grass (*Dichanthium sericeum*). Yabila (*Panicum queenslandicum*) was eaten more when conditions were dry. Feathertop (*Aristida latifolia*) was not eaten to any extent.

SHEEP PERFORMANCE

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Liveweight change and wool production were measured over a period of 7 years. During this time there were some good years, some average to bad years and above average winter rain in 1978 and 1981.

The animal performance has been examined at the two extremes of 80% utilization (high stocking rate) and 10% utilization (low stocking rate), and at 30% utilization.

Liveweight response closely followed the pattern of rainfall received, although the 80% group had more peaks and troughs in response to falls or failure of rain. The sheep in the lower stocking rate groups were consistently heavier than the 80% group. There was little difference between the 10% and 30% groups although the 10% group was usually marginally better than the 30% group.

Wool production per head did not vary greatly between the different groups although the 10% group was consistently heavier throughout. However, when wool production was considered on a per hectare basis, the 80% group was much better for the first 3 years of the experiment. This situation could not be maintained and even with the good winter rain received in 1981 the 80% group failed to increase its per hectare wool cut. The 10% group was consistently low and inefficient while the 30% group maintained a satisfactory level of production. The low carryover of feed into 1980 meant low sheep numbers in all groups in that year, and accounted also for the low per hectare wool cuts.

When feed is abundant a high utilization level will increase wool production per hectare, but this level cannot be maintained. A 30% utilization level will give a consistently reasonable wool cut per hectare, and with the opportunity being taken of using a higher utilization level (e.g. 50%) when the season permits, then per hectare production can be given occasional boosts. At the 50% level of utilization sheep liveweight performance should also be satisfactory in higher rainfall years.

APPLICATION OF THE UTILIZATION CONCEPT

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The formula used to calculate the number of sheep in any paddock is:-

$$\text{Stock No.} = \frac{\text{Forage Yield (kg ha}^{-1})}{\text{Animal Consumption}} \times \frac{\text{Utilization \%}}{100} \times \text{Area (ha)}$$

For a 30% level of utilization and a 1000 ha paddock this becomes:-

$$\frac{\text{Forage Yield}}{400 \text{ kg/head}} \times \frac{30\%}{100} \times 1000$$

Forage Yield (kg/ha)	*Sheep Number*	*Stocking Rate (sheep/ha)*	*Acres/sheep*
500	375	0.375	6.5
1000	750	0.75	3.27
1500	1125	1.125	2.18
2000	1500	1.50	1.64

With a pasture yield of 2000 kg/ha (or greater), you may consider using a higher level of utilization, say 50%. For a 1000 ha paddock with 2000 kg/ha and at 50% utilization, the number of sheep would be 2500 which represents a stocking rate of 2.5 sheep/ha.

BLACKALL PASTURE STUDIES

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Studies on the stability of Mitchell grass pastures in commercially grazed paddocks in the Blackall district began in 1975. Two paddocks, one with a history of "heavy" grazing and the other of "district average" stocking, are being monitored for forage yield, forage utilization and age structure of Mitchell grass. Forage utilization at the end of the dry season has averaged 35% (range from 6% to 50%) for the "heavy" paddock and 12% (range from 6% to 18%) for the "district average" paddock. There have been no major differences in forage yields but those have fluctuated with seasonal rainfall.

Grazing at 35% utilization has resulted in a more even age structure of Mitchell grass plants than at 12% utilization. "Heavy-grazing" appears to stimulate the

production of Mitchell grass inflorescences ("seed heads") and results in higher seed production which resulted in the establishment of more new plants.

CSIRO FORAGE SPECIES ADAPTATION TRIALS IN THE AUGATHELLA DISTRICT

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Over the period 1976–1980 species of *Cenchrus*, *Digitaria*, *Stylosanthes* and *Urochloa* were the most persistent and productive of 50 legume and 37 grass species grown on red earth soils (Gn 2.12) at six sites in central and western Queensland. The current program is comparing the adaptation of these to the soils of the Chinchilla and Augathella districts. In December 1980, ninety legume and 65 grass species selected on past performance or environment of origin were planted on the Lyons family properties near Augathella on four soil types: mitchell grass grey cracking clay (Ug 5.2), gidyea red/brown cracking clay (Ug 5.3), mulga red earth (Gn 2.1) and a shallow surface soil alkaline red duplex (Dr 2.3) carrying poplar box and sandalwood.

