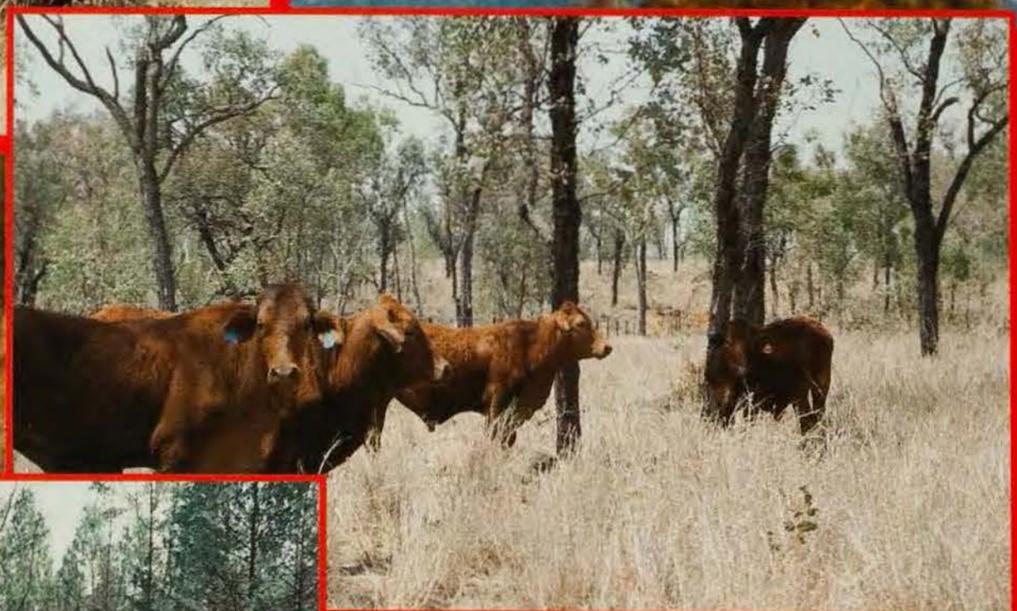
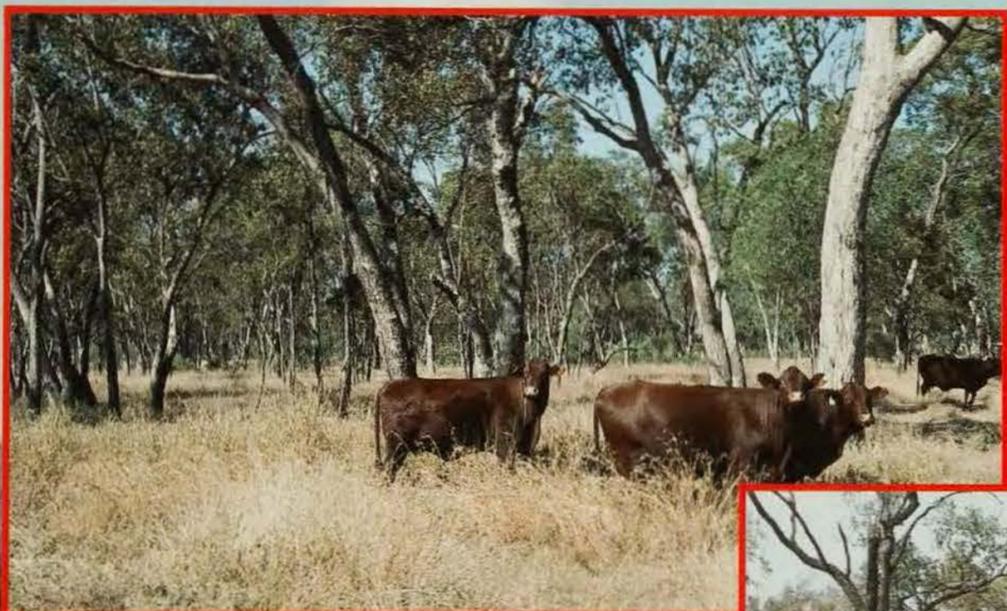


# Managing grazing in the semi-arid woodlands

a graziers guide

Ian Partridge





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**a graziers guide**

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The information in this booklet comes from a wide range of sources—from research and extension officers of the Queensland Department of Primary Industries and from CSIRO Tropical Agriculture. All of these acknowledge the experiences of many graziers and property managers.

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QBII: Queensland Beef Industry Institute; CINRS: Climate Impacts and Natural Resource Systems

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*'Biodiversity' just means keeping nature in balance.*

# Preface

Successful graziers and property managers are successful because of their expertise in managing their livestock. Income from these livestock provides for the needs of the family and for future development of the property.

Most of their stock will eat native pastures for much or all of their lives. However, even if the stock are in good condition, it does not necessarily follow that the pasture is.

The condition of the diverse native pasture resources is of vital importance to the long-term profitability of each property and to the viability of the Queensland pastoral industry as a whole. This has been well recognised by most graziers for many years.

New technologies to improve the efficiency of beef production also offer the opportunity to push stocking rates beyond the carrying capacity of the land. At the same time, however, the level of management has reached new heights, and managers have increased their awareness of the ecological aspects of beef production and the need for biodiversity.

The Federal and State governments regard maintenance of our natural resources as one of their important functions. Government and producer organisations seek to help land managers to protect their asset for the present and future. The Natural Heritage Trust has provided funds for research into grazing management in the semi-arid woodlands; Meat and Livestock Australia (formerly the Meat Research Corporation) has provided funds for the production of this guide.

This booklet concentrates on the plant side of the northern livestock industry. I hope it will help you by:

- bringing together the knowledge that you already have
- telling you about some of the management practices being developed through research
- stimulating more interest in what is happening in your pastures.



*Seed heads of native millet blown by the wind.*

# In a nut shell

There are no fixed recipes for managing your native pastures. Instead you need to:

- understand how the grazing animals and different types of plants affect each other
- use some general and local practical guidelines
- look closely at your pasture on the ground
- modify your grazing management according to the condition of the pasture.

The major grazing management options are:

- setting a sustainable carrying capacity for your property
- adjusting your stocking rate each year according to the season
- spelling and burning
- improving pasture.

## Stock numbers

Stocking rate has the most important influence on the condition of your pastures.

Adjust the numbers of your stock at the end of the growing season according to the bulk and condition of the pasture in the paddock.

***“Adjust stock numbers according to the bulk and condition of your pasture.”***

Check whether seasonal forecasting can provide any extra skill in predicting rainfall in your district, and bear this in mind when setting stock numbers for the next year.

Spell paddocks in poor condition for a period during early summer to give the desirable grasses a chance to recover.

Learn the important grasses that indicate the response to past seasons or previous management.

***“Monitor your pastures at the end of the growing season.”***

## Burning

Woody plants have invaded or increased in density in many pastures because fires have been less frequent and less intense. Fire is the natural and ecological approach to maintaining grassland and opposing the invasion of woody plants.

***“Integrate fire into your normal pasture management.”***

Decide where, when and how to burn to improve grazing or control woody plants.

Monitor your paddocks for woody weed seedlings.

***“By the time you recognise a woody weed problem, it's almost too late.”***

Only hot fires control woody plants; burn after good years when there is plenty of fuel.

## Tree clearing

***“Check the current legislation before planning any clearing.”***

Always check the latest legislation before firing up the dozer. This legislation aims to develop systems of native vegetation management to protect biodiversity.

Regrowth can be cleared but consider clearing old-growth trees only for a specific purpose and only on better class land. Prepare a property vegetation management plan before considering or seeking permission to clear old-growth woodland.

# Introduction

## The aim—production with care

Good grazing management aims to achieve a level of production that can be maintained over decades—without the condition of the pasture deteriorating because woody species increase, palatable perennial grasses disappear or because the soil erodes away.

A recent survey of grazing in the inland woodland regions suggests that less than a quarter of the area is in top condition. However, much of the pasture that has deteriorated to a slight degree can be restored with suitable management.

## No fixed recipes

Managing native pastures is not always as simple as it looks—it needs some special skills. Rainfall varies from drought to flood between years, beef herds take years to build up, and costs have to be kept low. Pastures can change significantly over time, but gradual changes may be difficult to recognise.

There can be no fixed recipes for managing native pastures—unlike the management of crops or intensive sown pastures. Rather, you need:

- to understand how the grasses, trees, soils, grazing animals and climate affect each other—their ecology
- to follow some practical guidelines which are based on experience and research
- to check—monitor—changes that may occur, and then to adopt appropriate management practices.

The basic principles of native pasture ecology have been described in *Managing native pastures: a graziers guide*.

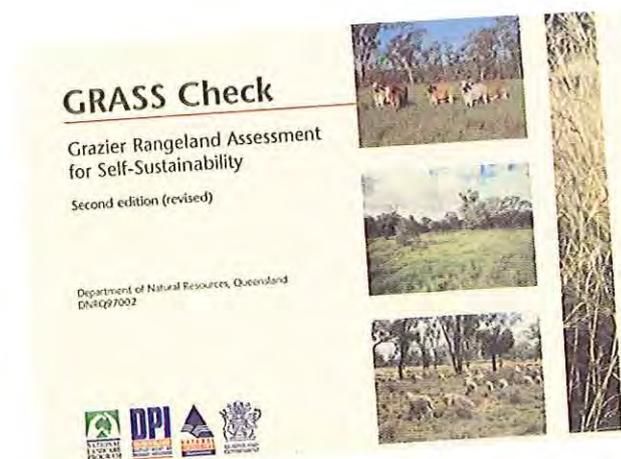
Methods of monitoring are described in a separate DPI publication **GRASS Check**.

This book provides some guidelines for managing grazing of the inland woodlands that lie in a discontinuous belt from the south of Cape York Peninsula in north Queensland to Dirranbandi in the south. It also helps you to identify important pasture species that respond to, or indicate, management.

You probably already know many of the individual guidelines, but this book may bring them together to help you devise your grazing management strategies. It may assist you to give the management of your native pastures the same consideration as the management of your stock.



*Pasture in good condition*



*GRASS Check—Queensland's monitoring manual*



*Pasture in poor condition*

## Wiregrasses and bluegrasses

Grazing country under the inland woodlands of Queensland covers some 30 million hectares. It lies in a discontinuous belt of semi-arid lands (500–800 mm of rainfall) down the Great Divide from the Gulf in the north to the New South Wales border.

The grazing resource includes a number of pasture communities in which either the wiregrasses (*Aristida* species) or bluegrasses (*Bothriochloa* species) or both are prominent. Rangeland ecologists refer to it as the *Aristida-Bothriochloa* pasture community or abbreviate this to A-B for want of a better term. We will call it the A-B lands in this booklet. Graziers use no common term, except maybe 'forest country' or 'box country' to differentiate it from their better brigalow cropping land in relevant regions.

All these grassy communities are now, or were once, under woodland or open forest of eucalypt or pine, and they grow mainly on infertile earths, duplex soils or sandy soils.

There are often no clear boundaries between the different vegetation zones within the A-B region. On the better and heavier soils, the balance is towards the bluegrasses; on the poorer and lighter soils, the wiregrasses dominate.

In the north with more monsoonal summer rainfall, the pasture species are large and bulky whereas in the south with its better distributed rain, many shorter species can grow well in autumn and spring.

Most bluegrasses are highly desirable species, being leafy, productive and palatable perennials. The wiregrasses are also strongly tufted perennials, but with wiry or stalky stems and only sparse leaf.

Wiregrasses have probably become more common since the regions were first settled, as a result of heavy grazing pressure and a reduced fire regime.



*Desert bluegrass*

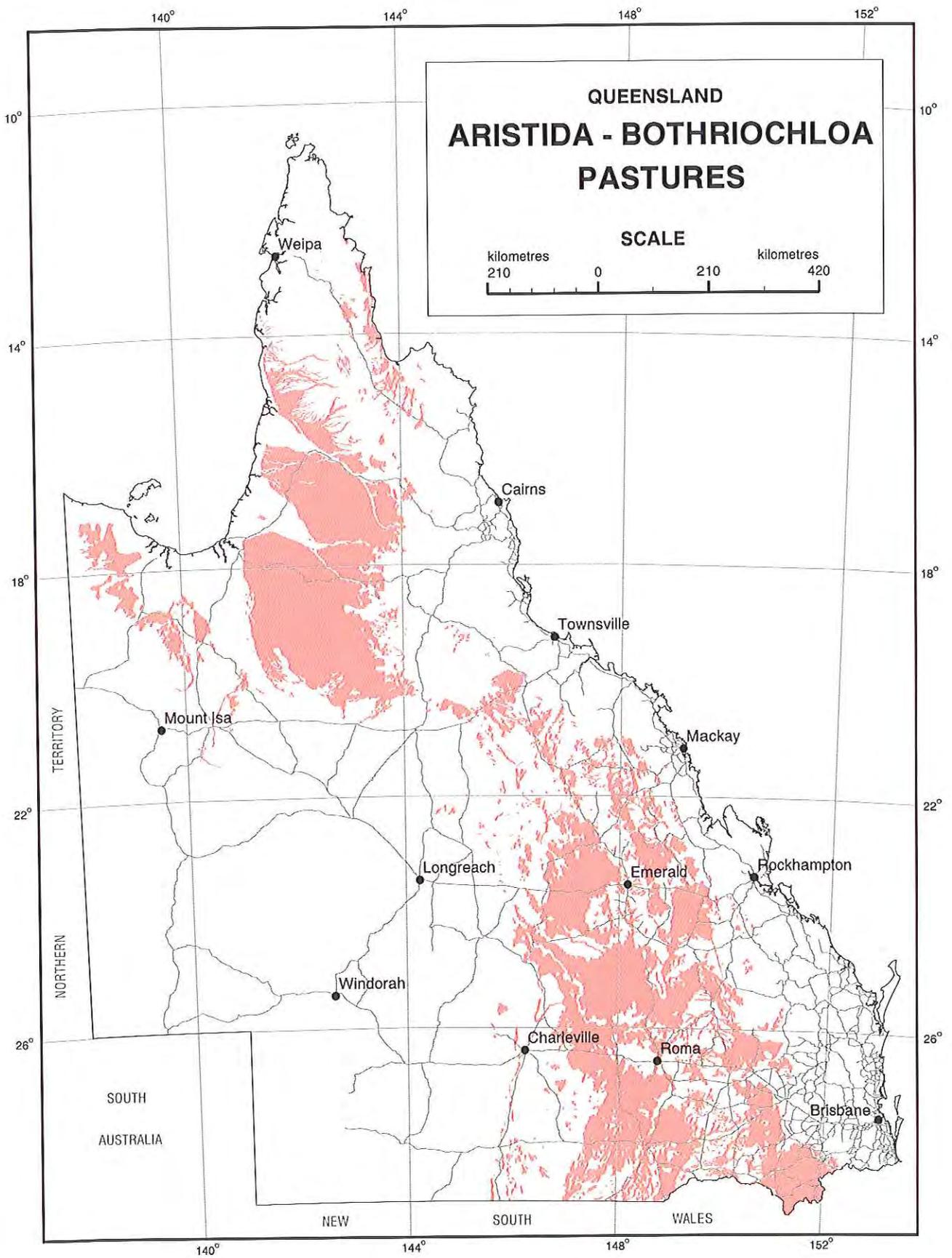
*Jericho wire grass*

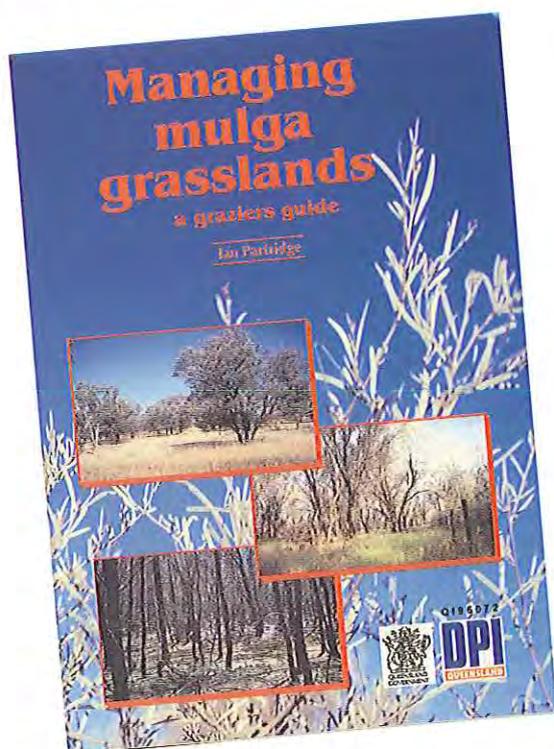
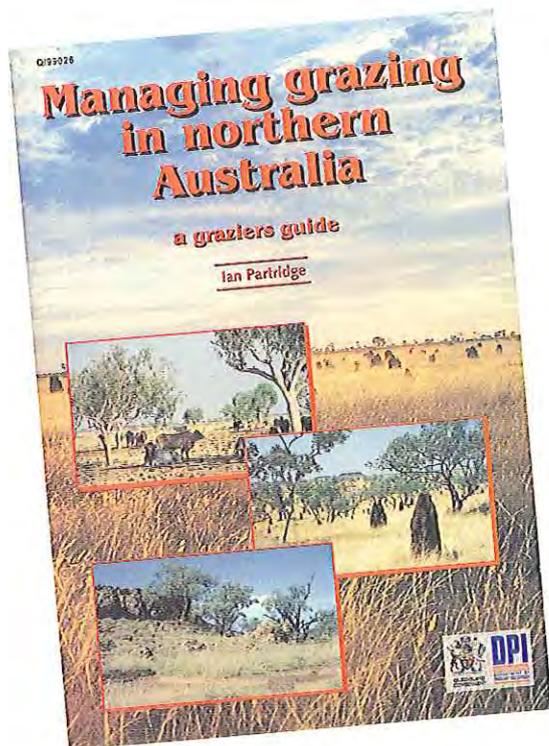


*Leafy desert bluegrass*



*Wiregrass—stemmy and little leaf*





## Pasture types

The major pasture types within the A–B pasture communities are:

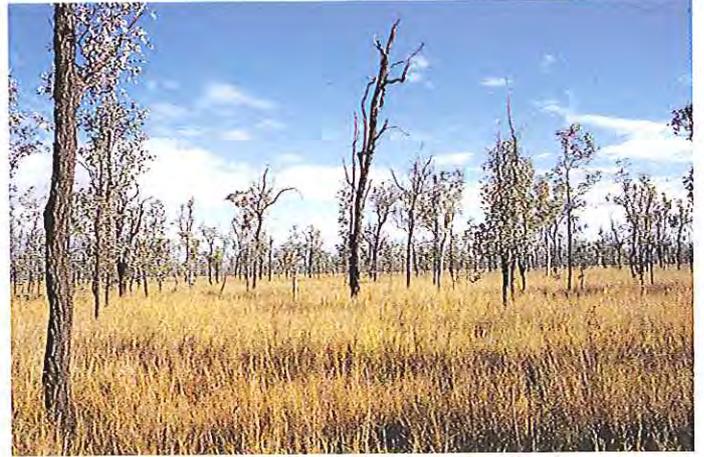
- bluegrasses, windmill grass and wiregrasses under woodlands of poplar box and sandalwood on red and grey duplex soils of moderate fertility (and with marginal cropping potential).
- bluegrasses, black speargrass and golden beard grass under silver-leaved and narrow-leaved ironbarks on duplex and thinner soils.
- wiregrasses and a range of other species, including kangaroo grass, barbwire grass and canegrass under eucalypts on the broken sandstone country of the main range.
- sparse wiregrass and poverty grass on cypress pine country on deep sandy duplex soils.
- wiregrass and lovegrasses under cypress pine on southern sandy country and under bulloak on lower lands with infertile solodic duplex soil. Bulloak grows on the water-shedding soils but can also withstand waterlogging—unlike cypress pine.
- wiregrasses, mulga oats, mulga Mitchell, *Digitaria* and herbage on poplar box–mulga country in the south of the Maranoa on deep red earth soils.
- bluegrasses, wiregrass and temperate species such as *Stipa* and *Danthonia* under eucalypts on granite-traprock country south of the Darling Downs.
- wiregrasses, golden beard grass and perennial sorghum on the western slopes of the Einasleigh uplands under eucalypt woodland on infertile earths and duplex soils, and on the paperbark low woodlands on infertile sands.

