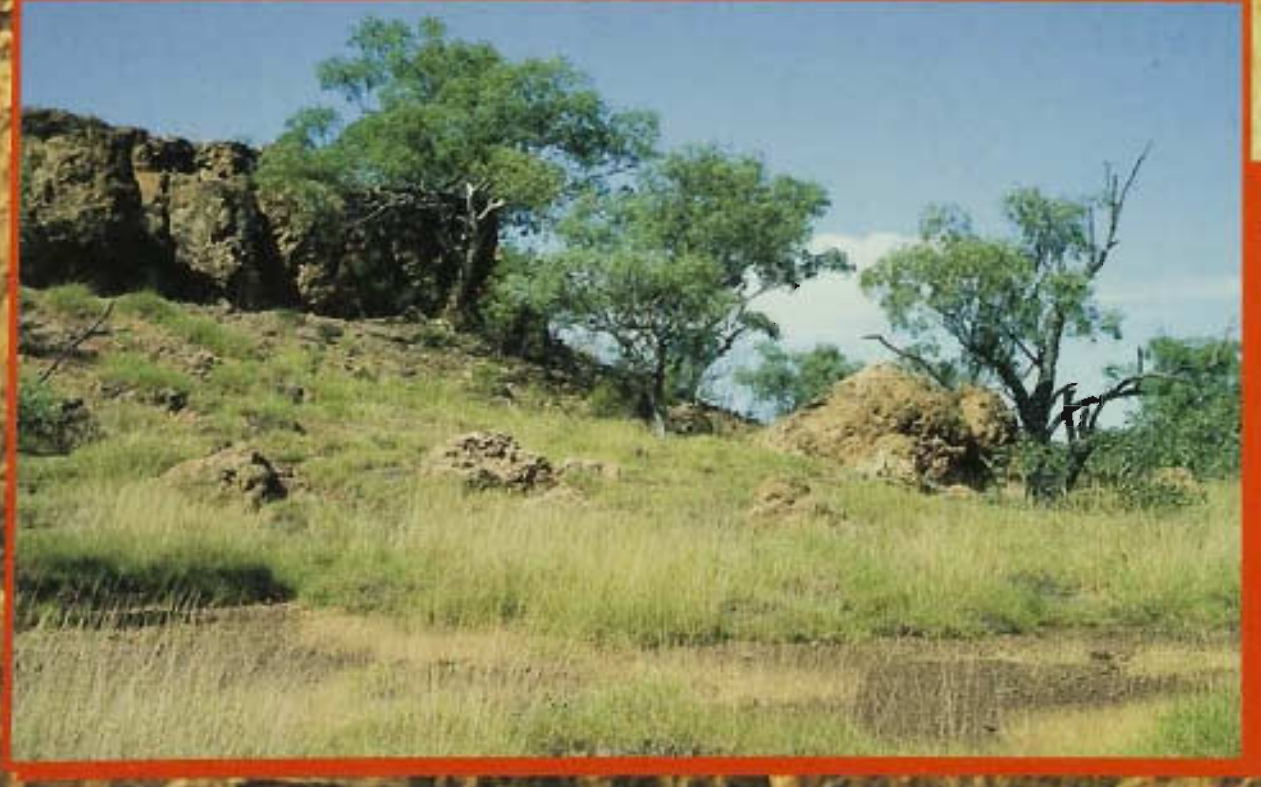
QI99026

Managing grazing in northern Australia

a graziers guide

Ian Partridge



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Managing grazing in northern Australia

a graziers guide

Ian Partridge

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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, the Northern Territory Department of Primary Industry and Fisheries, Agriculture Western Australia, CSIRO Tropical Agriculture, and from rangeland management officers of pastoral companies. All of these acknowledge the experiences of many graziers and property managers.

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(QBII: Queensland Beef Industry Institute; CIGS: Climate Impact and Grazing Systems)

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Sunrise in the Victoria River District

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, for future development of the property and, in the case of pastoral houses, for returns on their investment.