Over 90% of the sown species germinated on each soil but persistence has varied greatly due to incidence of rainfall, soil moisture characteristics, salinity and pH. After 15 months the best results have been achieved on the mulga and gidyea soils where the most productive species belong to the genera *Cenchrus*, *Digitaria*, *Indigofera*, *Rhynchosia*, *Tephrosia* and *Urochloa*. *Stylosanthes* species are very well adapted to the mulga soil.

Highlights of the field meeting were the obvious high yield and quality (percentage green leaf) of the introduced grasses compared to the native grasses; the outstanding yield of *Stylosanthes* spp on the mulga soil even without fertiliser; the excellent recovery of *Indigofera* and *Tephrosia* spp on gidyea soil after severe grazing by sheep; and the obvious loss of pasture to kangaroos ($\pm$ 600 kg/ha) in the mulga area.

The relationships between rainfall, soil moisture, temperature, root growth, persistence, seedling regeneration and dry matter production are being investigated on selected species.

A MULGA EXPERIENCE—MT. PLEASANT PROPERTY

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"Mt. Pleasant"—Charleville

This property of 24 300 ha is divided into five main paddocks each of 4050 ha and nine holding paddocks. Large paddocks are suitable in this country so long as there are plenty of holding paddocks. "Mt. Pleasant" presently runs 2000 sheep and 500 cattle. After good years e.g. (1973/74) when the paddocks are very well grassed, it can carry up to 900 cattle and 4000 sheep. The property normally however runs 4000 weathers and 400 cattle.

Grazing management routinely is cattle followed by sheep. Sheep are necessary on mulga country to control the mulga regrowth. Cattle cannot control the regrowth which can quickly attain a size where it prevents grass growth. The carrying capacity of Mt. Pleasant could be increased by pulling more mulga.

Experience on this property indicates that the paddocks should be spelled regularly to allow the grasses to seed down. This helps retain the softer, better grasses. In a good year, with a long growing season, it is possible to spell two paddocks until the grasses have set seed and this seed is starting to fall. One early and one later in the growing season. The cattle help in re-establishment of the soft grasses as they can't

graze them until they can bite them off. Sheep are much harder on them pulling the seedling plants out before their roots have a good grip on the ground.

At present this area is suitable only for dry sheep because there are not enough watering points. These are all 6000 m^3 dams but are not equipped with mills or troughs and it is 6–8 km between dams. If it were possible to have flowing bores or closer spaced dams it would be possible to lamb in this area.

Cattle, (1 = 10 sheep) eat a lot of grass, they also eat a lot of mulga even when the grass is good. They break down limbs from quite big mulga trees and whilst they don't handle young mulga as well as sheep they do better from big mulga. The mulga pods are also good feed. Wethers will nearly fatten on them. Winter rain stimulates a good pod set as well as good herbage. If there are a lot of parrots about their wasteful feeding habits drop the green pods to the ground where they are eaten by stock. Normally, pods don't fall until they are ripe and brown.

MULGA FODDER PLANTS

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Mulga country is characterized by a wide range of plants which stock eat. Some common grasses are:

Aristida armata and *A. jerichoensis* two wire grasses which are only palatable for short periods when young.

Cymbopogon obtectus (silky heads) which is not seen much where country has been heavily grazed, especially with sheep. It is common after country has been freshly cleared. It has the characteristic *Cymbopogon* odour. The seedlings have orange roots. Herbage is fairly palatable.

Thyridolepis mitchelliana (mulga mitchell) is the best mulga grass, it is very palatable with high protein and phosphorus and good spring and autumn growth and a little winter growth. It seeds well, is very drought tolerant but tends to be overgrazed and eaten out by sheep.

Monachather paradoxa (mulga oats) grows with mulga mitchell but is not as palatable or nutritious and is inclined to be more seasonally sporadic, especially in the west. It is present in good years but not always in bad years.

Eriachne helmsii (A wanderrie grass) without a specific common name. Has a woolly growth below the ground. It is not highly palatable but it grows under mulga scrub and will increase in size with clearing. More digestible than *Aristida* spp.