Property sizes and intensity of management may range greatly between these different vegetation zones, but many strategies of grazing management are similar in the central and southern regions. The central region covers the Central highlands to the Carnarvon Range, the southern region south to the Queensland Border.

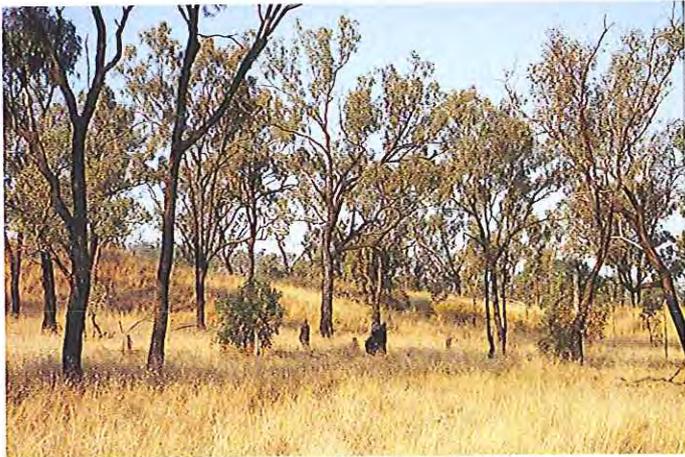
This booklet does not cover the traprock country with its unique circumstances—well-distributed rainfall, winter-growing grasses and fine-wool production. Management of much of the poplar box–mulga country is more appropriately described in ***Managing mulga grasslands*** because of the use of mulga as browse, while management of extensive grazing of the northern A–B regions is probably more appropriately described in ***Managing grazing in northern Australia***.



*Poplar box woodlands on moderately fertile duplex soils*



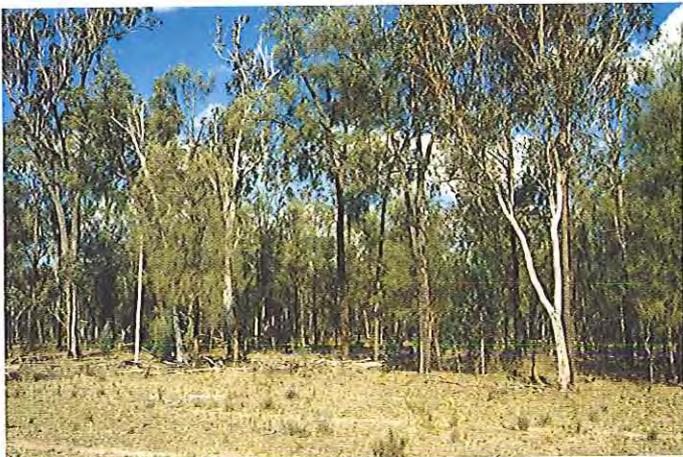
*Silver-leaved and narrow-leaved ironbark woodlands*



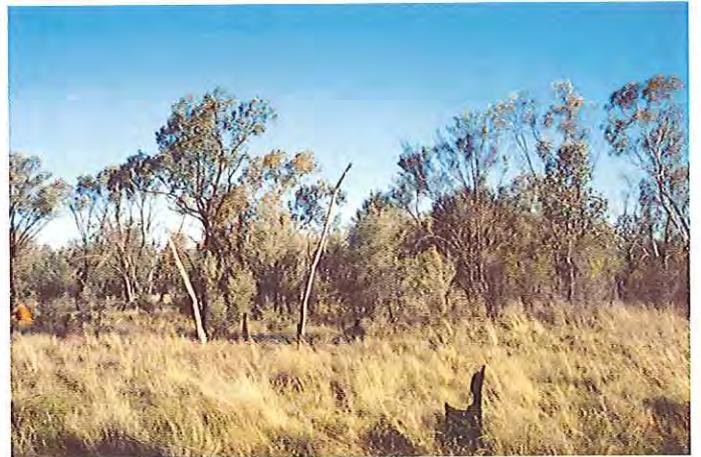
*Sandstone country of the main range under ironbark*



*Cypress pine country on deep sandy duplex soils*



*Poplar box and bullock on solodic soils*



*Poplar box-mulga country on deep red earths*

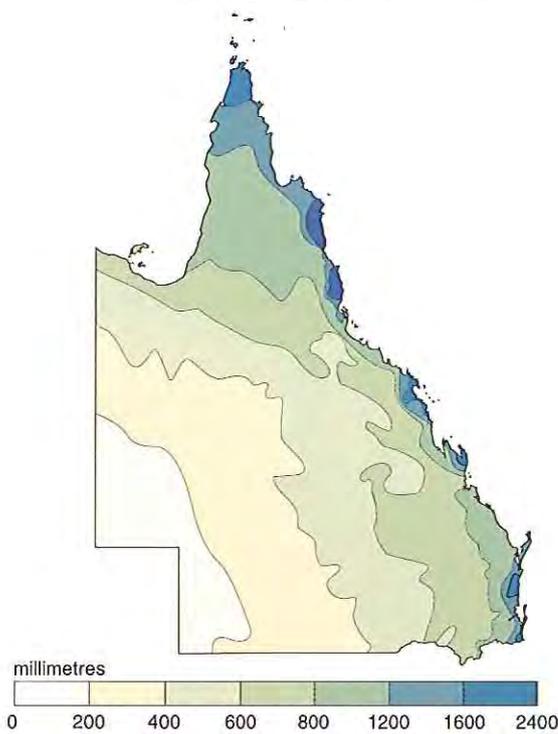


*Eucalypt country on traprock*



*Northern uplands under eucalypts or paperbark*

## Mean annual rainfall (mm)



## Rainfall and droughts

Annual rainfall of the semi-arid woodlands varies from 800 mm in the north, 700 mm on the eastern border to about 500 mm inland. In the regions included in this book, most rain falls in summer—more than 90% in the north down to about 65% in the south.

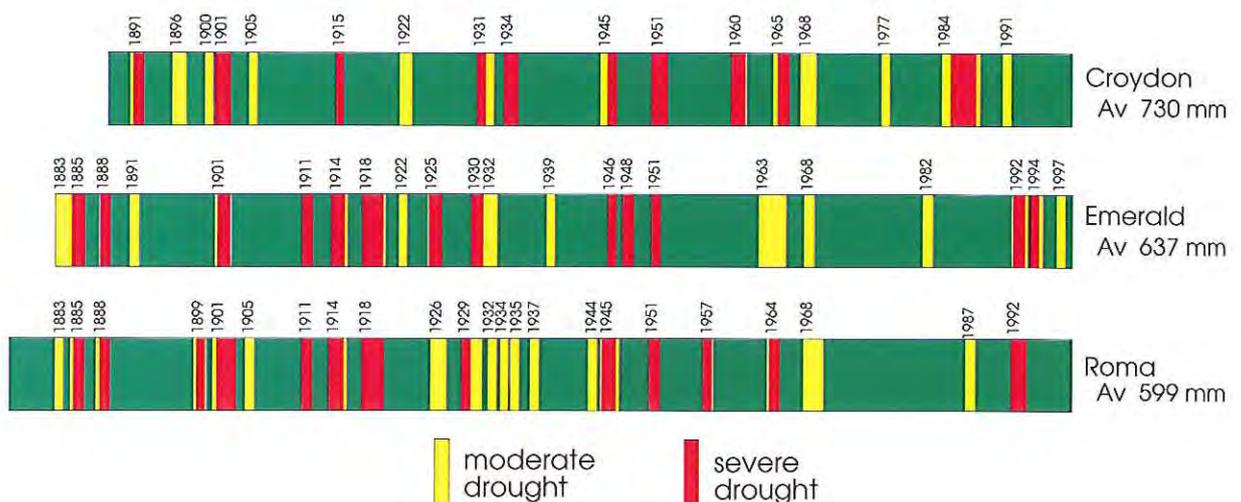
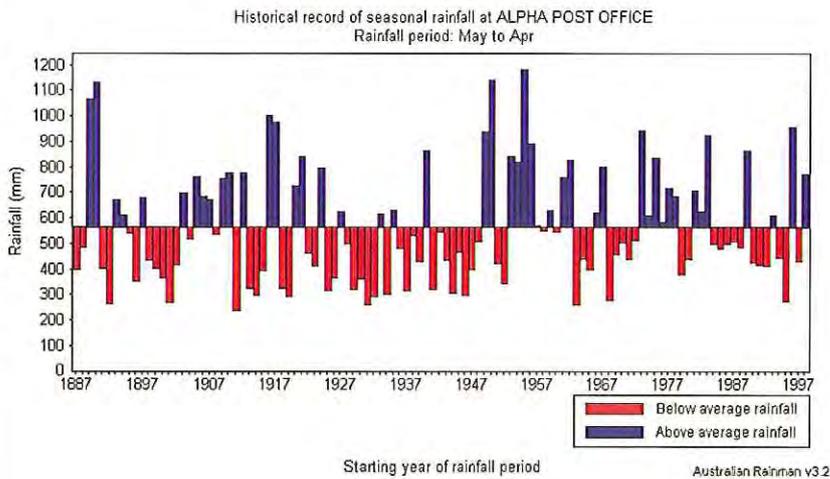
Rainfall is highly variable between years—a sign that the region is under the influence of the Southern Oscillation. Droughts are a normal, if irregular, part of the climate. Most droughts develop after the failure of the rains during one wet season, but those lasting longer have more important consequences for pastures and stock.

While droughts do not occur at regular intervals, they will keep on occurring in the future and must be planned for as a part of normal property management.

The occurrence of moderate and severe droughts for Croydon, Emerald and Roma over the last century is shown below.

## Frost

Frost affects animal performance in much of the southern part of the A-B country, and can influence many stock management decisions in autumn. Frosted mature grass has very little feed value. An early frost may 'snap-freeze' green grass, but fungal attack after winter rain and heavy dew will reduce its nutritional value.



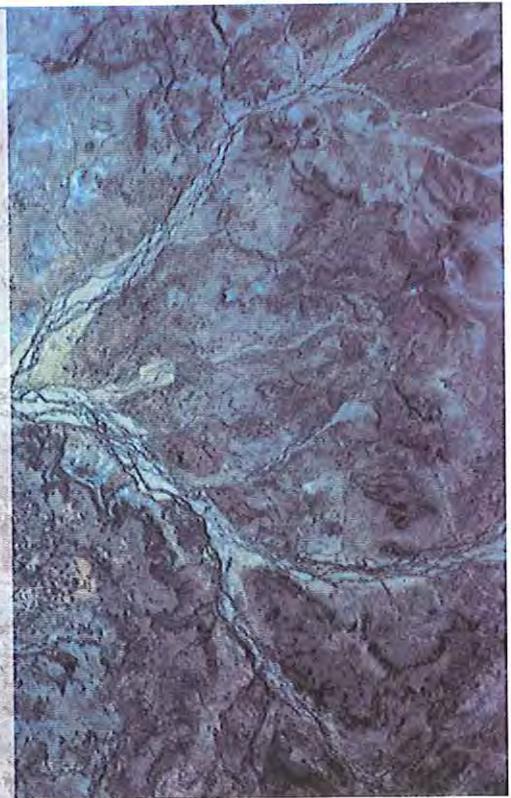
## Property management planning

Property management planning is about landholders and managers developing resource and business plans for their properties.

This planning encourages you to develop a vision of the whole property and also of its place in the overall water catchment. Planning builds on your knowledge and expertise, and allows you to:

- map your resources of land, water and infrastructure
- plan future management and improvements
- understand how to manage climate and risk
- consider the financial costs and benefits of your options
- manage and monitor areas of weeds, land degradation and conservation value
- assess the ability of your resources to achieve your objectives.

Property management planning usually starts with workshops on personal, financial, resource and production aspects of planning, and usually involves preparing a property map based on an aerial map or satellite image.



## Land management types

Graziers recognise that their properties may include different classes of land; these are often classified by the vegetation, for example as poplar box or brigalow. Where their management is similar, they can be described as 'land management types'.

In the north of the central region, a typical property may have only a few main paddocks, with some smaller ones for special use, on an area covering 25,000 hectares. In the south, properties may be under 5000 hectares, but these usually include a good proportion of cropping land.

The A-B lands may be interlaced with or grade into:

- brigalow for pastures or cropping
- Mitchell grass downs
- black speargrass lands
- mulga woodlands.

This mix of land types offers graziers in many districts the opportunity to integrate the use of their grazing and cropping lands. Short-term ley pastures can restore fertility after years of cropping while forages—oats where sufficient winter rainfall, forage sorghum in summer—can be used to finish cattle or relieve pressure on the native grasses.

When a paddock contains a mixture of land types needing greatly different management, these should be fenced separately if practical. For example, poor lighter soils could be separated from sweeter box flats on which stock may concentrate and thus overgraze.



*Improved pastures of buffel grass on brigalow land.*



*Mixed landscapes across one property.*



*Box country provides good-quality grazing.*



*Ironbark country provides moderate-quality grazing.*



*Cypress pine country provides poor-quality 'forest' grazing.*

## Local pasture units

The A-B grazing country in the central and southern regions can be subdivided into a number of local pasture types or units according to soil and climate.

The wiregrasses and bluegrasses grow across a range of soil types and fertilities. The best class of pasture is dominated by bluegrasses (desert and Queensland bluegrass) and is associated with clay soils.

Bluegrasses, kangaroo grass and sometimes black speargrass are found under poplar box on solodic (high sodium and dispersible) soils, and under ironbarks.

The worst pasture is dominated by wiregrass, and is associated with cypress pine on infertile sands in the south and with teatree on infertile hard-setting earths in the north. The poor grazing from poverty grass, wire-grasses and lovegrasses under bulloak hardly merits the description of 'pasture'.

The several land types growing A-B pastures which occur on a single property could include:

- creek flats or river frontage country
- poplar box woodland
- silver-leaved ironbark woodland
- ridges of narrow-leaved ironbark and wattles
- myall and yapunyah
- cypress pine woodland
- bulloak
- lancewood or bendee on jump-ups.



*Sparse grasses under bulloak hardly merit the term 'pasture'!*

## Changes under heavy grazing – basic ecology

### *When are grasses most susceptible to grazing?*

Grasses are most easily damaged by grazing when they are reshooting just after the first storms at the end of the dry season or a drought—the first green pick.

Until there is enough green leaf for productive photosynthesis, the plant has to produce new leaves from its reserves.

Pasture can be damaged in early summer if you have been carrying too many stock during winter or, for example, if you burn only a small part of a rank paddock and allow stock to concentrate on this.

### *What happens under heavy grazing?*

Under continued heavy grazing, the tussocks of palatable perennial grasses become smaller and produce less seed. The more open pasture then allows other grasses or weeds to increase or invade.

If these other grasses are less palatable, and are ignored by stock, they grow larger, taking more and more of the soil moisture and nutrients, and setting large amounts of seed.

Cattle seek out the remaining good grasses, further increasing the grazing pressure on them. The pasture gradually changes its composition with less of the desirable species and more unpalatable perennial grasses, more annual grasses, more weeds and more bare ground.

### *Which grasses do cattle like best?*

Stock obviously prefer young soft green leaf over old dry stem, but also have changing preferences during the year. They eat bluegrasses and black speargrass before wiregrass, but often prefer the small annuals (including chloris, bottlewashers, fairy grass, spring grass) in early summer. Queensland bluegrass, with its fine leaf and stem, is a preferred species during winter.

### *What sort of pasture is best?*

You should try to manage your grazing to keep the '3P' grasses dominant—those species that are perennial, productive and palatable.

**If your grazing country is not in the best condition, lowering your stocking rate will benefit the cattle and the pasture.**

**The 3 'P's of the best grasses—  
perennial, productive, palatable.**



*Overgrazing green pick can weaken the grass plant.*



*The root system, as well as the top growth, of a grass becomes much smaller under constant heavy grazing. The plant with the small root system cannot respond well to rainfall.*



*Cattle often prefer small annual grasses growing between the tufted perennials.*



## Managing your grazing

The options for managing grazing on A-B country are fairly limited because of the moderate to low potential of the land. The main grazing management options are:

- altering number of animals (stocking rate)
- moving stock (spelling)
- burning
- clearing or thinning trees
- adding a legume to existing pastures
- sowing a new pasture on better class land.

### Altering stocking rates

Stocking rate (number of hectares per beast or beasts per sq. km) is the most important factor in grazing management—whether under trees, on fully cleared land, or on native or sown pastures.

The main desirable species in native pastures are mostly erect clump grasses that cannot stand being grazed heavily year in, year out.

Light stocking is sustainable, keeps the land and pasture in good condition, allows burning and lets each animal grow faster.

Heavy stocking weakens the valuable species, encourages unpalatable grasses and weeds, exposes the soil surface to erosion, prevents fires thus allowing woody regrowth to take over, and produces slower growing cattle that are more at risk during drought.

**Nearly all deterioration seen in pasture lands has been caused by over-stocking.**

#### What is the difference between carrying capacity and stocking rate?

Carrying capacity describes how many animals a pasture can carry and still remain in good condition. Stocking rate describes how many animals are actually grazing the paddock.

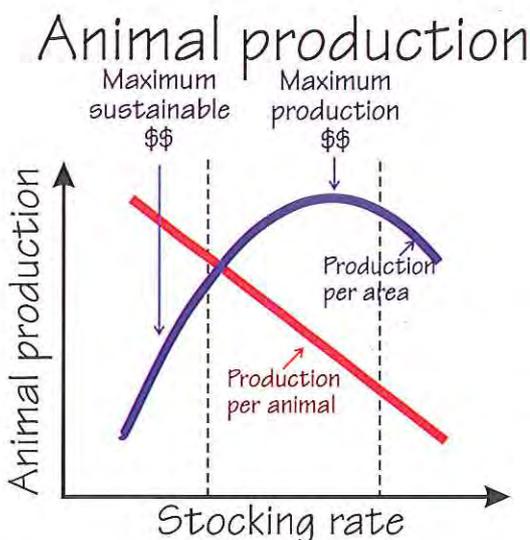
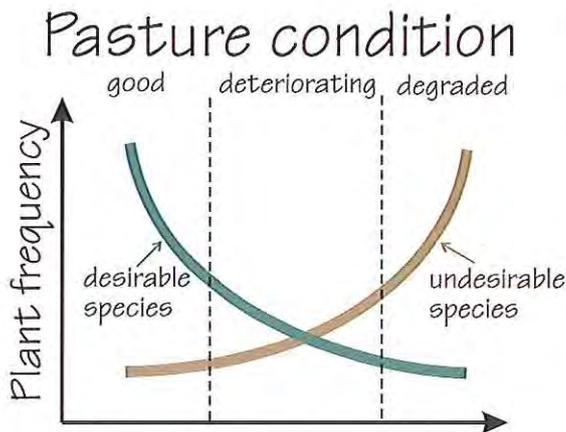
If your stocking rate exceeds the carrying capacity over a number of years, the condition of your pasture will decline.

#### How can carrying capacity be calculated?

A scientific approach is to calculate the amount of grass that grows—which depends on the soil type and rainfall—and to allow only a proportion of this to be eaten.

Rangeland scientists have worked out that, in this region, 20–30% of the summer growth can be utilised (eaten) during summer without damaging the pasture—20% on the light cypress pine soils to 30% on good box clays.

**Stocking rate has the over-riding effect on animal production and pasture stability.**



**Take half, leave half.**

### How much grass does grow each year?

For a given soil type, the amount of grass growing each year depends on the rainfall. Pasture scientists have calculated the amount of grass (kg of dry matter) that is produced per hectare for every millimetre of rainfall—the Rainfall Use Efficiency or RUE. This ranges from 7 on good frontage country to 1 for cypress pine forest on deep sands. (As an example, RUE of 4 X 600 mm rainfall = 2400 kg/ha/yr).

However, rain is less effective in wetter years because of increased runoff and fertility limitations; in very dry years, there is high soil evaporation and more competition from the trees.