Most of the stock will eat native pastures for much or all of their lives. However, even if these 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 northern pastoral industry as a whole. Fortunately much of the pasture land of northern Australia is in pretty good condition because stocking rates have been kept low by the nature of the land and climate.

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.

The Federal and State and Territory 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; 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.

Trucking cattle near Hell's Gate, Gulf

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 or 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 and adjusting the number of stock
- burning.

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.

"Monitor your pastures at the end of the growing season."

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.

"Adjust stock numbers according to the bulk and condition of your pasture."

Extra subdivision and water points may improve overall utilisation of an area and reduce the effective stocking rate.

Burning

Woody plants have invaded or increased in density in many pastures because of reduced fire regimes. Fire is the natural and ecological approach against woody plant invasion.

"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.

As a general rule, burn tropical tallgrass pastures two years in three, mid-grass pastures every 3–4 years, spinifex every 4-6 years, perennial short-grass pastures every 5–6 years and annual short-grass pastures not at all.

Do not clear trees except maybe for a special purpose on some of the better class land.

Introduction

The aim—production with care

The aim of good grazing management is to achieve a level of production that can be maintained over decades—without the condition of the pasture deteriorating because palatable perennial grasses disappear, woody plants increase or because the soil washes away.

A recent survey of grazing lands across northern Australia suggests that, overall, much of the far north is in good condition, largely due to the very low stocking rates carried. However, undesirable grasses have increased and woodlands have thickened on poor soils.

Pasture in good condition

No fixed recipes

Managing native pastures in the north is not simple—it needs some special skills. Paddocks are often measured in thousands of hectares and usually encompass a range of soil and vegetation types, rainfall is highly variable within seasons and between years, and production costs have to be kept low. Pastures can change significantly over a few years, but these changes may be difficult to recognise at an early stage.

There can be no fixed recipes for managing native 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 monitor gradual and other changes that may occur in your pastures
- adjust management accordingly.

The basic principles of native pasture ecology have been described in ***Managing native pastures: a graziers guide***, and are introduced again in this booklet.

Methods of monitoring are not described in detail here, but many of the important grasses are illustrated to help you assess the condition of your pastures.

Because of the widely differing types of pastures across the north, this book can provide only general guidelines for managing your grazing.

You probably already know many of the individual practices, but this may help you bring them together to devise suitable grazing management strategies. Equal consideration should be given to the management of both your native pastures and your livestock.

Pasture in deteriorating condition

Pasture in degraded condition

'Karumba to the Kimberley'