Digitaria ammophila (silky umbrella grass) is very palatable when green but not when dry. The mature seed heads blow away intact. Not very high yielding and not very long lived. Also lacks drought tolerance in the seedling stage being easily killed out by moisture stress.

Panicum effusum (hairy panic) is very common, very palatable and actively sought by stock at all times of the year. One of the more desirable types but not high yielding.

Amphipogon caricinus (grey beard grass or Nebine neverfail) is relatively unpalatable especially in summer. More palatable in winter. Kangaroos graze it more readily than sheep and both pick around the butt for fresh shoots.

Eragrostis eriopoda (woollybutt) doesn't have a lot of leaf and is not very palatable but is eaten and stays green through the winter. There is also a range of herbs including:

Sida cunninghamii important as a quality factor in diets because it is high in minerals. *Sida brachypoda* seasonally very palatable but at other times depends on choice available. *Goodenia glabra* a well liked perennial. *Calotis xanthosoidea* daisy burr. *Cheilanthes sieberi* (mulga fern) shoots quickly after rain, a perennial.

EXOTIC PASTURE SPECIES UNDER GRAZING ON A MULGA SOIL

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A site close to Charleville was cleared in June 1975. It carried a dense mulga (*Acacia aneura*) scrub with a scattering of emergent poplar box (*Eucalyptus populnea*) and silver leafed ironbark (*E. melanophloia*) plus some sandalwood (*Eremophila mitchellii*) and ironwood (*Acacia excelsa*). Eight exotic grasses (*Anthephora pubescens* (CPI43713), *Cenchrus ciliaris* (Q10077, Q10087, and cv. Biloela), *Eragrostis chloromelas* (CPI30374), *E. curvula* (CPI30379), *Schmidtia bulbosa* (CPI43715 and Q10092)), one exotic legume (*Stylosanthes fruticosa* (CPI40615)) and one native grass (*Thyridolepis mitchelliana*) were sown in early November 1975 into 0.5 ha plots with two replications. Germinating rains fell mid-December 1975 and establishment was excellent. As well there were two unsown paddocks.

Grazing commenced in March 1977 with four wethers per 0.5 ha paddock. Grazing lasts until the paddocks are well eaten down and stock are losing condition. The sheep are weighed in and out of each paddock.

To date it has been noted that *T. mitchelliana* has the best quality feed judged by sheep liveweight changes but poor yield. *A. pubescens* has good quality and moderate yield. *E. chloromelas* fair to good quality and good yield and the buffels only fair quality and good yield with cv. Biloela the best. *S. bulbosa* tend to be denser under the box trees and the buffels especially Q10087 are concentrated on the windrow burns. All species including *S. fruticosa* are quite tolerant of the heavy intermittent grazing. The *Eragrostis* spp. show excellent early spring growth when moisture is available and all but *E. curvula* and *S. fruticosa* flower and set seed well under the intermittent grazing. All paddocks have thinned badly during the prolonged run of dry summers since 1978.

BOOK REVIEW

Nitrogen fixation in Legumes—ED. J. M. VINCENT (1982) ISBN 0 12 721980 3 Academic Press: Sydney. 288 pp. A$26.60

This publication is based on the proceedings of an International Seminar held in Australia in 1980 and sponsored by the Australian Development Assistance Bureau and the University of Sydney. There are twenty-two chapters, twenty-one of which are based on the lectures given by fifteen Australian contributors, most of whom are well known for their contributions to knowledge of the Rhizobium—legume symbiosis. Chapter twenty-two is a collation prepared by the editor from the submissions of twenty-four participants from thirteen countries about the situation of nodulated legumes in their own country.

The publication contains a great wealth of useful information on all aspects of the Rhizobium—legume symbiosis. The editor, in his preface makes the statement that "the contributions have a practical flavour designated — to help less experienced workers get a start . . " Individually, each chapter has been very thoughtfully prepared so that not only will the less experienced benefit from it, but the experienced worker is also provided with food for thought. Each of the authors has drawn from experience to describe in detail how the symbionts can be handled to best effect and many have mentioned traps for the uninitiated so that they can be avoided. Very many useful technical details have been given. One novel suggestion that was made by one of the authors, was to use vodka, tequila, whisky etc. as substitutes for alcohol in the surface sterilization of nodules and the flaming of forceps. He is obviously widely travelled