You could calculate grass growth for an average year, but since there never is an average year it is preferable to include a safety factor based on 7–8 years out of 10.

Setting a stocking rate for the average year will lead to over-grazing in the 5 years with below-average rainfall. It can take a couple of years for pasture to recover from the effects of over-grazing during a drought. In the good years, you can plan to rest some paddocks or to burn.

Typical values for Rainfall Use Efficiency

Type of country	Wooded	Cleared
Frontage	3–5	6–7
Poplar box	2.5–3.5	5–7
Silver-leaved ironbark	3–5	5–7
Narrow-leaved ironbark	2–3	2.5–3.3
Cypress pine	0.5–1	2–3

### Eating less than a third does not sound much?

The idea is to allow stock to eat no more than the 20–30% of the summer growth during the summer.

The animals will eat and trample another 15–20% of the dry feed during the dry season without damaging the dormant grass plants. Thus, the total utilised over the whole year is 35–50%.

### What is a safe stocking rate for my paddock?

The stocking rates recommended by producers are fairly broad; they may range, for example, from 6 to 10 hectares for a beast within a land type. However, the following are guidelines.

Suggested sustainable stocking rates for native pastures  
(1 Animal equivalent [AE] = 450 kg beast)

Type of country	Stocking rate ha /AE	Steer growth rates kg/head/yr
Frontage	2–4	150–180
Improved pasture–buffel	2–3	150–180
Poplar box woodland	3–4	120–170
Silver -leaved ironbark	4–6	120–160
Narrow-leaved ironbark, wattle	10–12	80–130
Ironbark improved with stylo	3–5	150–160
Cypress pine woodland	10–15	
Bullock	12–15	
Spinifex	20–30	

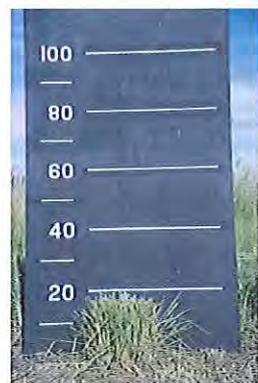
Sustainable pasture utilisation—how much of a grass plant can be eaten over (every) summer without damaging the pasture.



0% eaten – a complete rest for a month over the growing season can allow the plant to strengthen.  
(Height 100 cm)



25% eaten – you can aim for 20–25% utilisation for most species.  
(Height 30 cm)



50% eaten – too heavy for persistent grazing of most of the local native grasses.  
(Height 20 cm)



70% eaten – will soon lead to the loss of most desirable native grasses.  
(Height 10 cm)

The top two-thirds of a sward contains only one third of the bulk.



*Your effective stocking rate will depend on the distribution of water points.*

In large paddocks, your effective stocking rate will depend on the distribution of natural or installed watering points and whether stock utilise the whole area. However, ungrazed back areas of a large paddock help to maintain biodiversity of vegetation and fauna.

You will need to refine these stocking rates for your paddocks by monitoring your pastures every year to see whether they are improving or deteriorating. You need to understand what your management is doing.

Although the condition of pastures may take 3–4 years to change significantly, annual checks are needed to pick up the trend with confidence.

**You should check, or monitor, how much feed remains at the end of summer and which species predominate.**

### ***How do I calculate a stocking rate for this year?***

A practical method is to calculate the stocking rate that can be carried over the dry season or winter. This can be based on the amount of feed in the paddock at the end of the summer growing season and the amount of ground cover or fuel needed at the start of the next wet.

These calculations are done before the first weaning muster to allow excess stock to be drafted for sale or some extra animals to be purchased or dry grass to be kept for a strategic fire.

Stock numbers can be further adjusted at the second muster in June or later if extra rain has fallen or if the SOI indicates a potentially good spring and summer.

### ***How much cover do I need at the start of the wet?***

The soil and land are most liable to damage when you have lost your good pasture. However, during any year, soil is most susceptible to erosion if it is bare during heavy storm rains.

Soil erosion increases greatly when there is less than 40% ground cover. Although this figure of 40% includes weeds, tree litter and even stones, it still represents 800–1000 kg of dry grass per hectare with tussock grasses.

If you want a good fire in early summer, you will normally need even more dry matter for fuel, at least 1500–2000 kg.

***If you have to feed a lot of supplement every dry season, you are probably carrying too many stock.***



*A fire hot enough to kill woody top growth needs at least 1500 kg/ha of fuel.*



*Soil erosion increases rapidly once ground cover is less than 40% at the start of the wet season.*

## Checking your feed supply till next summer

Stocking rates can be adjusted at the end of the growing season according to the amount of feed in the paddock and the condition of the pasture.

- **If the bulk is high and pasture condition good, consider buying more stock.**
- **If the bulk is high but pasture condition poor, consider burning at the start of the summer rains.**
- **If the bulk is low, consider moving stock off.**

Estimate the feed standing in the paddock at the end of the growing season (March-April), either by using the photo-standards at the end of this book or by more direct measurement.

An animal equivalent (1 AE) on dry season supplements will eat 8–10 kg of poor quality feed per day, or 1900–2400 kg over the 8 month dry season.

You can now calculate your stocking rate by **either**

- a) simply allowing 20–25% of the standing feed for your stock

Standing feed (kg/ha)	25% utilisation eats (kg)	Stocking rate (ha/AE)
500	125	16 – destock
1000	250	8 – lighten off
1500	375	7
2000	500	5

Obviously if you have very little feed at the end of the wet season, you are in trouble and have to consider destocking.

**or**

- b) decide how much grass or fuel you will need when the wet season arrives, and thus how much your cattle can be allowed to eat.

- **40% ground cover needs at least 1000 kg/ha with tussock grasses**
- **a good fire needs at least 1500–2000 kg/ha.**

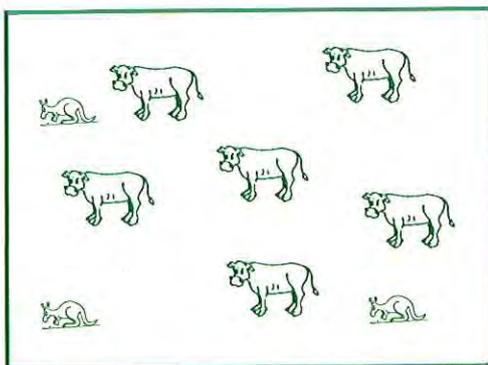
Subtract the required mass for the end of the dry (e.g. 1000 kg) from the present mass (e.g. 2000 kg) to estimate the feed that can be used. Divide the need by the available feed to calculate the number of hectares needed for each AE.





*The total number of stock is more important than how they are moved around.*

**Many of our native pastures in Queensland are already being stocked too close to capacity. Most stocking rates should be lowered rather than raised.**



*Continuous grazing—stock spread out.*

## Moving stock and spelling

Stock can be moved between native pasture paddocks under various grazing systems, or moved off the native pasture onto forages or improved pasture on the same property, or moved off property for agistment, sale or into a feed-lot.

Most managers on extensive properties leave a group of animals in one paddock all year round, others may move stock around a series of paddocks. Much interest in rotational grazing has been created recently by proponents of time-control (short duration, cell) grazing.

**The total number of animals on the pasture over the year is more important than how they are moved around.**

### **What grazing systems might be useful?**

A paddock can be grazed continuously or the cattle rotated between paddocks. It can be rested partially or completely at times in 'deferred' grazing systems.

Some form of rotational grazing is often used, especially in the southern region, but this has generally been more for the benefit of the animal than for the pasture. While any form of strict rotational grazing has little relevance on extensive properties, opportunistic spelling can definitely be beneficial for heavily grazed paddocks.

### **Is continuous grazing the same as set-stocking?**

Continuous grazing just means that animals are not moved between paddocks; however, the number of stock should still be adjusted to the feed available.

With our highly variable summer rainfall, set stocking with the same number of animals every year could mean eating 80–90% of the feed grown in dry years and only 10% in the wettest years.

### **What is spelling?**

Spelling means destocking a paddock completely or reducing stock numbers. Complete spelling in a good year may be needed to allow the desirable 3P grasses to recover or to build up a good load of fuel to control woody species.

### **Strategic or opportunistic spelling?**

Let's just say that opportunistic spelling should be part of general grazing management strategy. Spelling on a fixed rotation, for example every fourth year, will not be feasible if it coincides with a drought. So spell one paddock in a good year when there is plenty of grass around.

### **What is opportunistic spelling?**

Opportunistic spelling means that, in good years, you allow the grass to recover from the bad years. Greatly

increasing stock numbers to eat all the extra feed may give a short-term profit, but may not be best for the pasture.

### Why should I spell my pastures?

Complete rest for at little as three to six weeks during the early to mid-growing season can have long-term benefits for your pastures.

It gives highly desirable but slow-to-establish species, such as kangaroo grass and forest blue, a chance to rejuvenate their crowns and to set seed.

Spelling for 1-2 months during the peak growing season will allow the palatable grasses to set seed; spelling for 4-8 months allows fuel to accumulate for a fire to control woody weeds.

How long you need to destock depends on the condition and amount of pasture, on rainfall during the growing season and on your reason for spelling.

Partial destocking may not always be effective if the remaining stock still concentrate on their preferred species.

Strategic spelling for several months during summer can also aid in tick eradication programs.

### When should I spell?

It is obviously most practical to spell in a wet year when there is plenty of grass. You can get forewarning of the wet years by checking the SOI during winter. A strongly positive SOI is often associated with early breaks to the wet season and a wetter-than-normal growing season.

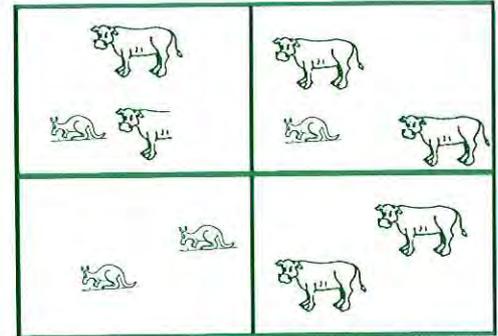
Lighten off a paddock from the beginning of the wet season to favour bluegrasses as they flower in spring or mid-summer—earlier than black speargrass for instance. Kangaroo grass flowers best around late December.

Spelling during the winter or dry season gives no benefit because the grasses are dormant.

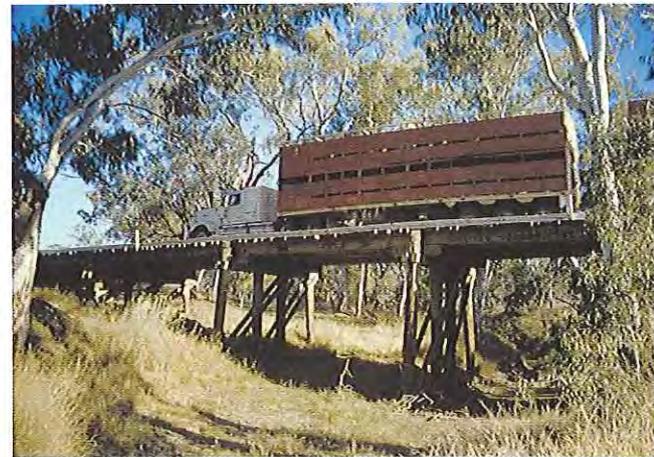
### How often should I spell?

It may take two consecutive growing seasons for a tussock grass in poor condition to recover. In the first year, the weak plant will send out seed heads and more tillers; in the second year, the crown and root system of the whole tussock strengthens.

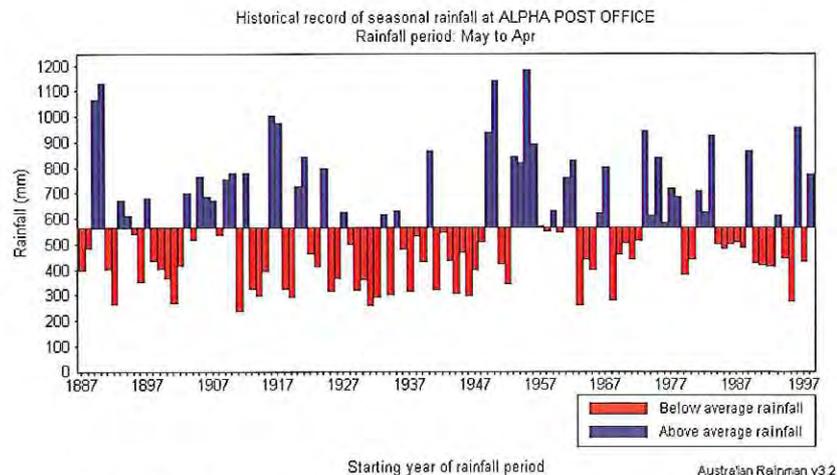
Once a paddock is in good condition, spelling it once every ten years may be enough to keep it in good condition.



The best system?—continuous grazing with fewer stock and opportunistic spelling in good years.



Truck livestock out quickly during a drought, bring them back slowly to give grasses a chance to recover.



How often is one wet year followed by another wet year?



*Roos may concentrate on spelled paddocks.*

### **Are kangaroos a problem on spelled paddocks?**

There are always kangaroos and wallabies around timbered country, but in most northern districts, their numbers are not often so devastating as to cause a problem when pasture is spelled.

If roos do accumulate on a spelled paddock in south Queensland regions, commercial shooters are usually glad to deal with concentrated mobs.

### **Why not encourage rotational grazing?**

Strict rotational grazing may well be the most efficient system for high utilisation of high-quality temperate pastures using specially bred plant species that can be resown. This is not the case for our fragile variable-quality native species growing on marginal productivity land under a variable climate.

The extra costs of management and sub-division fencing demanded by fixed rotational grazing systems bring little or no benefit in terms of animal production or pasture condition on extensive native pastures.

Generally animals gain more weight when able to select their diet over the whole area under continuous light grazing than when forced to eat more of the mature herbage before being moved to the next sub-division in rotational grazing. However, most native grasses cannot stand constant heavy grazing.

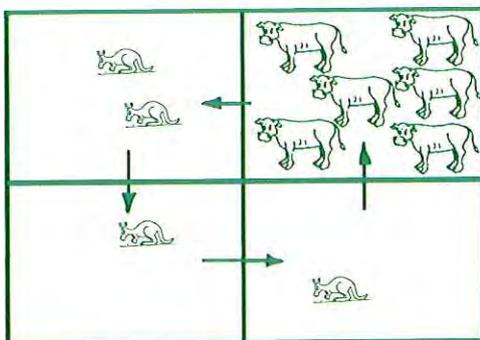
You may get quieter stock because they are handled more frequently, and extra fencing may improve distribution of grazing within a large paddock.

### **What about short duration grazing?**

Once again, it's a case of costs against benefits. The claimed benefits of SDG have been increased carrying capacity, better animal performance, reduced soil capping, better pasture and reduced regrowth of woody weeds.

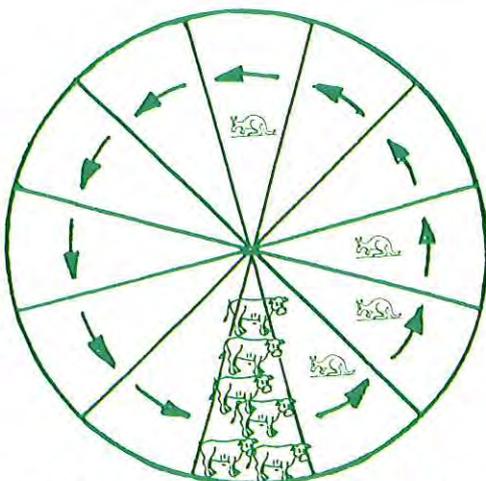
Unfortunately, in objective trials over several years, SDG has not yet shown these benefits on native pastures anywhere in the world. Whenever stocking rates were increased, the opposite occurred—the pastures deteriorated, hoof action compacted the soil surface, and the stock gained less weight. The system often crashed in severely dry times.

Another problem is woody regrowth. This is best controlled by periodic burning, which may be difficult under a cell grazing system. We suggest that extra fencing for better distribution of cattle and more even grazing, better water distribution, improving pasture with legumes, fencing separate land management types, and controlling woody regrowth offer more productive returns and better long-term care of your land.



*Rotational grazing—periodic high grazing pressure.*

**Any system of grazing that encourages you to look more carefully at your pastures is likely to give positive results.**



*SDG is an extreme form of rotational grazing with stock held on each of many paddocks for only a few days, and with long rests between grazing.*

### When do I adjust stocking rates?

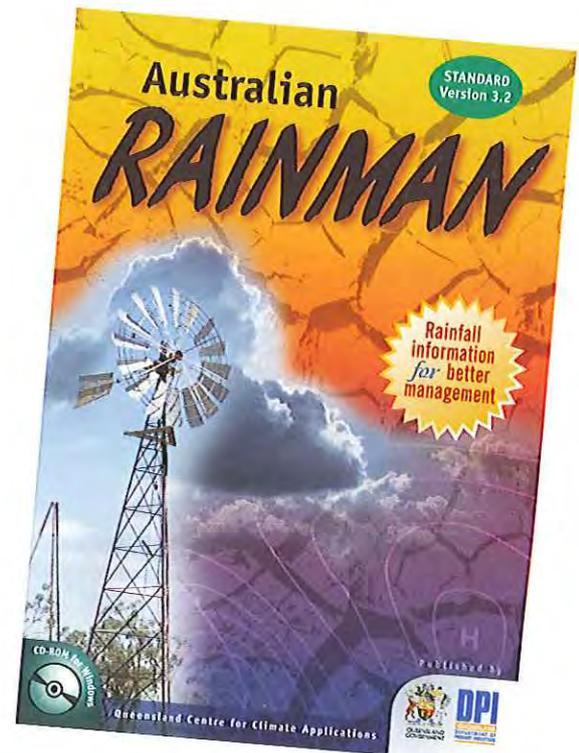
If you are short of feed in February, sell stock early while the market is still reasonable. Don't get caught with no feed and no market.

Normally, stock numbers should be adjusted at the end of the growing season in April–June after checking the amount of feed in the paddock, and taking into account the rainfall expected over the next summer.

The probability of a coming season being wet or dry can be based on the Southern Oscillation Index. However, any relationship between the SOI and rainfall is rarely fixed until the end of May—which may be too late for the first weaning muster.

### 'God's will'— or can we forecast droughts?

Until recently, the triggers for droughts were not understood and we accepted them as random events. As we get a better understanding of the climate systems, we may be able to forecast the seasons ahead based on the Southern Oscillation Index or sea surface temperatures in the Pacific and Indian Ocean.



### What's the SOI this month?

Monthly SOI values are given on the weather page of the Queensland Country Life and on the ABC Weather Forecast on Wednesday evenings.

You can check the latest values for the SOI by phoning the DPI Hotline on (07) 4688 1623 or the Farm Fax Hotline on 1902 220 042. A recorded message gives the updated value on the first and fifteenth day of each month, and a comment on the implications for the coming season.

Other sources of up-to-date information through the Internet include:

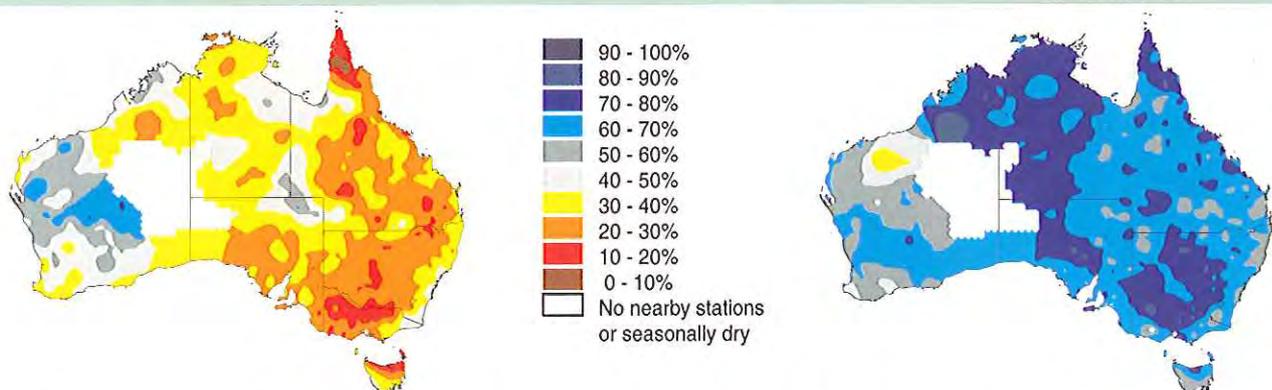
The Long Paddock site at: <http://www.dnr.qld.gov.au/longpdk/>

Bureau of Meteorology at : <http://www.bom.gov.au>

The DPI and Bureau of Meteorology run *Managing for climate* workshops to explain weather forecasting and seasonal climate forecasting.