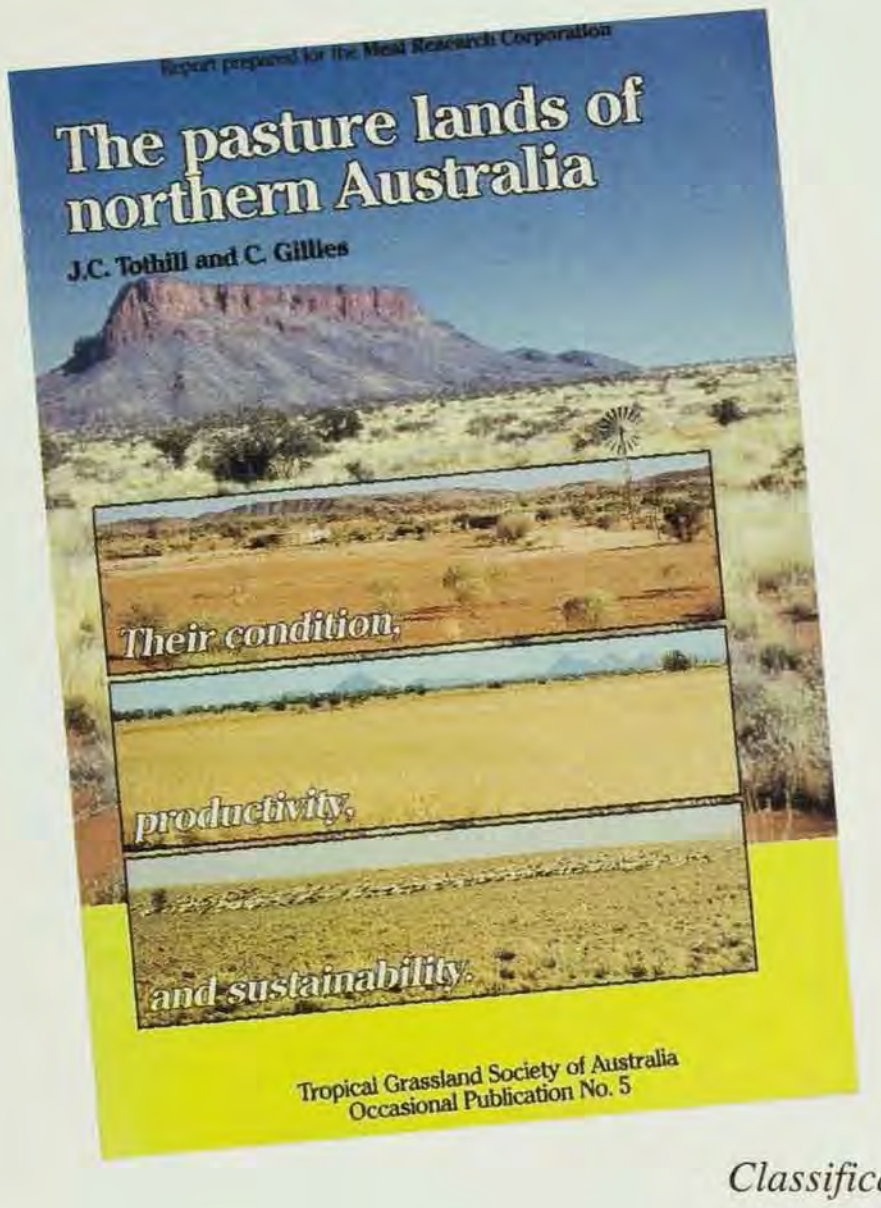
Pastoral leases and freehold grazing lands across far north Australia cover some 30 million square kilometres. They stretch continuously from the Gulf of Carpentaria to Western Australia, approximately from 'Karumba to the Kimberley', although large parts have minimal cattle, being Aboriginal Reserve (for example, Arnhem Land), For the Department of Defence or National Park. The southern limit of relevance is not distinct, but runs approximately through Mt Isa, Tennant Creek, Wave Hill and Halls Creek.

The 'Tropical Savanna' extolled in tourist brochures conjures up images of open grassland with scattered trees. In reality, the grazing land is comprised of several different native pasture communities, some open plains, others under continuous woodland, as determined by rainfall and soil type. Within these major communities there are many local pasture types, frequently determined by local variations in soils, and within a paddock there is further variation due to topography and soil, and to past grazing.

Despite all this variability and the large paddock sizes, some guidelines can be applied to management of each main community. Many of these guidelines come from the collective wisdom of property managers, some from more detailed research.