The AUSTRALIAN RAINMAN decision support program can show you whether the SOI, or the sea surface temperatures in the Indian Ocean, can provide any extra skill in forecasting rainfall over the coming seasons—for some 3700 locations in Australia.

**Accurate short-term seasonal forecasting can help more efficient use of our grazing lands.**



Chance of exceeding median rainfall from September to November when the SOI has been in a negative (left) or positive (right) phase over July–August.



*Periodic burning has kept this box flat clear of regrowth.*



*"Five suppressed seedlings for every mature tree."*

**Do not burn indiscriminately. Work out why and where you need to burn.**



*A total ban on burning cypress country can result in useless whipstick growth.*

## Burning

Graziers burn for many reasons; these include improving access to green leaf by removing old rank material and controlling woody regrowth.

All our A-B country is naturally timbered—and it is trying to stay that way. There are always tree seedlings or suckers present in the grassland, but they are suppressed by the mature trees, dense pasture or by natural fires.

Remove the mature trees or take away fire (deliberately or because stock have eaten too much of the fuel), and regrowth is going to occur. For example, over the recent decades cypress pine has invaded a lot of the light soil country that is being well grazed and not burned, while false sandalwood has increased on heavier soils.

Fire is a basic management tool for maintaining the A-B grasslands and woodlands in good condition.

### **Should I burn my grass?**

Fire is an integral part of good native pasture management whether the land is timbered or cleared.

Fire as a management tool can:

- remove excess rank grass
- reduce some wiregrasses
- control woody weeds and eucalypt regrowth
- thin young, encroaching cypress pine.

Burning rank wiregrass in gullies can encourage stock to graze the young growth and so weaken the plant. However, both purple and many-headed wiregrasses have low, protected crowns and are little affected by fire or grazing.

Burning seems to favour golden beard grass in the absence of heavy grazing, but does not stimulate regeneration of bluegrasses—unlike the effect on black speargrass. The fluffy seeds of bluegrasses do not penetrate into the soil, and are destroyed by fire.

Fire must be used carefully around areas with valuable cypress pine for timber—as in state forests or timber reserves. However, a total ban on burning cypress pine country can result in dense 'whip-stick' growth with no commercial value.

### **How often should I burn?**

Although you should plan on a good fire every 4 to 7 years, in practice you will have to wait until after a good wet season. This may be too infrequent to control some woody regrowth.

Tree seeds in the soil will germinate when conditions are right—good rainfall and open pasture.

Eucalypt seedlings grow slowly (10–15 cm in the first year), but put down a strong taproot.

Fire will kill the seedlings in their first year; there-after it will kill the top growth up to a couple of metres but not the whole plant. However, a hot fire can kill mature eucalypts with damaged bark or with exposed hollow trunks. It can also kill larger trees of sandalwood, belah and wilga especially if the soil is dry.

Cypress pine is different— moderately hot fires will kill saplings up to 3 metres high and even mature trees.

**Fire may not kill established eucalypts and shrubs but will control them.**

**If you are able to burn with a moderate fire every 4 to 7 years, your stocking rate has been about right. If you never seem to have enough grass to get a burn, you are stocking too heavily.**

### **How much fuel is needed to control regrowth?**

A hot fire needs over 1500 kg of fuel if it is to damage woody saplings up to 2 metres in height or kill seedlings in their first year. In an average year, a pasture will produce 1500–2000 kg/ha of fuel, but this can accumulate to 5000 kg over a few years if ungrazed.

### **When should I burn?**

**To remove old rank grass**, burn in late winter but after some rain. With this cool fire, control is easier, green pick soon shoots and susceptible trees are not damaged. However, without follow-up rain, the grasses can be damaged.

**To kill woody regrowth**, burn with a hot fire in spring or early summer but again after some rain. In spring or winter, old grass is too damp and the resultant cool fire will be ineffective.

### **What about a later fire?**

Burning after the grass has produced new leaf from its crown reserves may weaken the grass plants in the same way as grazing, and may kill any new grass seedlings. However, it could make young wiregrass more acceptable to stock.

**To reduce susceptible wiregrasses**, try to burn in early summer after the wiregrass has green shoot and after the surface soil dries out a bit. These types of fire are opportunistic depending on the rainfall pattern.

### **What if it has not rained?**

If the rains have not arrived by January, do not burn because this could leave you without any feed.

We have seen the relationship between the SOI in winter and rainfall in spring on page 17. If the SOI during winter is strongly negative, the chances of good spring or summer rain are low—so do not burn big areas.



*A hot fire will kill the top growth of saplings and defoliate taller trees.*



*At least 1500 kg of fuel is needed to control woody regrowth.*

**If you never seem to have enough grass to get a burn, you are stocking too heavily.**



*Low fuel loads and winter conditions result in a cool fire.*



*Wattles are easily killed with fire, but seed will germinate after a hot fire.*



*Do not graze newly burnt grass until it has 15 cm of leaf.*

**Get a Fire Permit first and abide by its conditions.**



*Nutrient losses in smoke are very low and soon replaced by natural cycling.*

### ***Doesn't fire encourage wattle seedlings?***

Wattles are generally found on the poorer soils where there is little valuable grazing. As hot fires will crack their hard seed coats, allowing them to germinate, use a cool fire in winter. As shrub seedlings generally will not flower in their first three years, another burn in this period will prevent more seed dropping. However, species that sucker from their roots, such as sally wattle, can drop seed in the same year that they are burned.

### ***What about burning part of the paddock?***

It is usually better to burn the whole, or a large part, of a paddock so that stock do not concentrate on the burnt areas and weaken the resprouting grasses.

However, fire can be used to even up patchy grazing or to weaken wiregrasses by encouraging stock into the previously ungrazed areas.

### ***When can I restock after burning?***

Grass plants are susceptible to grazing immediately after a fire (or drought) when trying to grow from the crown. If possible, keep stock off newly burnt pasture until the grass is over 15 cm high. Earlier grazing may weaken some wiregrasses.

### ***What are the benefits of burning to your stock?***

Fire removes the low-quality roughage (dead leaf and stalk) allowing stock to get a more nutritious pick. Steers can gain up to an extra 25 kg in the first 3 months after a spring fire, but those on unburnt pasture may catch up later.

### ***Does burning increase the risk of soil erosion?***

Although a fire will remove much of the cover, there will be much less erosion than from a bare overgrazed pasture. For a pasture to burn, it must have had healthy plants that maintain the soil structure and allow water to infiltrate.

### ***What nutrients are lost in a fire?***

Plant nutrients that become gases are lost to the atmosphere. Nitrogen becomes ammonia (which is why smoke makes your eyes sting); sulphur becomes sulphur dioxide. Potash remains unchanged, but some phosphorus can be vaporised with a hot fire.

Some nutrients lost in smoke may return to another part of the paddock as ash, and you may get someone else's nitrogen or sulphur if the gases dissolve in raindrops.

The level of nitrogen (and sulphur) in dead leaf and stem is very low, and burning 1500 kg of dry matter per hectare will lose less than 10 kg of nitrogen. Thus nutrient losses due to burning is very low, and are easily replaced in natural cycling.

## Clearing or thinning trees

A–B pastures grow naturally under an open canopy of 30–80 large eucalypt trees per hectare. Pasture is reasonably productive under the trees although they compete for water and nutrients. Trees also suppress many woody shrubs.

During wet summers, there is often enough moisture for both grass and trees, but in drier years and as the season progresses competition increases. The effect is strengthened if the population of trees and shrubs increases.

In more southern regions, killing trees may double the growth of the understorey pasture, and it may be worthwhile clearing some of the better class of country.

**Think very carefully before clearing mature trees. Much of the benefit is offset by the cost of controlling regrowth.**

### *What are the advantages of clearing?*

**More grass.** Grass production can double on the better box soils, with the advantage most pronounced in dry summers. However, the benefits depend on the fertility of the soil, the density of the trees and the region.

You can carry more animals or increase the weight gains per animal if the land and grass quality are good enough. You may want to develop better class land with a fully sown pasture for fattening or weaning.

Clearing may allow the grass cover to thicken, reducing erosion and loss of soil.

**Easier stock handling.** Mustering is easier in cleared country. Cattle may be self-mustered by using speartrap gates onto a cleared area that may be improved with sown or fertilised pasture.

**Easier mechanical clearing of woody weeds.** Dense infestations of currant bush or rubbervine can be cleared more easily with a dozer in open country.

### *What are the problems with clearing?*

**Biodiversity.** Overcleared land loses its ability to keep nature in some sort of harmony. Without this balance, your land is potentially subject to degradation and loss of future productivity.

**Cost.** The cost of clearing may outweigh the benefits on poor country. You need to consider the initial cost of clearing, the expected benefits in terms of grass and stock, and how long your management allows the benefits to last before they are wiped out by regrowth.

Don't clear country with plenty of wattles, narrow-leaved ironbark or cypress pine. It is not worth the effort and is bad for land management.



*Trees compete for water with the adjacent grass or crop.*

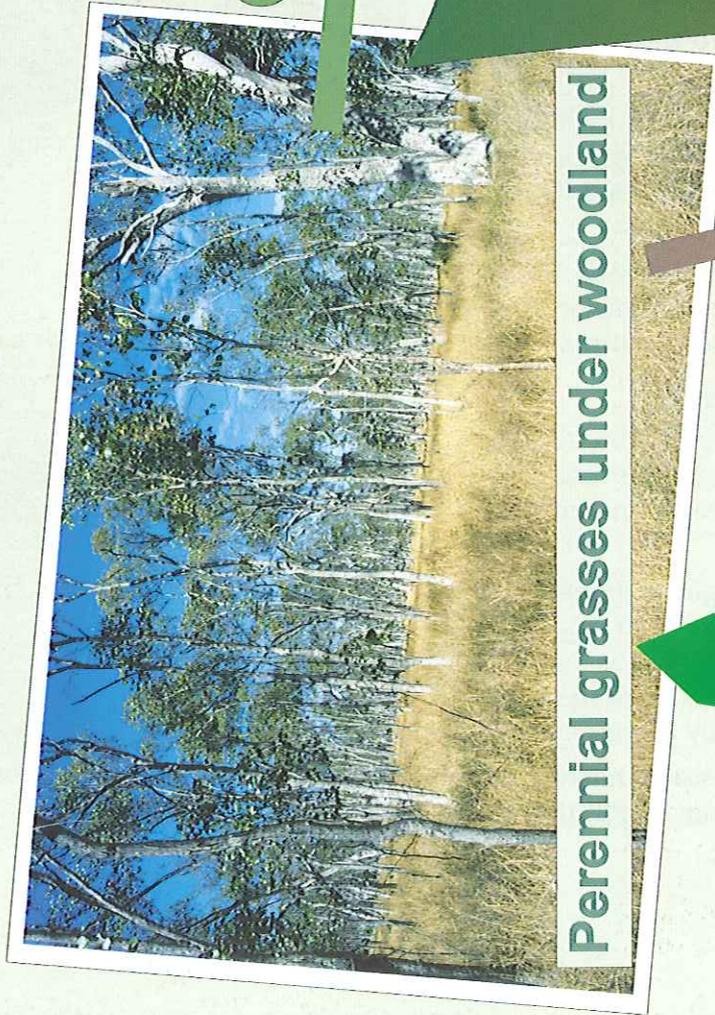


*Open grassland after partial clearing.*



*Do not clear sloping land with an unstable subsoil.*

# Grazing in the semi-arid woodlands



Perennial grasses under woodland

Clear



Perennial grassland

Good

Grazing, no hot fires

Spelling or  
light grazing,  
+ hot fire

Heavy grazing, r

Clear  
or herbicide,  
then snell

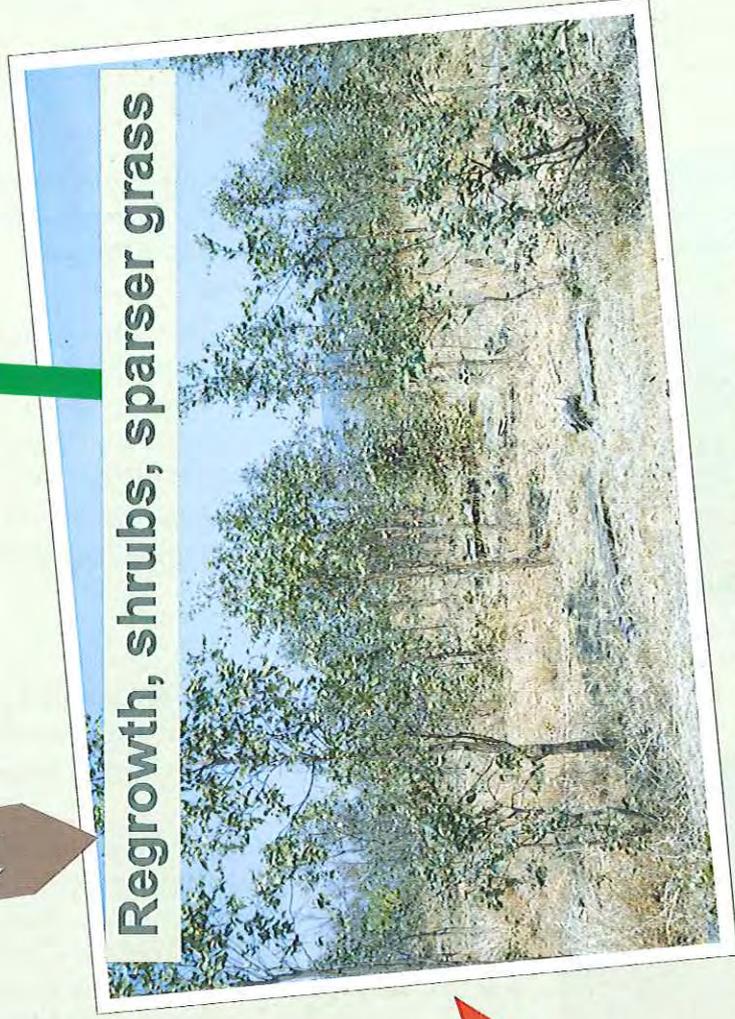
no hot fires



Increasing shrubs

deteriorating

for hot fire



Regrowth, shrubs, sparser grass

# The state of your pastures

depends on past seasons and on your management -

- right stocking rate
- periodic wet season spelling
- fires



*These wattles took off after the big trees were killed.*



*False sandalwood increasing under box.*



*Cypress pine invading because of lack of fire.*

**Develop your property plan to guide any tree clearing.**

**Erosion.** Box trees frequently grow on solodic soils. Pulling trees or cultivating deeply afterwards can expose the dispersable subsoil to rain water, resulting in severe gully or tunnel erosion.

**Salinity.** Clearing ridges with permeable soils can cause salinity to break out on toe slopes or adjacent flats. Once the surface soil is saline, all production will be lost. Remedial techniques such as replanting are expensive, long-term and sometimes of doubtful effectiveness.

**Woody weeds and regrowth.** Seedlings and root suckers of trees and shrubs keep growing larger every year.

### **What regrowth?**

Within five years after clearing and under minimal management, hundreds of small seedlings per hectare can grow into a much worse problem than the original open woodland.

More than half of the total population of eucalypts in a natural woodland are saplings under 1.5 metres high—suppressed by the mature trees. These saplings are usually missed when the trees are pulled with a chain or injected with herbicide. Once the mature trees are killed, the eucalypt saplings start to grow and new seedlings establish. At the same time, suppressed sandalwood, wattles, limebush and cypress pine start growing. False sandalwood may grow slowly (about 30 cm a year), and does not become a real problem for 5–6 years, but the other species can grow to 1.5 m in a good year.

If the soil has been disturbed by pulling, seed of many species may germinate. Seeds of currant bush, whitewood, sandalwood, cypress pine and wattles may have been lying in the soil, while seeds of rubber vine and bitterbark can blow in from nearby frontage country.

### **Do trees provide any benefit to grazing stock?**

Animal production may be slightly higher under a light tree canopy in higher rainfall districts where there is less competition for water. Shaded green grass may be more digestible, and the grazing stock may suffer less heat stress in summer. The grass will be protected from light frosts in winter; minimum temperatures can be 2°C higher under living trees and 1°C higher under standing dead trees.

Some plant nutrients may be cycled from greater soil depth by the tree roots, but the overall effect of this on pasture growth is minimal. However, soil micro-organisms are more active in cooler, shaded soil and these can improve soil structure and infiltration rates.

Trees for shelter belts or stock camps should always be retained—even on your best country.

### ***If I want to clear some land, where should I start?***

Develop the best land on your property first—typically the brigalow land.

On fertile brigalow land:

- your sown grass will grow more densely and be of better quality
- blade-ploughing is cost-effective for sucker control and renovation in brigalow pastures.

Under the Native Vegetation Management Policy, you have to retain certain vegetation to avoid land degradation, maintain biodiversity and maintain 'ecological processes'. However, you can reclear woody regrowth and put in fencelines and firebreaks in 'essential' and 'routine' management operations.

### ***What are the guidelines for clearing trees?***

Even if it appears economical to clear trees, there are areas that should never be cleared. Land clearing guidelines for different types of country from the Department of Natural Resources are useful principles for any land.

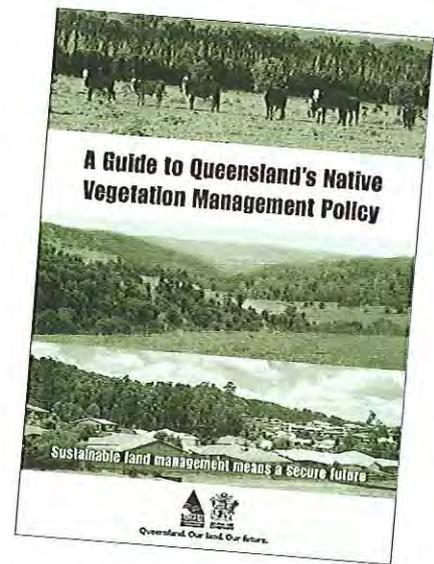
Plan to leave all these areas uncleared:

- steep hillsides or slopes
- erodible soils
- around water courses, wetlands or lakes
- intake ridges that produce potential salting
- useful or commercial timber
- dense understorey growth
- scenic value spots
- wildlife havens such as areas with old, hollow trees
- at least 10% of all land types.

On the land to be developed, keep at least 20% of the original tree population in strips at least 100 metres wide. The strips should connect the water courses and areas of retained timber on your, and neighbouring, land.

- Keep clumps of trees for cattle camps at least 5 ha in area. With smaller clumps, the soil becomes overgrazed and compacted, while the tree-line is 'eaten' away at the edges by fires.
- Do not clear within 100 metres of 'permanent creeks' (those able to hold waterholes); tree roots prevent bank collapse better than grasses.
- Check local recommendations in your local Tree Clearing Guidelines or their successor.

*Check the legislation before you start planning.* You will need to submit a Land Management or property vegetation management plan before a Tree Clearing Permit can be issued by the Department of Natural Resources.