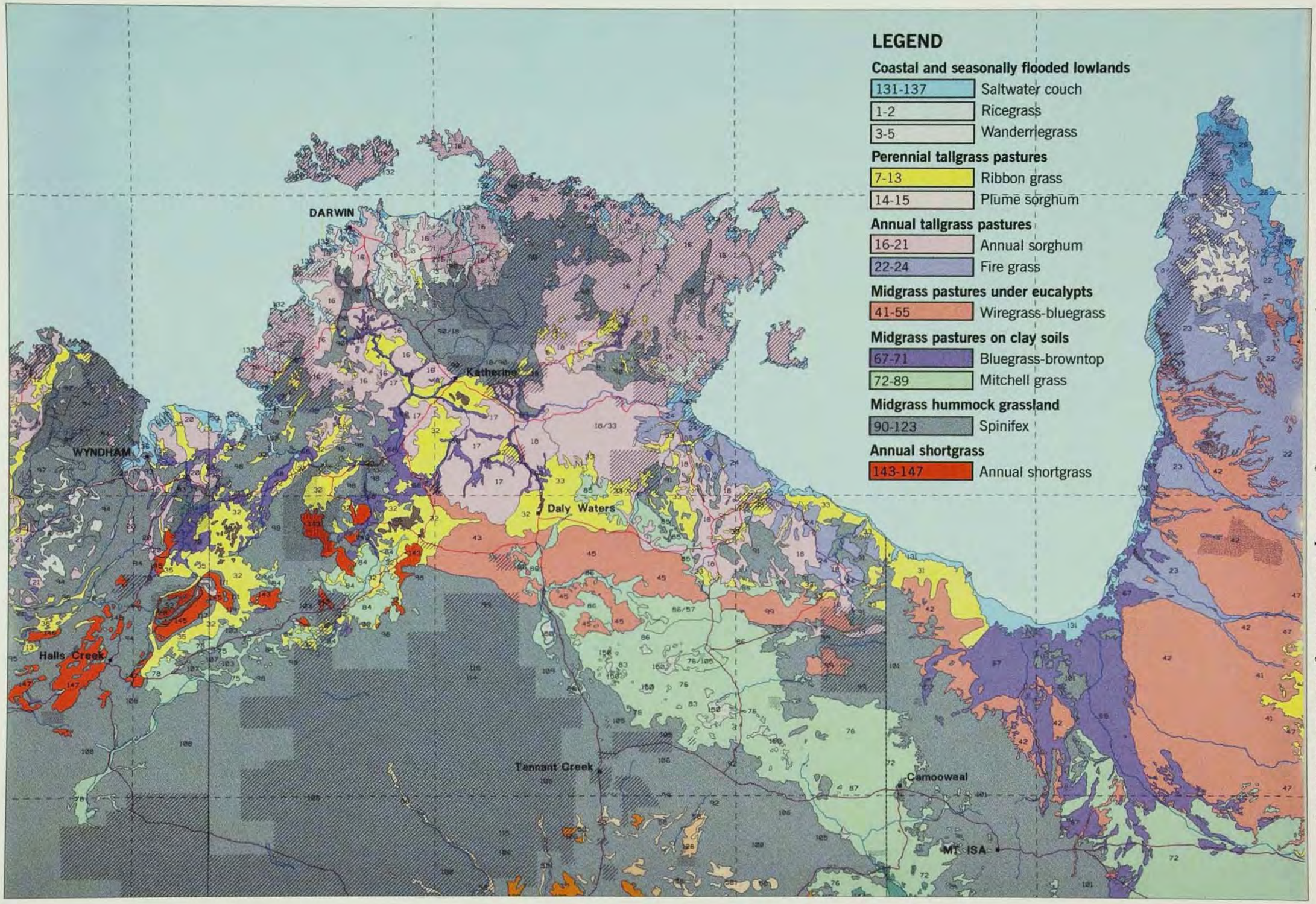
The major pasture communities can be broadly described by the height of the grass vegetation—monsoon tall grasses, the mid-grasses and the short grasses.

These grasslands can be categorised in a table, but are also illustrated on the next pages.



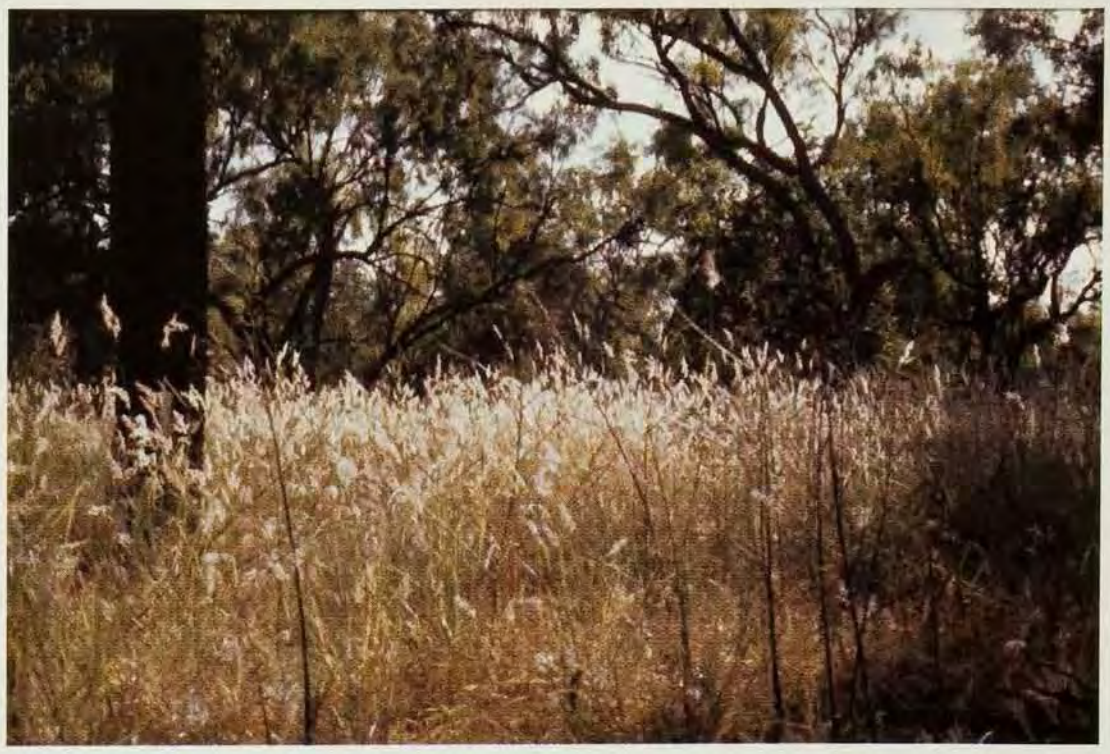
Classification of the grasslands of northern Australia

Classification	Pasture types	Characteristic species
Monsoon tall-grass	Coastal and seasonally flooded lowlands	Rice grass (*Xerochloa*) Wanderrie grass
	Perennial tall-grass	Ribbon grass Perennial sorghum Kangaroo grass
	Annual tall-grass	Annual sorghum – Fire grass
Mid-grass pastures	Pastures of eucalypt forest and open grassland	Wire grass (*Aristida*)
	Grassland on heavy clay	Mitchell grass Bluegrass, Browntop
	Hummock grasslands	Spinifex
Short-grass pastures	Perennial pastures	Salt water couch
	Annual short-grass–forbs	Bottlewashers /limestone grass (*Enneapogon*)



The major native pasture communities of northern Australia (from ***The pasture lands of northern Australia****)*

Rice grass (Normanton)



Wanderrie grass (Normanton)

Annual sorghum (Katherine)

Perennial sorghum (Sturt Plateau)

Ribbon grass (Ord River)

Bluegrass-Browntop (Burketown)

Bull Mitchell grass (VRD)

Barley Mitchell grass (Kalkarindji)

Spinifex (Cloncurry)

Spinifex (Halls Creek)

Salt water couch (Karumba)

Bottlewashers/Kimberley couch (VRD)

Whitegrass (Kalkarindji)

Wiregrasses (Croydon)

Wiregrass/firegrass (Boroloola)

Buffel on frontage (Cloncurry)

Local Pasture Units within Pasture types are described more fully in ***The pasture lands of northern Australia.***

Despite the low potential for intense grazing management on large properties, there are some strategies that are common across the region.

More detailed guidelines are available for some specific pasture communities in Queensland and these may be useful for similar communities elsewhere. They are included in *Managing northern speargrass, Managing Mitchell grass, Managing mulga grasslands* and *Managing grazing in the semi-arid woodlands.*

Production systems

Breeder herds on large company properties typically range from 10,000 to 20,000 head, with smaller properties running 1000 to 3000 breeders. Management of these herds has undergone enormous increases in efficiency over the last twenty years.