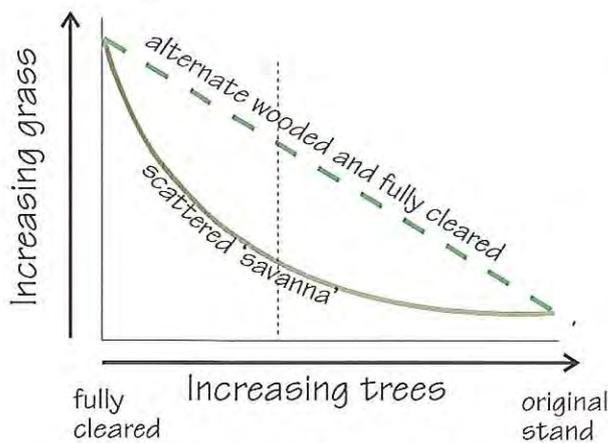
*Check the latest tree clearing guidelines.*



*Alternate strips of cleared and original woodland—20% of the original tree population in strips at least 100 metres wide.*



*A savanna of scattered trees looks pleasant but it produces less grass and encourages widespread seedling regrowth.*



For the equivalent number of trees, the alternate strips system produces more grass, and is better for biodiversity.

### Thin the stand or clear the lot?

If you are going to clear, alternate the cleared grassland with strips of uncleared forest. A 'savanna' of scattered trees may look scenic, but it needs only 5 mature trees per hectare to reinfest the whole area with seed. Many of the large trees that are left are old and will die sooner or later, although they may provide homes for native birds and small animals.

Alternating forest and cleared land has benefits for both. The forest of mixed species and ages of tree is self-regenerating, can be a source of timber for farm and sale, and provides shelter for stock and wildlife; the grasses in the open space will grow vigorously without being widely re-infested with tree seeds.

Do not spend so much money pulling a large area that you cannot afford to manage the regrowth that is sure to come.

Develop only an area that you can look after.

### How soon can I graze after clearing?

The grass responds immediately after clearing or as soon as trees treated with arboricide stop using water.

Do not try to recover the costs of treatment quickly by putting in more stock right away. If there is an understorey of small trees and shrubs, rest the paddock to build up fuel for a hot fire—or you will just be starting another cycle of regrowth.

Eucalypt saplings grow out of reach of fire after about 3–4 years, become small trees in about 10 years, and sizable trees after 20–30 years. Thus pasture should be burned within 2 years of clearing.

If Graslan® (tebuthiuron) kills the suppressed understorey, you may be able to start grazing earlier than with other treatments.

### What is the best way to control regrowth?

The cheapest control is to burn your grass while the woody weed seedlings are small. Fire will kill seedlings and keep saplings up to 2 metres tall under control by destroying the top growth. Periodic cool fires will prevent cypress pine invading on marginal country.

**Fire should become a basic tool for managing your grazing country. If you can burn every 5–7 years, it means that your stocking rate is about right.**

### What are the other methods of control?

Dry years favour trees in grazed country. If the regrowth gets away from you, the young trees and shrubs will have to be killed in some other way besides fire—all will involve major expense.



Do not put in stock immediately after pulling. Accumulate grass fuel to burn within two years to control regrowth.



Fire was used (eventually) to control box and wilga regrowth after this country was pulled.

The DPI computer-based *Woody Weed Adviser* and the DNR Pestfacts can help you decide on the best chemicals and most practical methods for controlling the various woody weeds that you may have.

**Broad area regrowth control.** Repulling with a light chain can be cheap and fast—if there are no stumps or standing trees. It misses flexible-stemmed seedlings under 5 years old. Do not pull when the soil is very dry as the tree stems snap off leaving roots to sucker. Don't pull when it is too wet as small plants push over without being uprooted.

Graslan is effective on eucalypts if there are no resistant species present, but it is expensive and may prevent pasture legumes being established in the short term.

Blade ploughing can be effective if the land has already been cleared of tree stumps and roots; it is generally too expensive for low potential land, and may increase the risks of erosion, especially on slopes with unstable subsoils. Pasture seed should be sown if land is blade-ploughed.

**Individual tree treatment.** It is usually impractical to treat individual trees over large areas, but this may still be the best method against weeds such as rubber vine on some frontage country and isolated clumps of currant bush.

## Controlling weeds

As in other regions, there are numerous weeds or problem plants that are either widespread throughout the A-B country or that are specific to certain districts.

Widespread woody weeds include currant bush (everywhere) and rubber vine in the north.

Currant bush (a.k.a. berry bush, Burrum bush, conkerberry) (*Carissa ovata* and *C. lanceolata*) is a prickly shrub that has thickened up over some 10 million hectares of grazing land.

### **What is the best way to control currant bush?**

The cheapest way is the ecological approach of light stocking and burning—currant bush can be killed with a hot fire. The problem is that once the bushes become large or close together, there is insufficient fuel surrounding them.

### **What are the other options?**

**Mechanical clearing** with chisel ploughing followed by stickraking can reduce the bush canopy by 90%, and kill 80% of the bushes.

This costs about \$55/ha and is the most cost effective mechanical treatment for dense currant bush.



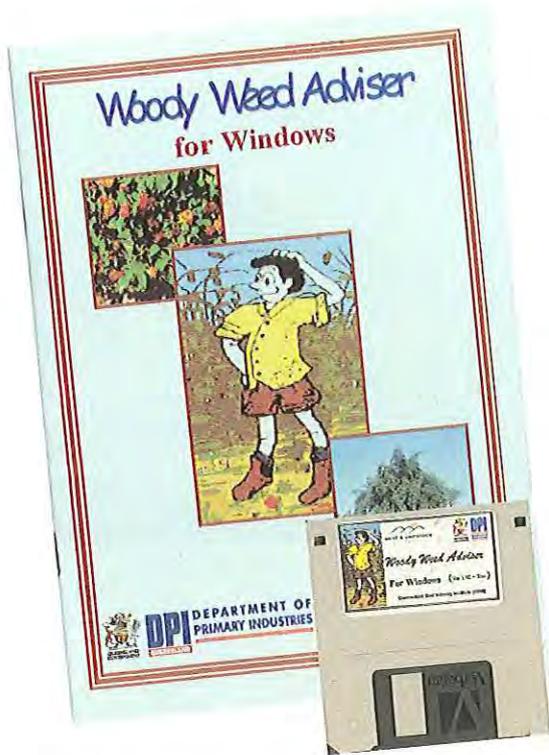
*Blade ploughing is effective and economical only on cleared brigalow regrowth.*



*Currant bush is thickening on over 10 million hectares of grazing land.*



*Keep out rubbervine — a serious weed of riparian vegetation and frontage in north Queensland.*



Woody Weed Adviser—  
all the control recommendations on one disk.

**Stickraking** without first ripping out the bush with a chisel is much less effective.

**Chemical treatment** with Graslan pellets blown out of a mist blower has reduced bush canopies and given moderate kills on open pasture land. Graslan will also kill local standing trees but not resistant shrubs such as false sandalwood.

### **Is rubbervine invading?**

Rubbervine has become one of the most serious weeds in the north, and could invade to take over much of the best frontage country. It could spread out along smaller watercourses and into open country.

### **How can I kill rubbervine?**

Rubbervine in open grassland can be killed by fire. In frontage country, rubbervine is not difficult to kill when it is a single plant; several herbicides are effective. It becomes a problem because of the scale of the invasion and the cost and logistical difficulty of getting at the plants.

A leaf rust released in north Queensland will defoliate rubber vine; this may allow more grass to grow for fuel.

### **What are the recommended herbicides?**

DNR and DPI list a number of herbicides and methods of application for rubbervine on a range of sites.

### **What about that parthenium on the roadside?**

Parthenium prefers fertile clay soils but can spread into native pastures. It is better to keep it out than trying to eradicate it once it has taken hold.

Parthenium seed is spread in dirt carried by vehicles or between the hooves of stock. Clean vehicles and equipment coming from infested areas, and regularly inspect any quarantine area for seedlings.

Watch roadsides and access ways. If you see an isolated plant, pull it out and put it in a plastic bag rather than 'reporting' it and allowing it to drop seed while waiting for someone else to deal with the problem. However, larger patches will have to be sprayed, so contact the local council, Rural Lands Protection Board or DNR office for recommendations and possible assistance.

The best defence is a vigorous grass pasture to smother seedlings. It is easier done in buffel grass on brigalow country than in more open native pastures.



Parthenium can spread into the A-B pastures.  
Hit it as soon as you see it in your district.

**If there is an open space and soil moisture, some plant is going to fill it.**

### **What are other local problem weeds?**

**Heartleaf.** Heartleaf poison bush can be prevalent in marginal A-B areas adjacent to desert country in central Queensland. It is poisonous in nearly all stages of growth, and regrowth sprouting after a fire is often eaten. Isolated bushes can be controlled, but often high risk areas are fenced off and not stocked. Feeding cattle in risky areas with molasses-urea supplement during winter may reduce the need for stock to browse heartleaf.

**Pimelea.** Pimelea is a native annual which can be prevalent on red sandy country in the southern Maranoa. It is more prevalent in wet winters in pastures left open after a dry summer, while abandoned cultivation is a major source of infestation. Little can be done to get rid of pimelea.

Sheep are more tolerant of pimelea than cattle, and local cattle suffer less than newly arrived stock which should be placed on 'clean' pastures in 'bad' years.

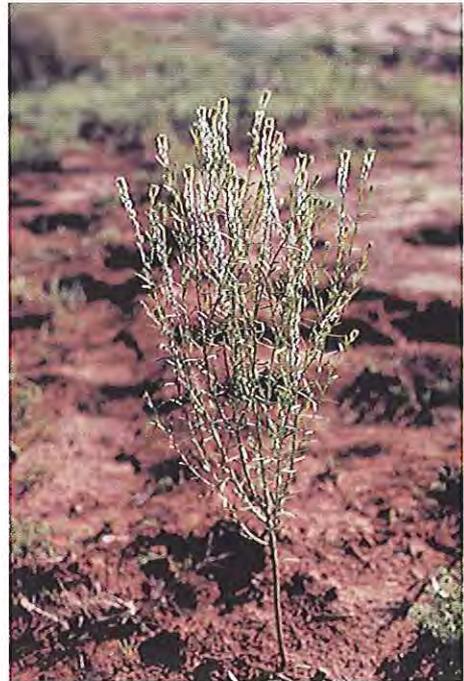
**Mother-of-millions.** Mother-of-millions is a perennial frequently seen along roadsides, even under quite dense timber, and spreads from there into grazing paddocks. It becomes more noticeable and more attractive to stock in winter when in flower and the grass is dry.

Mother-of-millions can be sprayed with a suitable herbicide provided this can penetrate the waxy cuticle. Use oil-based esters or add sufficient wetting agent to water-based sprays.

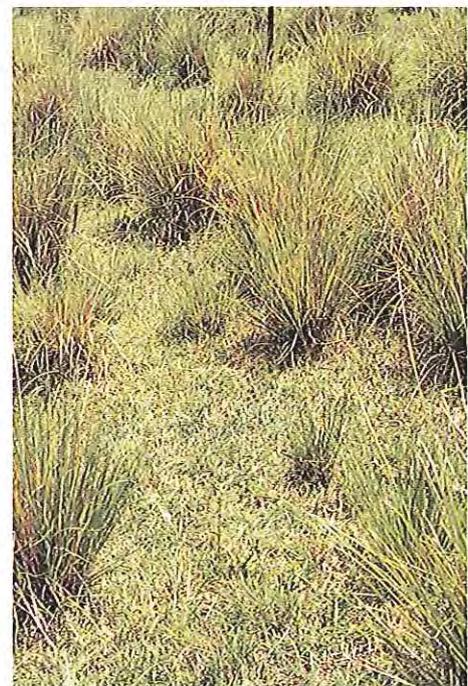
**Giant rats tail.** GRT (*Sporobolus pyramidalis*) is a tall wiry grass that is increasing in native pastures in coastal Queensland, and could come into some of the A-B country through seed attached to vehicles or equipment. There are a number of smaller harmless native species of *Sporobolus*, but keep an eye out for giant rats tail. It is very difficult to remove one grass species out of a pasture, so timely control of the first invader is essential. Control methods are described in DPI/DNR leaflets from the Burnett.



*Mother-of-millions – poisonous if eaten in the dry season.*



*Pimelea – kills cattle more than sheep; more abundant in overgrazed pastures followed by a wet winter.*



*Giant rat's tail could be introduced from more coastal regions through vehicles, machinery, hay or grass seed.*

## Improving grazing

Native pastures on soils of reasonable fertility are productive when managed well. The nutritive value of young bluegrasses is as good as that of any other grass for 4–8 weeks.

On poor soils in high rainfall monsoon regions, the concentration of nitrogen in the leaf becomes diluted from about the middle of February. By mid-March, available soil nitrogen has run out and, although the leaf is still green, there is no new growth. Quality begins to drop further once flowering is initiated.

On better clay soils in more arid districts, pasture quality lasts longer or until the grasses flower or are frosted.

The quality of grazing can be improved by sowing adapted legumes into the native or naturalised pasture.

### *Where can I sow a new pasture?*

Better class (fertility and slope) land can be cleared, ploughed and sown to improved species that are more leafy and generally more resilient under heavy grazing.

The main species sown over the decades has been buffel grass (Gayndah or American), and 30–40 year-old buffel pastures still exist as almost pure stands on the lighter red sandy soils.

Buffel is so well adapted in parts of the Maranoa that it has naturalised over about a million hectares, even on soils normally considered to have marginal phosphorus for buffel. But this naturalised buffel grass has used or tied up much of the available soil nitrogen, and often fails to respond to later rain in wet years. Buffel has spread along many roadsides and on stony ridges.

Many graziers have cleared light country, cropped it or sowed Silk sorghum for a couple of years to control any regrowth problems, and then sown buffel or other grasses.

Other grass species could include Premier digit grass on poorer sandy soils, with Bisset bluegrass and Indian bluegrass maybe in higher rainfall districts. Sabi urochloa has naturalised along many roadsides as far south as the Maranoa and may be invading old run-down buffel pasture. Sabi does well in the wet years with early summer rain, but becomes unpalatable when frosted. Swann bluegrass has shown promise in the south as a permanent pasture species in frost-prone areas, but its role in central Queensland is untested.

Green panic also grows well along roadsides and creek banks, but is too palatable and not sufficiently drought-tolerant to persist except with some form of rotational grazing.



*Buffel grass has been planted on the better A-B soils.*



*Buffel has spread along roads and has become naturalised on large areas of marginal fertility country.*



*Run-down buffel on marginal soils could benefit from a legume.*

Some old cultivation land could be replanted with pastures, including native species. Desert bluegrass (forest Mitchell) would be a good species, especially in central Queensland, if seed was harvested commercially.

Elsewhere, legumes can be sown into native pastures—stylos in the north and medics or serradella in the Maranoa.

### **What are the main benefits from legumes?**

The animals benefit through an improved diet from higher levels of protein and minerals, and from the better digestibility of the legume leaf. A vigorous legume can put an extra 40 kg of gain on a steer each year at about the same stocking rate.

The hardy tropical legumes usually have little visible direct effect on the growth of grass unless they are fertilised, whereas the temperate species in the south can fix abundant nitrogen.

Legumes are needed to recycle nitrogen to restore fertility in much of the run-down buffel in the Maranoa.

### **Which are the best legumes for my country?**

You need well-adapted species that will naturalise and thicken up in your paddocks; the DPI recommends different legumes for different soil types, so seek local advice on species and methods of planting.

No sown perennial species has been a universal or outstanding success in A-B country so far.

**North and central.** Tropical and subtropical species, such as the shrubby stylos, grow best in northern and central regions, but cannot withstand the more severe winters south of the Carnarvon Range.

The main tropical legumes are the shrubby stylos (Seca and Siran) and the Caribbean stylos (Verano and Amiga); Wynn cassia behaves as an annual in lower rainfall regions. Finestem stylo is more subtropical, and will grow on sandy soils as far south as Injune.

The shrub legume, leucaena, is a permanent high-quality fodder that grows magnificently on deeper, more fertile brigalow soils that are interspersed with the poorer A-B country, but does not persist on typical A-B country. The most southerly commercial stands of leucaena are in the Arcadia Valley.

Kangaroos can decimate establishing, isolated or small stands of leucaena if they graze unchecked.

**Southern.** Desmanthus has a wider temperature tolerance than the other tropicals, and will grow in the Maranoa—on the neutral to alkaline clays of the better end of A-B country. However, its performance to date has been disappointing.



*Sabi grass can stand heavier grazing than many native species.*



*Seca stylo along the roadside—a hardy tropical legume for poor soils.*



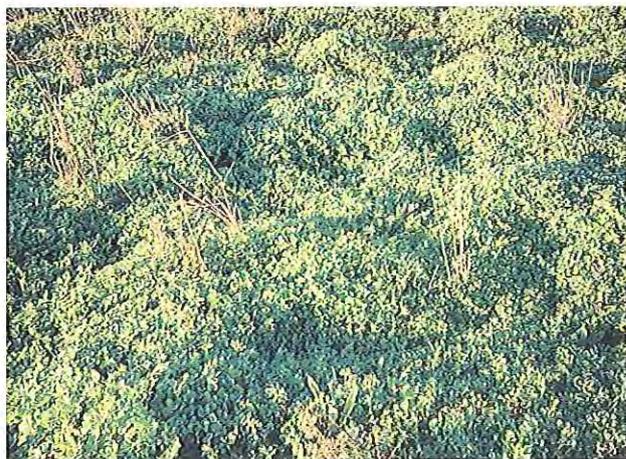
*Leucaena—high-quality permanent feed but best on good cropping soils north of the Arcadia Valley*



*Caatinga stylo — a new pasture legume with some cold-tolerance and for clay soils.*



*Desmanthus is cool-tolerant and will grow on neutral to alkaline clays.*



*Medics—for clay soils with winter/spring rainfall.*

**Use legumes to put more weight on each animal rather than to greatly increase the stocking rate.**

Caatinga stylo is a new cold-tolerant stylo for heavier soils, and is looking promising as far south as the Maranoa.

South of the Carnarvon range, there is sufficient winter rainfall for the temperate species, and the medics (woolly burr, barrels and cut-leaf) have naturalised on the heavier and more alkaline soils. Serradella could find a place on the sandy, more acid soils.

The temperate legumes can grow vigorously with sufficient winter rainfall because there is no competition from the summer-growing grasses. The best medic years are those when a dry summer that leaves little cover of grass is followed by a wet autumn and winter.

### **How useful are the native legumes?**

There are many native legumes in A–B pastures, including rhynchosia, glycines and desmodiums. Some of them are illustrated here, and others can be identified in *A Guide to Herbaceous and Shrub Legumes of Queensland* and in *Plants of central Queensland*.

Native legumes rarely comprise more than about 10% of the total herbage, but are very common. Many are eaten at different times of the year and form a higher proportion of the animals' diet.

### **What are the risks from growing legumes?**

Of the legumes described above, only the medics cause bloat in stock.

Other risks arise from management rather than the legume. The protein from the legumes allows cattle to eat more low-quality grass, and so tends to encourage more stock to be carried.

At high stocking rates, cattle put too much pressure on the grasses, resulting in paddocks of nearly pure legume, particularly with stylo. This is an unstable state with poor ground cover that accelerates erosion.

Over time, nitrogen fixation by legumes can acidify a light sandy soil at depth. Keeping a good proportion of grass will minimise acidification as grasses help to take up released nitrogen before it is leached down the soil profile.

### **Which country should I improve first?**

Improve your best country first. This could be brigalow for fully sown pastures. 'Better country' for oversowing stylos into native pasture needs a soil with at least 4 ppm of available soil phosphorus and a loose soil surface.

### **Will fire damage my sown legumes?**

New plantings of legumes must be allowed to drop good seed before the first fire.

After this, stands of most hardy legumes can be rejuvenated by a fire, even if the top growth is lost. Seca and Verano stylo and Wynn cassia can drop masses of seed; the hard-seed is cracked by the heat of the fire, and new seedlings establish. The legumes may also shoot from the base or crown.

Sensibly used, fire can help maintain a good balance of grass and legume. Over-optimistic stocking rates and lack of fire could lead to legume dominance and lower pasture stability.

### **What about feeding supplements?**

Phosphorus is deficient on some of the lighter soils and is supplied as a supplement.

Phosphorus feeding systems are well described in the DPI book *Phosphorus nutrition of beef cattle in northern Australia*.

Phosphorus supplement is needed on low P soils during the wet season when the animals are growing, and when there is adequate nitrogen from the grass and sown legumes.

During the dry season, stock need less phosphorus but more nitrogen so that they can use standing dry herbage. This nitrogen may be fed as non-protein-nitrogen (urea) or in protein form as, for example, cotton seed. Sulphur can be included in the supplement if warranted.

### **What problems arise from dry season supplements?**

Dry season supplements are now part of routine stock management in many districts but they may be needed less if early weaning or lower stocking rates are used.

Dry season supplements allow an animal to increase its intake by 30–40% over the dry season, equivalent to 30% more stock and so potentially putting excessive pressure on the native pastures.

### **What about fodder crops?**

Fodder crops can be a valuable option in A–B country that is intermingled with cropping soils, and can allow native grass paddocks to be rested at critical times. Silk sorghum may last for a number of years on good soils, forage sorghum can be grown during summer, while sweet sorghum can be used as stand-over feed into winter.

The sorghums are 'hungry' crops and should be planted only on soils with reasonable fertility.

With sufficient winter rainfall, oats can be grown for fattening stock.

Seek local advice for suitable soils for forage crops.



*Desmodium varians*—one of the native legumes.



*Stylo dominance is unstable—stock do well but stocking rates can be too high for the native grasses.*



*A paddock of forage sorghum may allow you to rest your native pasture at a critical time.*

# Monitoring pastures

Traditionally, graziers have monitored pastures through the condition of their cattle. However, the pasture itself has to be monitored to obtain early indications of changes that are occurring, and to amend grazing management accordingly.

Monitoring encourages you to look more closely at the pasture, and it provides a record so that you can detect gradual changes occurring over the years.

This book does not tell you how to monitor pastures because the various methods are described in another DPI publication – **GRASS Check**.

## ***What is the best way to monitor pastures?***

The first step is to learn to recognise those grasses that indicate change. Monitoring and recording species then becomes less daunting; once tried, it is quite simple—and very interesting.

GRASS Check offers you a number of techniques, with varying levels of detail. You can assess the amount of herbage in the paddock, the ground cover, desirable and undesirable species, individual species and the density of mature or regrowth timber.

The DPI runs training workshops to explain and demonstrate the various methods described in GRASS Check.

The DPI also has a program called Pasture Watch which encourages secondary school children to understand pastures and the effects of management.

## ***When is the best time to monitor pastures?***

Monitoring is best done at the end of the growing season, around April. It is a cooler time than summer, and it allows you to make decisions on stocking rates based on the amount of grass in the paddock at the end of the main growing season.

You can estimate the bulk of grass by either comparing with the photo-standards shown in this book, or by direct measurement.

Making this decision even earlier in autumn (March) may mean that you could sell any excess stock while they are in good condition and the market is still reasonably attractive.

## **GRASS Check**

Grazier Rangeland Assessment  
for Self-Sustainability

Second edition (revised)

Department of Natural Resources, Queensland  
DNSQ7002



*GRASS Check — How to monitor your pastures.*



*Learning monitoring techniques is often easier with a group.*

## Estimating feed or fuel in a paddock

The weight of herbage (total dry matter, not wet green leaf) allows you to assess your stocking rates or the effectiveness of a fire. The herbage weight can be measured directly by cutting a quadrat, drying and weighing (modern electronic kitchen scales are cheap

and can weigh to 1 g accuracy). Alternatively herbage can be estimated approximately by comparing against photo-standards—photographs of typical pastures where the amount of feed is known.

### Photo-standards of an A-B pasture (kg/ha of dry matter or fuel)



500 kg/ha



850 kg/ha

Photo-standards of an A-B pasture (kg/ha of dry matter or fuel)



1200 kg/ha



1800 kg/ha



2500 kg/ha



3600 kg/ha

## Important grasses for northern (n), central (c) and southern (s) Queensland

### Desirable perennial grasses

Black speargrass	<i>Heteropogon contortus</i> (- n,c)
Buffel grass	<i>Cenchrus ciliaris</i> (n, c, s*)
Desert bluegrass/forest Mitchell	<i>Bothriochloa ewartiana</i> (- n, c, s)
Early spring grass	<i>Eriochloa pseudoacrotricha</i> (c,s)
Forest bluegrass	<i>Bothriochloa bladhii</i> (- n, c, s)
Kangaroo grass	<i>Themeda triandra</i> (- n, c, s)
Queensland bluegrass	<i>Dichanthium sericeum</i> (- c, s)
Sabi grass	<i>Urochloa mosambicensis</i> (+ n, c, s*)

### Intermediate value grasses (perennials and annuals)

Barbwire grass	<i>Cymbopogon refractus</i> (n, c, s)
Button grass	<i>Dactyloctenium radulans</i> (+ c)
Comet grass	<i>Perotis rara</i> (+ n, c, s)
Fairy grass	<i>Sporobolus caroli</i> (+ c, s)
Finger grasses	<i>Digitaria</i> species (s)
Golden beard or ribbon grass	<i>Chrysopogon fallax</i> (n, c, s)
Indian bluegrass or couch	<i>Bothriochloa pertusa</i> (+ n*)
Leafy nine-awn/bottle washer	<i>Enneapogon polyphyllus</i> (+ n, c, s)
Liverseed grass	<i>Urochloa panicoides</i> (+*)
Mulga mitchell	<i>Thyridolepis</i> species (s)
Native couch	<i>Brachyachne convergens</i> (+)
Panics	<i>Panicum</i> species (+)
Pitted bluegrass	<i>Bothriochloa decipiens</i> (n, c, s)
Poverty grass	<i>Eremochloa bimaculata</i> (c, s)
Red Natal grass	<i>Melinis repens</i> (+ n, c, s)
Silky browntop	<i>Eulalia aurea</i> ( <i>E. fulva</i> ) (- n, c)
Slender chloris	<i>Chloris divaricata</i> (+ n, c, s)
Twirly windmill grass	<i>Enteropogon</i> species (+ c, s)
Woodland love grass	<i>Eragrostis sororia</i> (+ n, c, s)

### Undesirable or low value grasses

Fairy grass	<i>Sporobolus australasicus</i> (+ n, c, s)
Five minute grass	<i>Tripogon loliformis</i> (+ c, s)
Granite love grass	<i>Eragrostis molybdea</i> (+)
One seed grass	<i>Cleistochloa subjuncea</i>
Pigeon grass	<i>Setaria</i> species (n, c, s)
Rat's tail grasses	<i>Sporobolus</i> species (+ n, c, s)
Rough speargrass	<i>Stipa scabra</i> (s)
Small burr grass	<i>Tragus australianus</i> (+ n, c, s)
Sedges	<i>Cyperus</i> and <i>Fimbristylis</i> (+)
Slender bamboo grass	<i>Stipa verticillata</i> (+ s)
Wiregrass, feathertop	<i>Aristida latifolia</i> (+ n, c, s)
Wiregrass, dark	<i>A. calycina</i> (+ c, s)
Wiregrass, Jericho	<i>A. jerichoensis</i> (+c, s)
Wiregrass, many-headed	<i>A. caput-medusae</i> (+ s)
Wiregrass, purple	<i>A. ramosa</i> (+ c, s)

+ indicates that this species increases under heavy grazing; - indicates this species decreases under heavy grazing;

\* indicates exotic species. The intermediate value rating applies to a species in its relevant soil type.

## Other important plants

### Native legumes

Birdsville indigo  
Glycine, hairy  
Glycine pea  
Rhynchosia  
Tick trefoil

*Indigofera linnaei*  
*Glycine tomentella*  
*Glycine tabacina*  
*Rhynchosia minima*  
*Desmodium varians*

### Broad-leaved weeds indicating heavy grazing

Flannelweeds  
Fruit salad plant  
Mexican poppy  
Pigweed

*Sida* and *Abutilon* spp.  
*Pterocaulon redolens*  
*Argemone ochroleuca*  
*Portulaca* spp.

### Other problem plants

Currant/blackberry bush  
Heartleaf  
Limebush  
Mimosa bush  
Mother-of-millions  
Parkinsonia  
Parthenium  
Pimelea  
Rubbervine

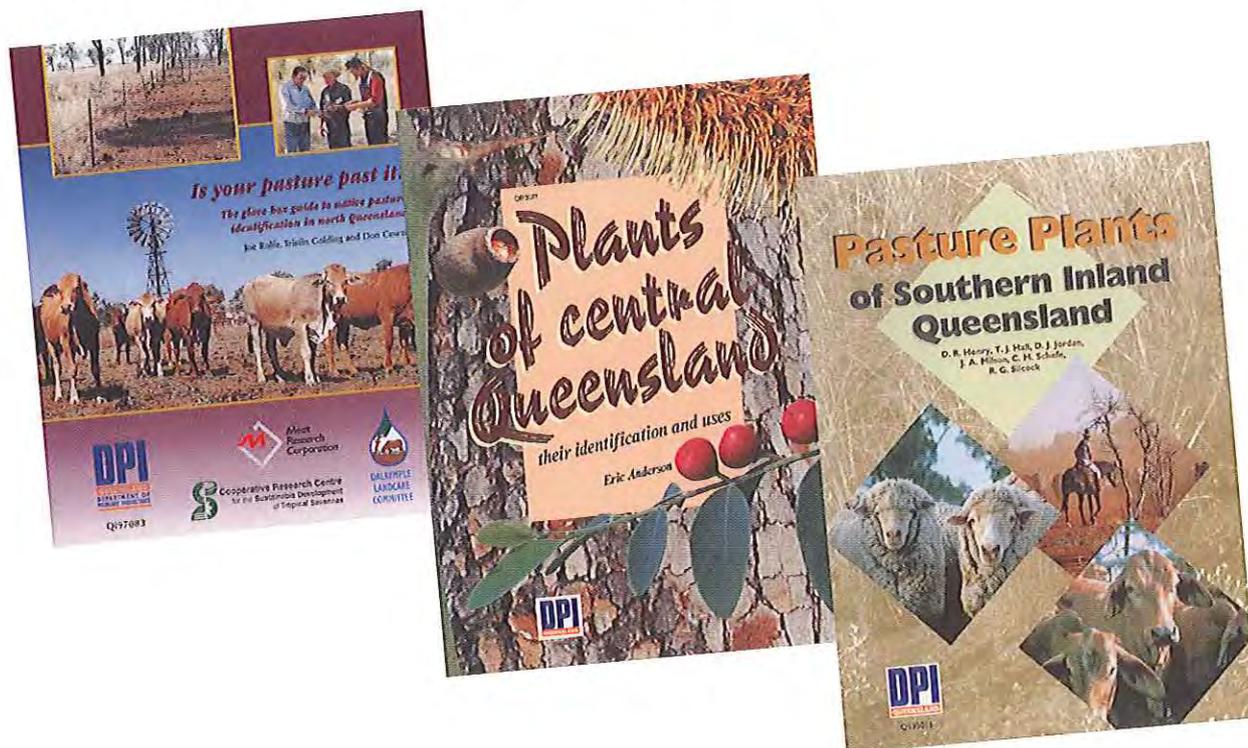
*Carissa ovata*  
*Gastrolobium grandiflorum* (n)  
*Eremocitrus glauca*  
*Acacia farnesiana*  
*Bryophyllum* spp.  
*Parkinsonia aculeata* (n)  
*Parthenium hysterophorus*  
*Pimelea* spp. (s)  
*Cryptostegia grandiflora* (n)

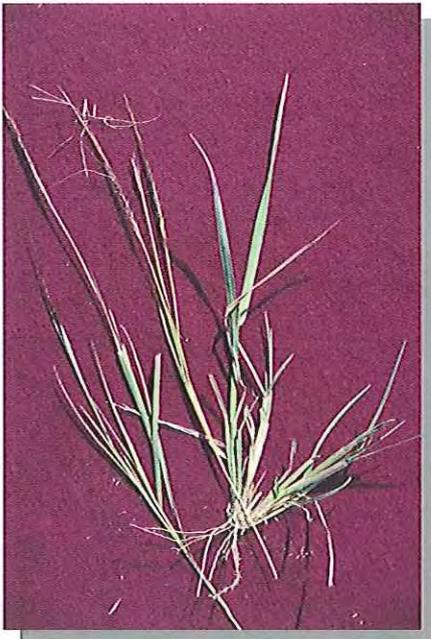
Many of these plants are illustrated and described in:

***Is your pasture past it?*** for the northern region,

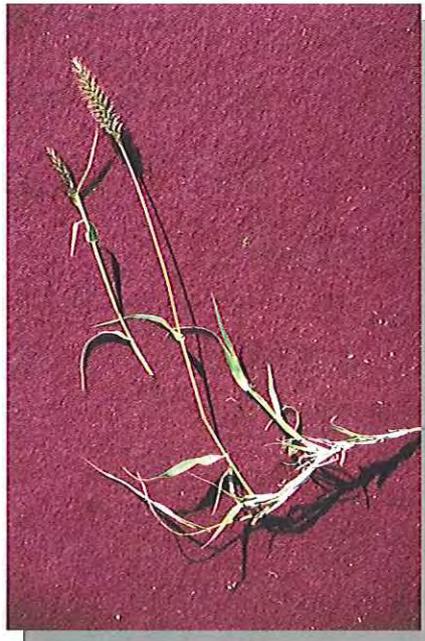
***Plants of central Queensland: their identification and uses*** for central Queensland,