This started with improved fencing and stock control during the BTEC scheme, and continued as the markets demanded younger cattle and as new genetics and technologies were introduced. The younger cattle now go south for fattening in channel country or in feedlots, or north to the ports for live export. Live export steers are 1.5 to 2.5 years old, depending on the country of destination.

On many properties, better breeder management with year-round phosphorus supplements, non-protein nitrogen dry-season supplements and early weaning has greatly improved weaning rates (now 65–85%) and reduced breeder mortality from 15–20% to 5–8%.

Most breeders are Brahman-cross, with higher proportions of Brahman genes in the wetter, tall-grass areas, but with more British and European blood in the short-grass pastures.

Droughts and floods are a normal part of the climate.

Rainfall and droughts

Annual rainfall in the region covered in this booklet ranges from more than 1500 mm on the north coastline to less than 350 mm at the southern edge. Rainfall is mostly monsoonal and hence strongly seasonal, with about 85% falling between December and March. The wet season stops so sharply that existing herbage hays off rapidly. Any further deterioration in quality of this herbage is due more to physical factors, such as leaf drop, than to fungal decomposition—until it rains again. However, moisture in the soil can produce green pick well into the dry season.

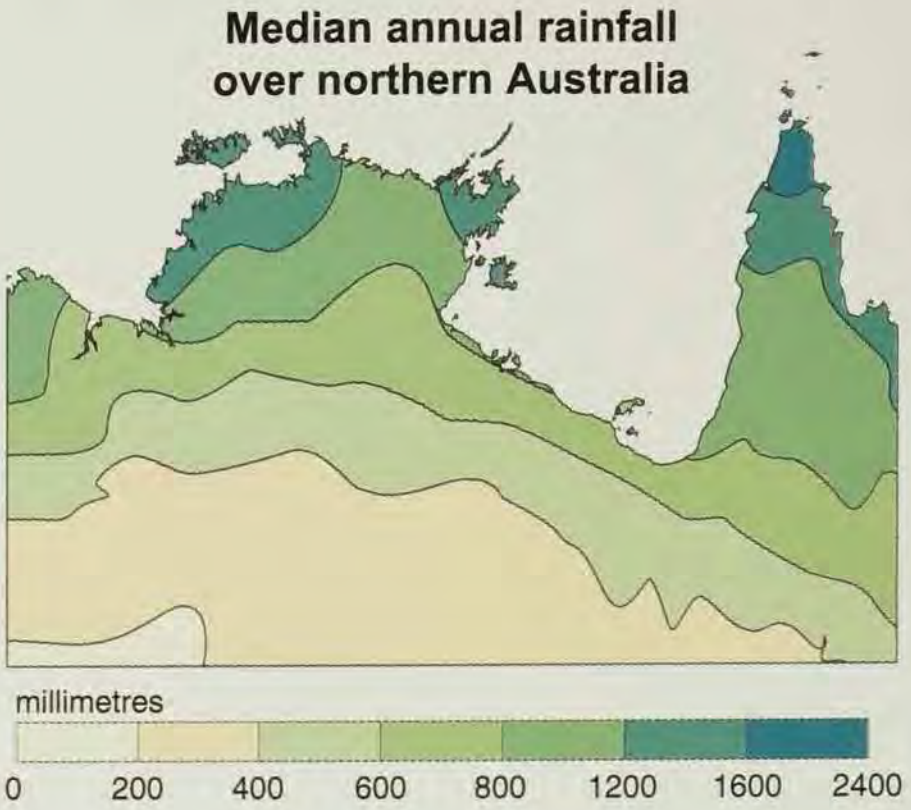
Rainfall varies considerably between years. The Southern Oscillation has only a small influence in the west of the region, but is stronger in the east where it affects the time of the break of the monsoon. The wet season arrives earlier when sea surface temperatures around northern Australia are high and when the SOI is strongly positive. (See page 23 for maps showing where and when the SOI has influence.)