***Pasture plants of southern inland Queensland*** for the south.

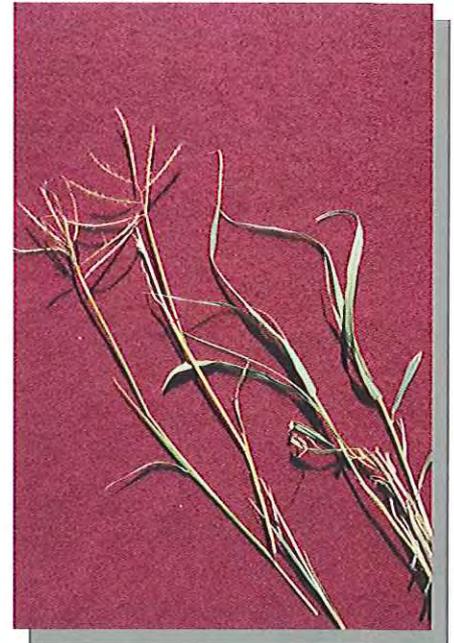




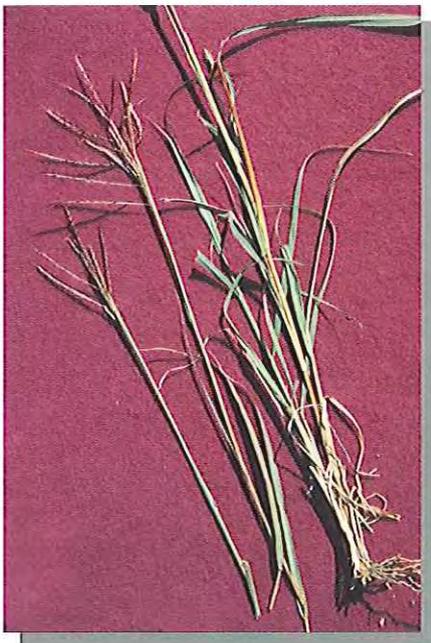
*Black speargrass*



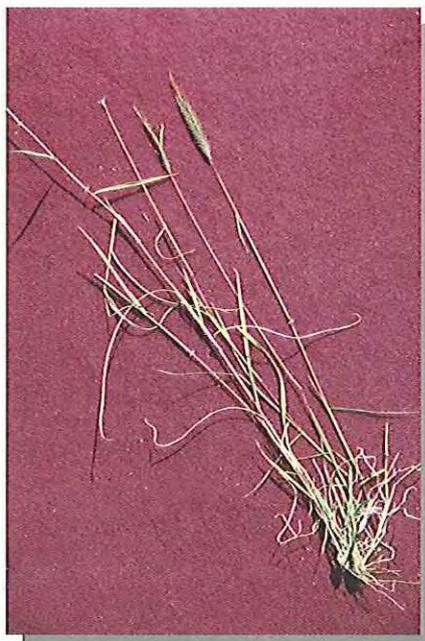
*Buffel grass*



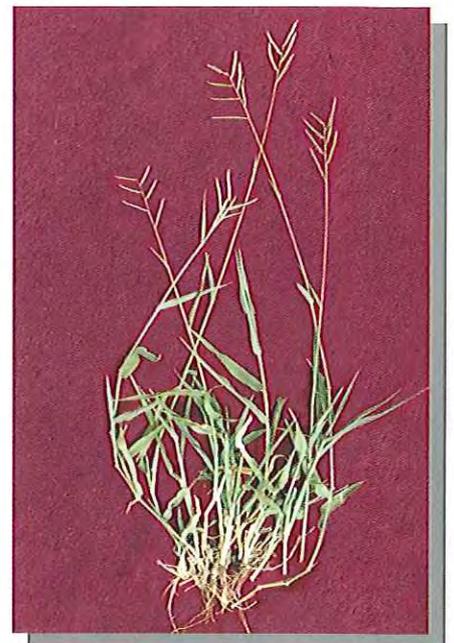
*Desert bluegrass  
(forest mitchell)*



*Forest bluegrass*



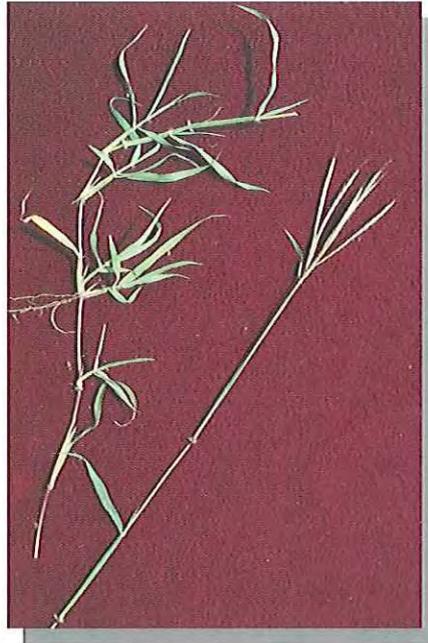
*Queensland bluegrass*



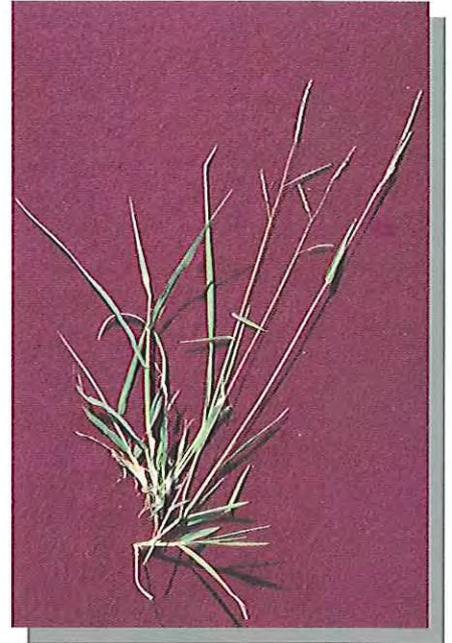
*Sabi grass*



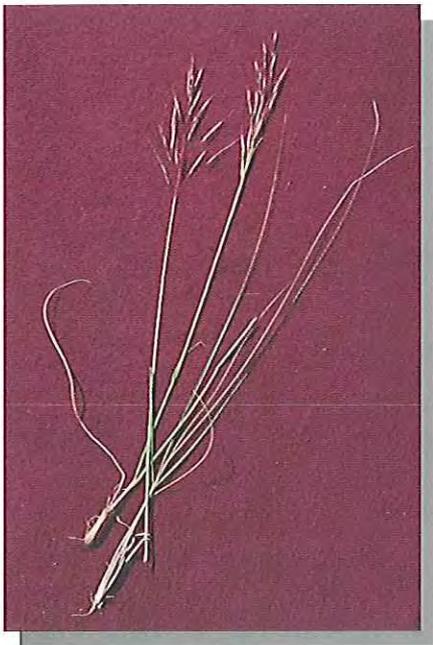
*Kangaroo grass*



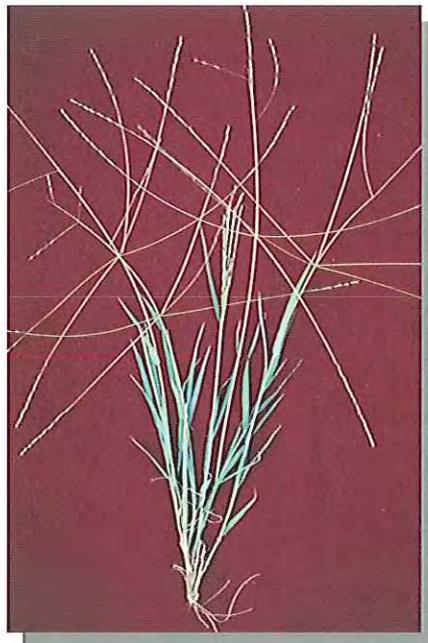
*Indian bluegrass  
(Indian couch)*



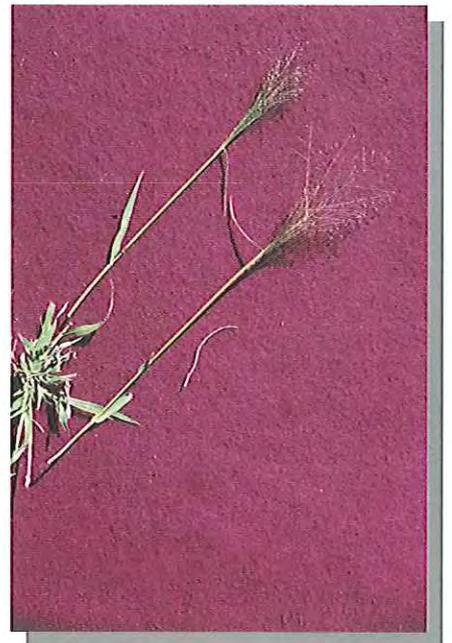
*Early spring grass*



*Golden beard grass*



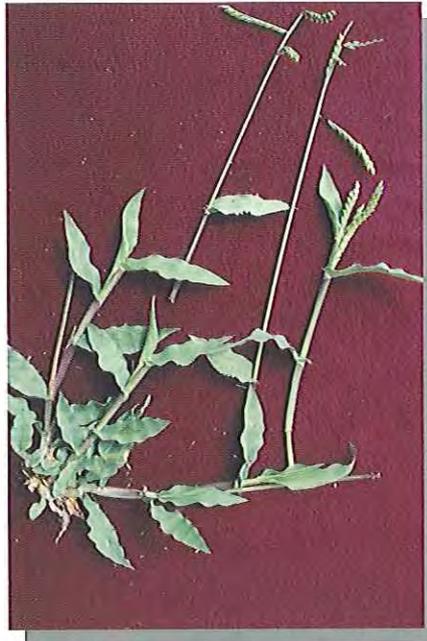
*Finger grass*



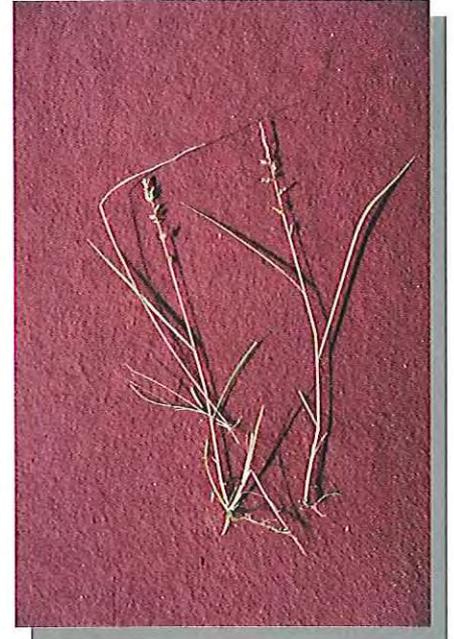
*Fairy grass  
(S. caroli)*



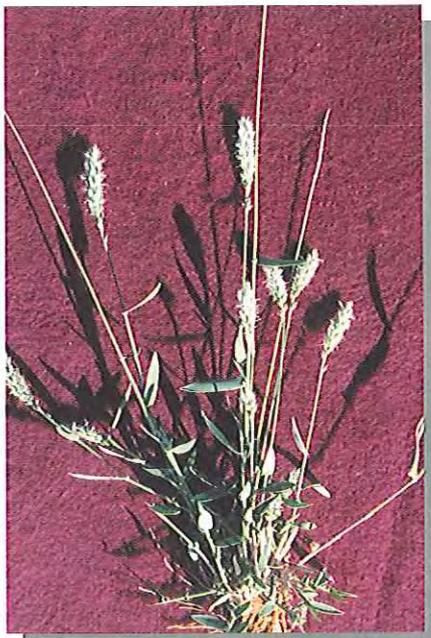
*Leafy nine-awn grass or  
bottle washer*



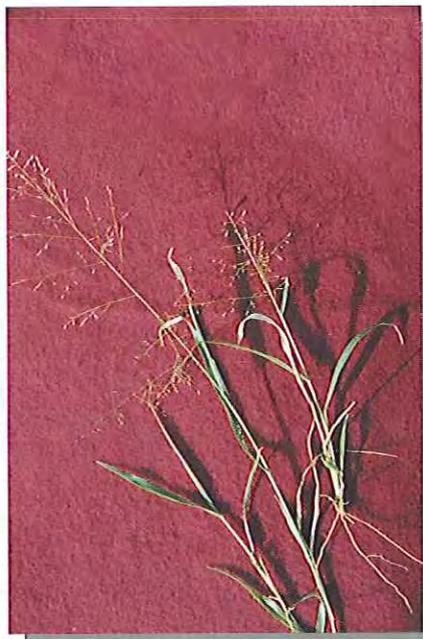
*Liverseed grass*



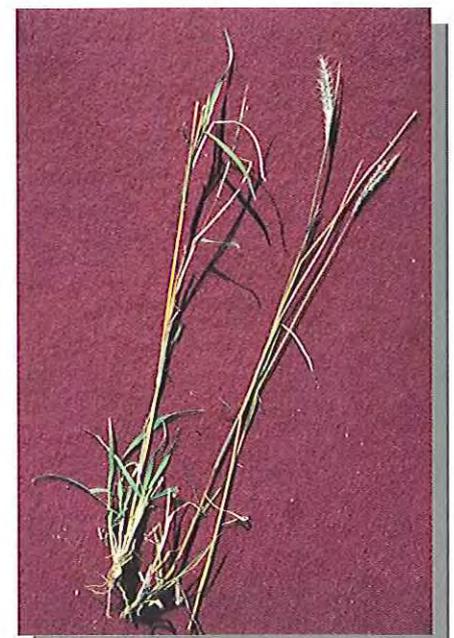
*Woodland love grass*



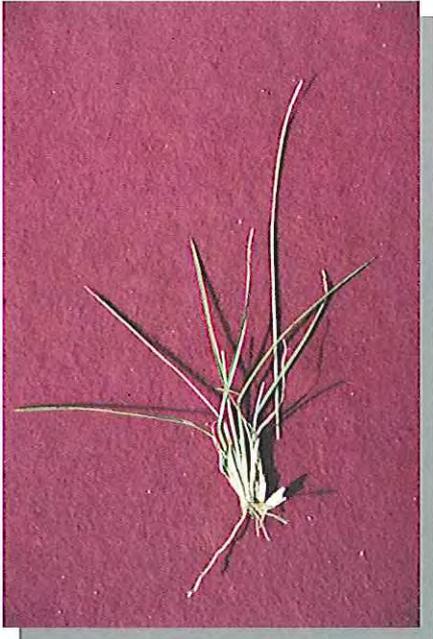
*Mulga Mitchell*



*Hairy panic*



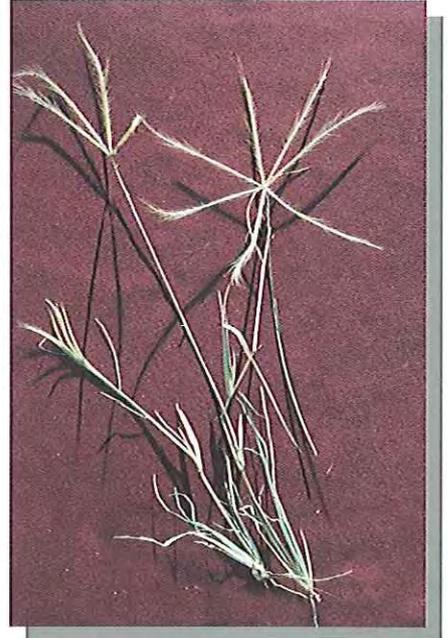
*Pitted bluegrass*



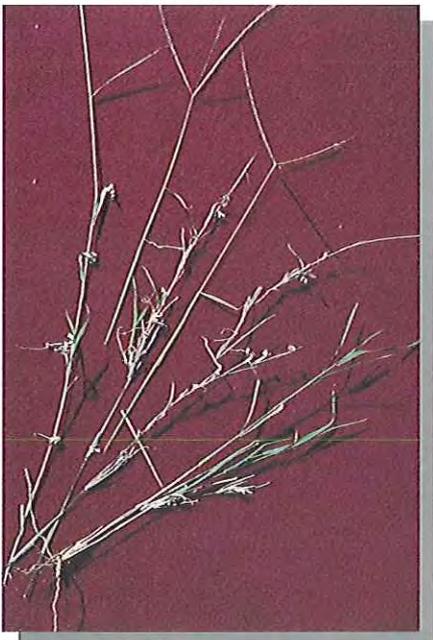
*Poverty grass*



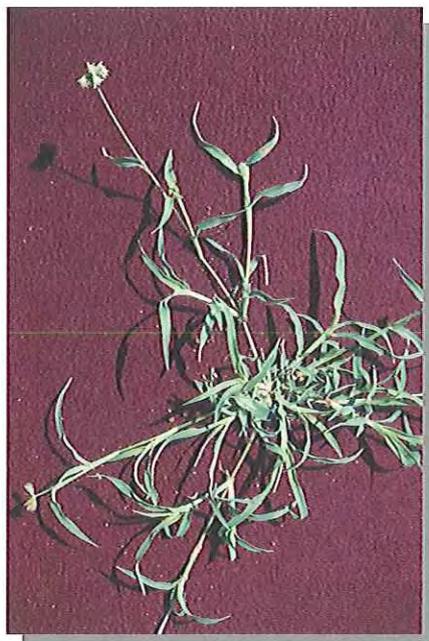
*Silky brown top*



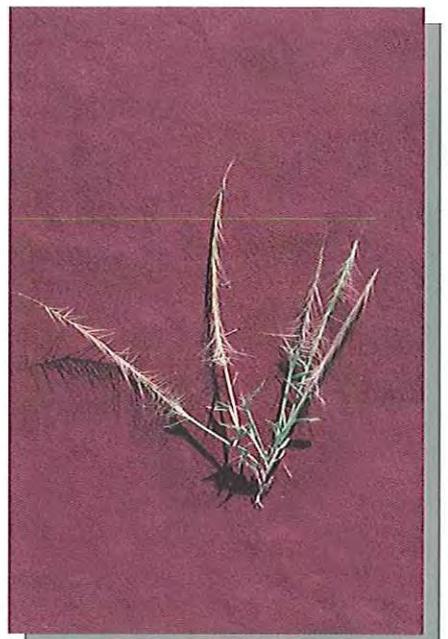
*Slender chloris*



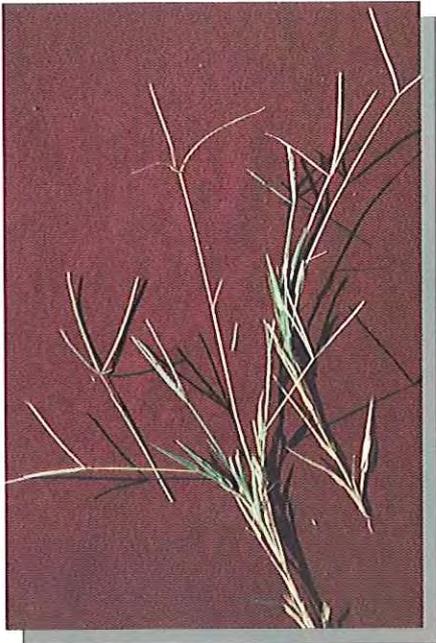
*Twirly windmill grass*



*Button grass*



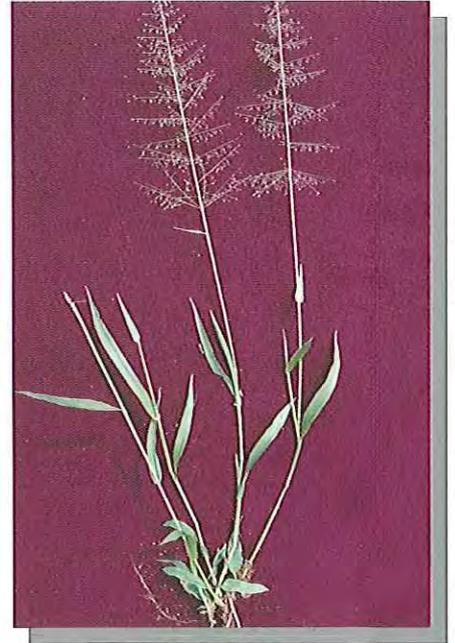
*Comet grass*



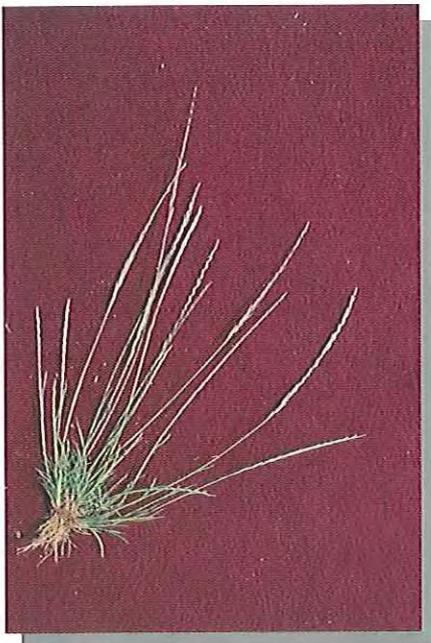
*Native couch*



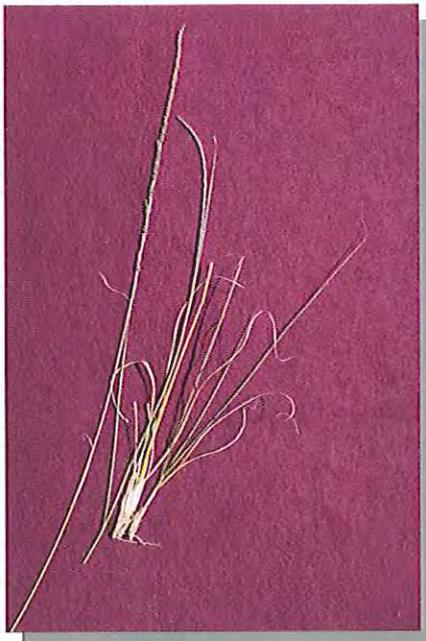
*Small burr grass*



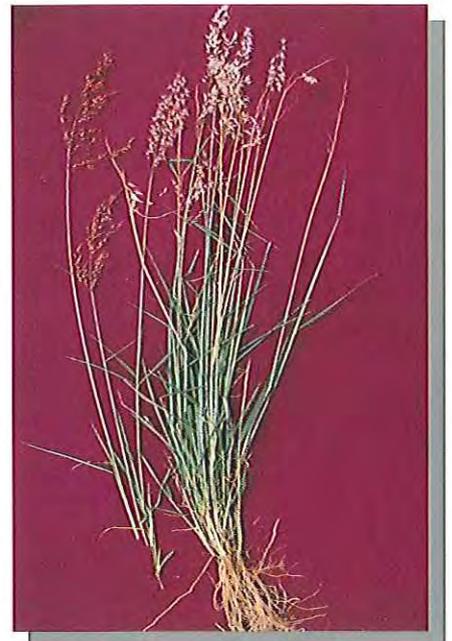
*Fairy grass*  
*(S. australasicus)*



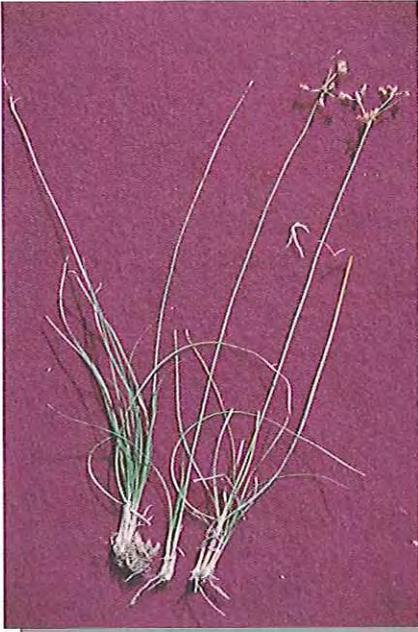
*Five minute grass*



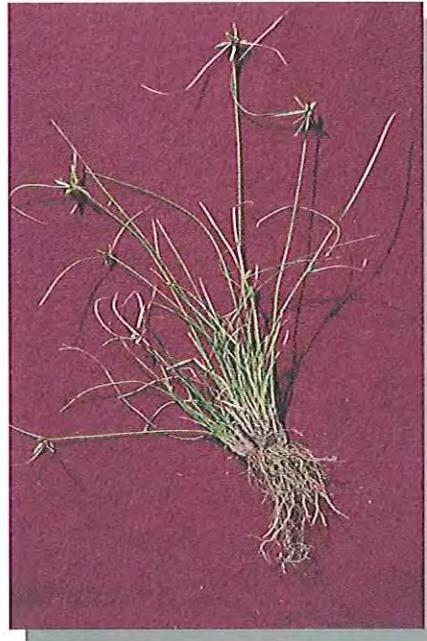
*Rats tail grass*



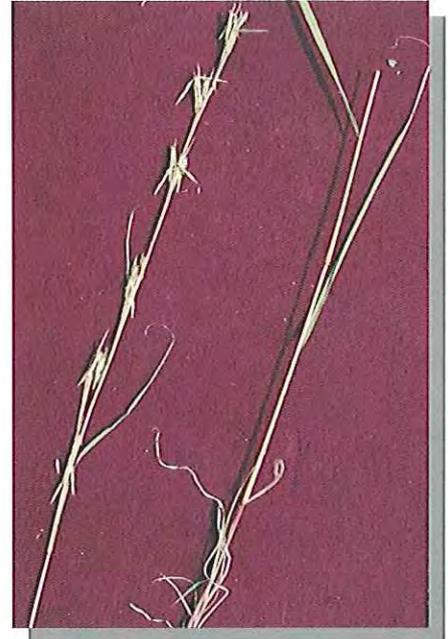
*Red Natal grass*



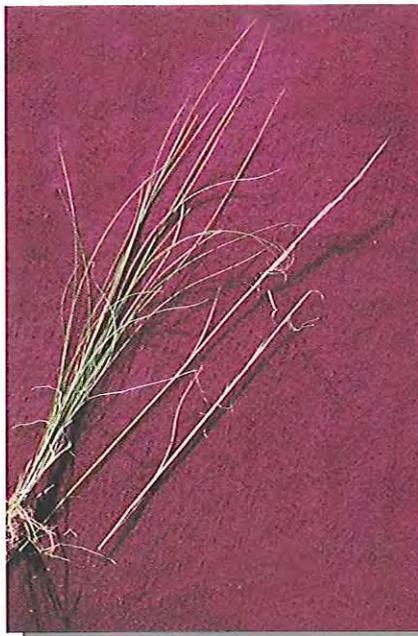
*Sedge (Fimbristylis sp.)*



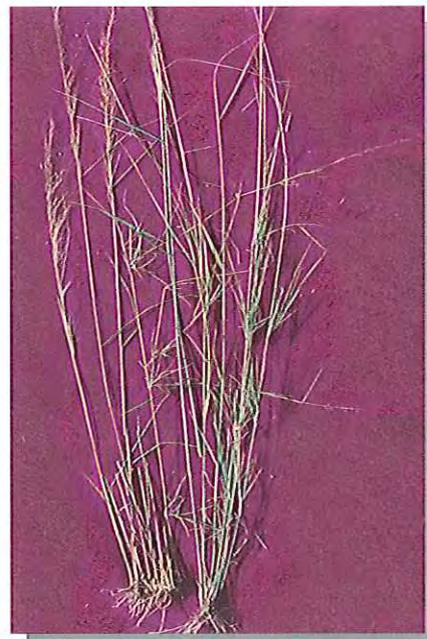
*Sedge (Cyperus sp.)*



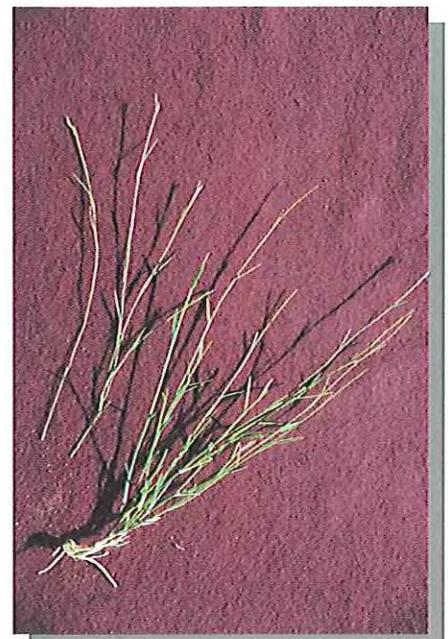
*Barbwire grass*



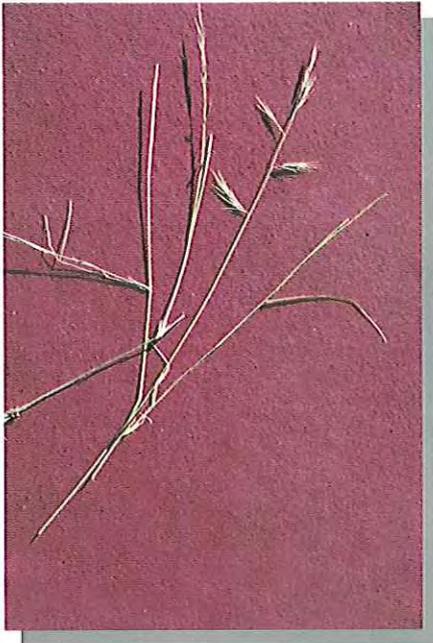
*Rough speargrass*



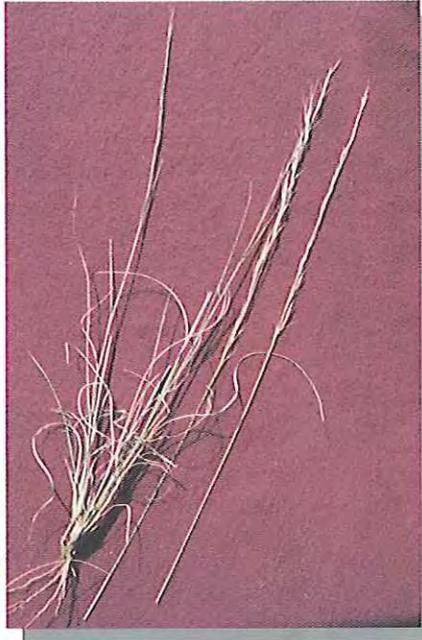
*Slender bamboo grass*



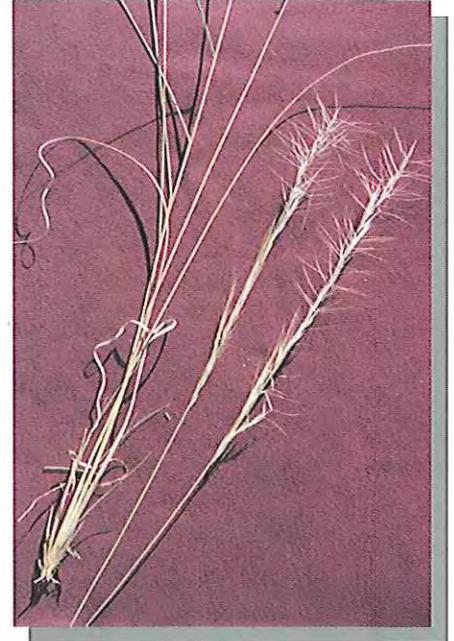
*One-seed grass*



*Dark wiregrass*



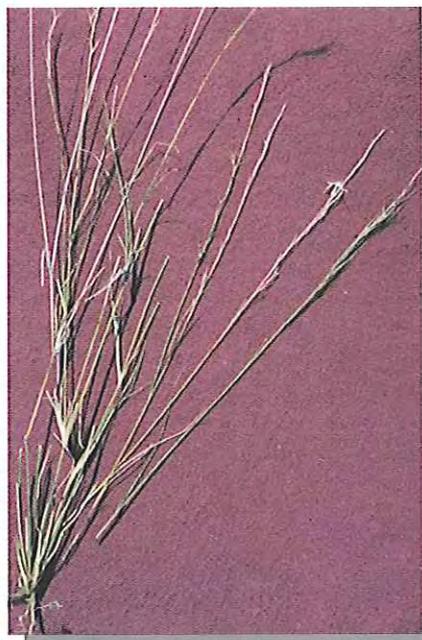
*Jericho wiregrass*



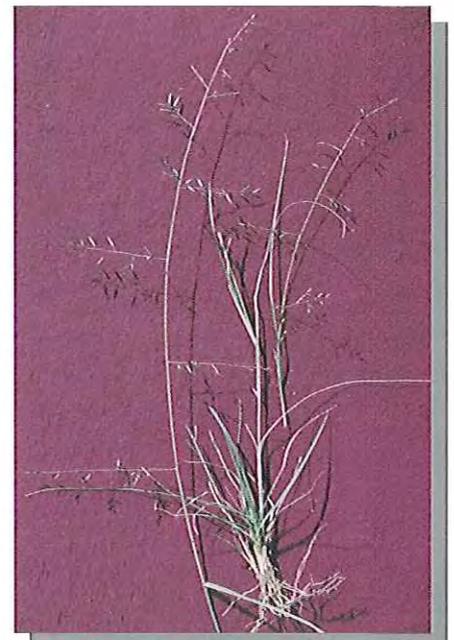
*Feathertop wiregrass*



*Many-headed wiregrass*



*Purple wiregrass*



*Granite lovegrass*

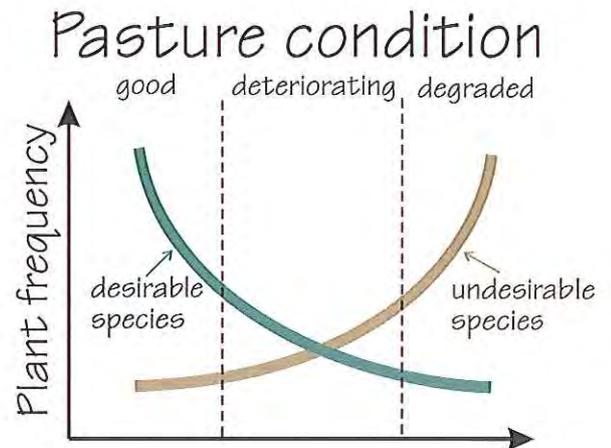
## How are your pastures?

You can check the condition of the grazing in your paddocks after monitoring. Condition can be categorised (on the proportion of the different species present and on the soil condition) into three states—good, deteriorating, and degraded.

### Deteriorating or degraded?

A 'deteriorating' condition is one that can be reversed to 'good' condition by changing management, for example by lightening the stocking rate and burning, or by a return to more normal rainfall patterns, as after a drought.

'Degraded' land can only be returned to inherent productivity by practices or expenditure outside normal management for this type of country.



*Pasture condition has deteriorated after a dry year—but it will recover.*



*Pasture (and land) condition is degraded  
—and it is not economical to recover it.*

### What 'state'?

These conditions 'good', 'deteriorating' and 'degraded' are much simplified. Pasture ecologists have developed the terms '*state*' and '*transition*' to describe more detailed changes in native pastures under the influences of various pressures. Pastures may be in a certain '**state**' or moving between states — '**transition**'.

Some transitions may be reversed under management strategies such as adjusting stocking rate and burning, whereas others may require substantial inputs, for example mechanical clearing of regrowth, once they have gone too far.

These general 'states' for the A-B pastures are described on the next page.

## 'States' recognised in the A-B communities:

### State 1. Woodland

Good condition pasture dominated by palatable, native perennial tussock grasses such as desert blue, forest blue, pitted blue, Queensland blue, black spear, golden beard and some wire grasses under a woody overstorey typically of eucalypts or cypress pine. Seedlings of eucalypts and some shrubs suppressed by the overstorey and periodic fires.

### State 2. Grassland

Vegetation dominated by perennial grasses. These include the grasses in State 1 with sown or naturalised buffel grass. Maintained by moderate grazing and periodic hot fires.

### State 3. Woodland with scattered shrubs

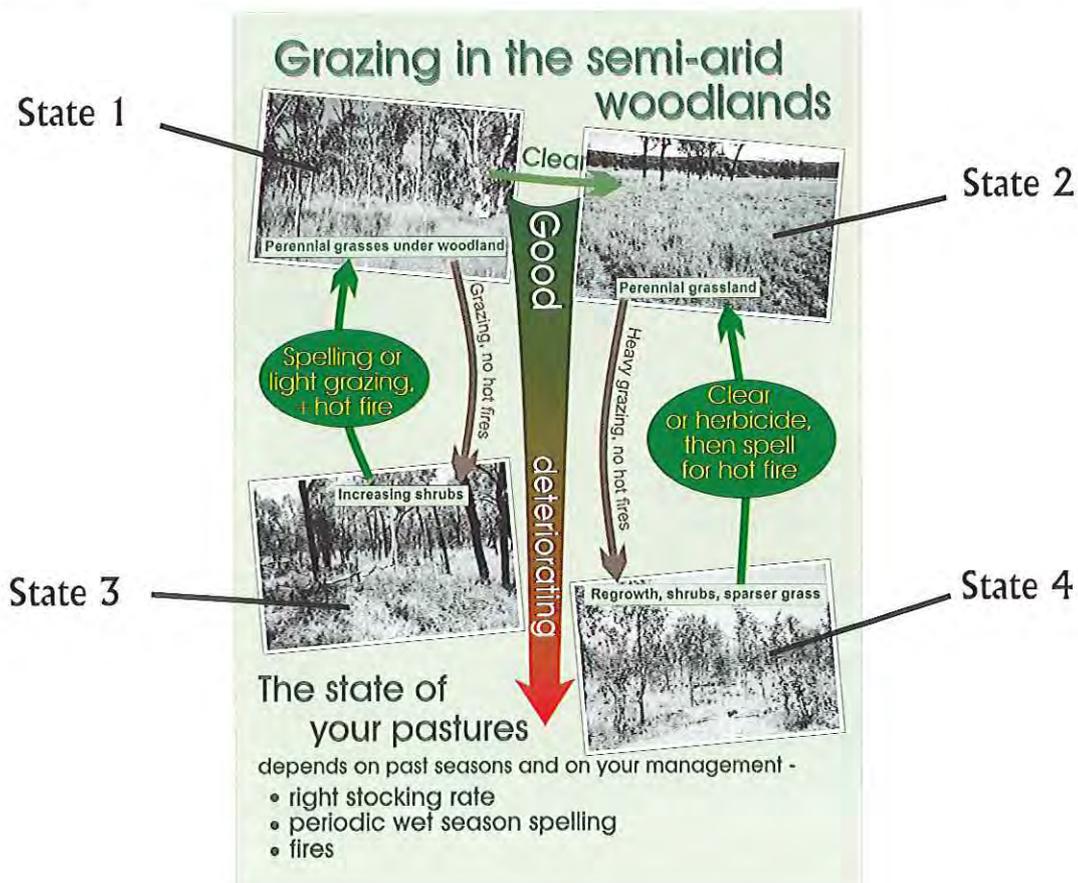
Same perennial grasses as in State 1, but with saplings of overstorey trees and increasing shrubs. Typical shrubs include false sandalwood, currant bush and hopbush.

### State 4. Dense regrowth

Pastures under dense regrowth of eucalypts or cypress pine, false sandalwood and currant bush. Sparser perennial grasses with increasing unproductive species including wiregrasses, chloris, bottlewashers, windmill grass, small burr grass and flannel weeds.

### Causes of transition between the vegetation states and their ease of implementation

Transition	Cause	Ease of implementation
1 to 2	mechanical and chemical clearing of trees and maybe grass seed sown	high
2 to 4	heavy grazing, accentuated by dry summers and wet winters, no hot fires, 2-15 years	moderate
1 to 3	heavy grazing, accentuated by dry summers and wet winters, no hot fires, 3+ years	moderate to high
3 to 1	wet season spelling or light grazing to allow hot fires; can take 15+ years	moderate
4 to 1	moderate grazing and some fire, can take 30+ years	v. low
4 to 2	mechanical or chemical tree treatment, then light grazing and good seasons for 1-2 years to allow a hot fire	high for timber treatment medium for fire
4 to 3	continued moderate to heavy grazing and few fires; takes decades	moderate to high



# Further reading

## General

*Managing native pastures: a graziers guide* — by Ian Partridge (1992) DPI, Queensland.

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

*Native pastures in Queensland: the resources and their management.*— Edited by W.H. Burrows, J.C. Scanlan and M.T. Rutherford (1988) QDPI, Brisbane.

*Managing mulga grasslands: a graziers guide* — by Ian Partridge (1996) DPI Brisbane

*Managing mitchell grass: a graziers guide* — by Ian Partridge (1996) DPI Brisbane

*Managing grazing in northern Australia: a graziers guide* — by Ian Partridge (1999) DPI Brisbane.

*Phosphorus nutrition of beef cattle in northern Australia* — by Terry McCosker and Lyle Winks (1994) DPI Brisbane.

*Will it rain?: The effect of the Southern Oscillation and El Niño on Australia* — edited by Ian Partridge (1994) DPI Brisbane.

## Monitoring and plant identification

*GRASS Check* — by Karen Forge and L. Pegler (2<sup>nd</sup> edition)(1997) DNR Queensland.

*A Guide to Herbaceous and Shrub legumes in Queensland.* — by J.B. Hacker (1990) Queensland University Press, St Lucia.

*Pasture plant identification in the arid zone* — by Jennifer Milson (1991), QDPI, Longreach.

*Pasture Plants of Southern Inland Queensland* — D.R. Henry, T.J. Hall, D.J. Jordan, J.A. Milson, C.M. Schefe and R.G. Silcock (1995) DPI Brisbane

*Plants of central Queensland: their identification and uses.* — by Eric Anderson (1993) DPI Queensland.

*The Grasses of Southern Queensland* — by J.C. Tothill and J.B. Hacker Reprint (1996) Tropical Grassland Society of Australia, Brisbane.

*Is your pasture past it?* — by Joe Rolfe (1998) DPI Brisbane.

*Poisonous plants: a field guide* — R.M Dowling and R. A. McKenzie (1993) DPI Brisbane.

*Weeds of Queensland* — by H.E. Kleinschmidt and R.W. Johnson, DPI Queensland

*State and transition models for rangelands.* Tropical Grasslands Vol 28, No. 4 (1994)

## Decision support programs

*AUSTRALIAN RAINMAN: rainfall information for better management.* Version 3 — J. F. Clewett, P.G. Smith, I.J. Partridge, D.A. George and A. Peacock (1999) DPI, Brisbane.

*Woody weed adviser: options for woody weed management* — P. Back , A. Jamieson and G. Lambert (1993), DPI Rockhampton.

*Rangepak Herdecon: a microcomputer-based Advisory System for Pastoral Land Management.* CSIRO National Rangelands Program, PO Box 2111, Alice Springs NT 0871.

*DroughtPlan — Managing Climate Variability* — David Cobon and Jeff Clewett (1999) DPI, Queensland.



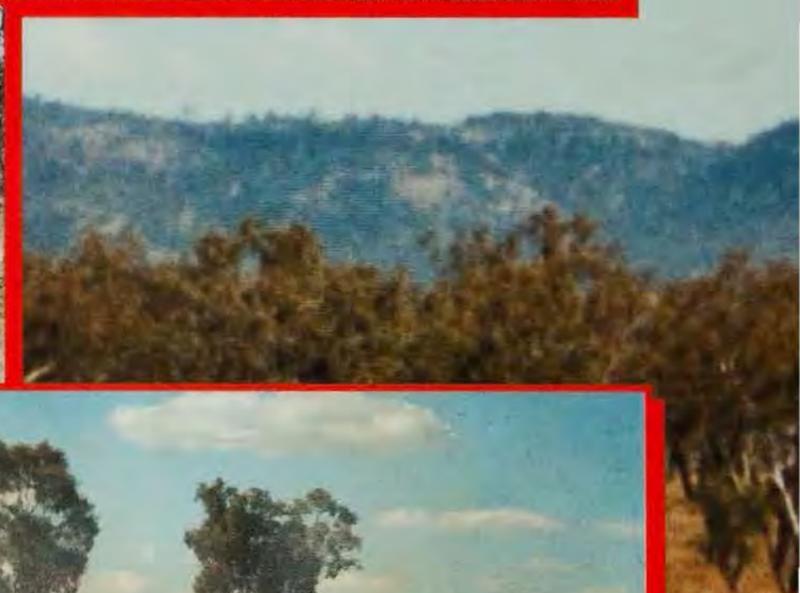
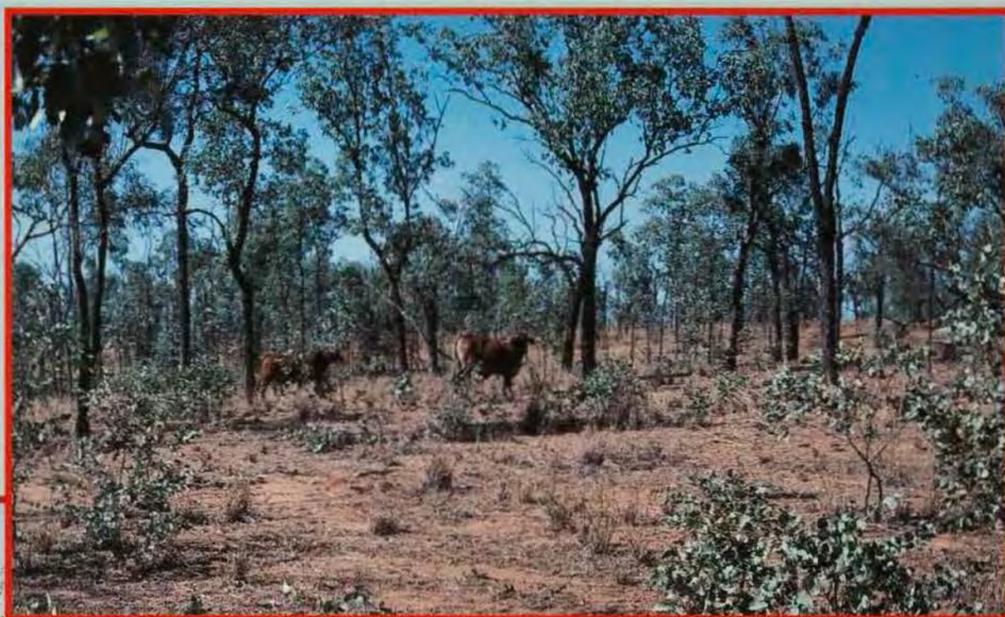
**M**anaging grazing in the semi-arid woodlands provides guidelines for the large, but discontinuous, area of the *Aristida-Bothriochloa* grazing lands in Queensland.

Written in a readable question-and-answer style, and illustrated with many colour photographs, *Managing grazing in the semi-arid woodlands* describes briefly the pasture types and the management options for sustainable production.

These options include:

- setting stocking rates
- moving stock and spelling
- burning
- clearing or thinning trees
- weed control
- improving the grazing.

The booklet describes how monitoring can assess the condition of the pasture so that management can be modified if necessary.



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