Once the monsoon is set, rainfall is relatively reliable although there can be extended dry periods. Flooding of low flat country is common after heavy rain.

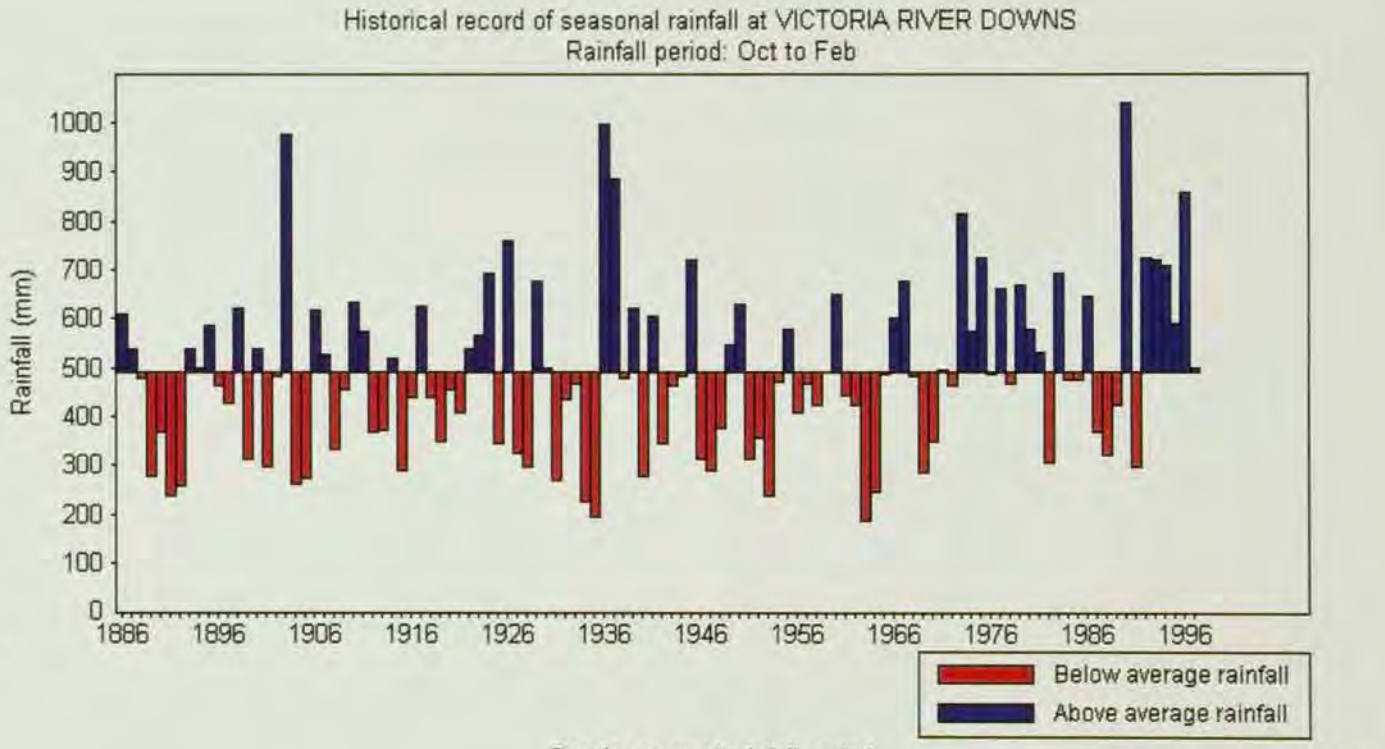
Droughts have to be considered as a normal, if irregular, part of the climate cycle; they must be planned for as a normal part of property management. Most droughts develop with the failure of the rains during one wet season, but low rainfall extending over a number of years can have more important consequences for stock and pastures.

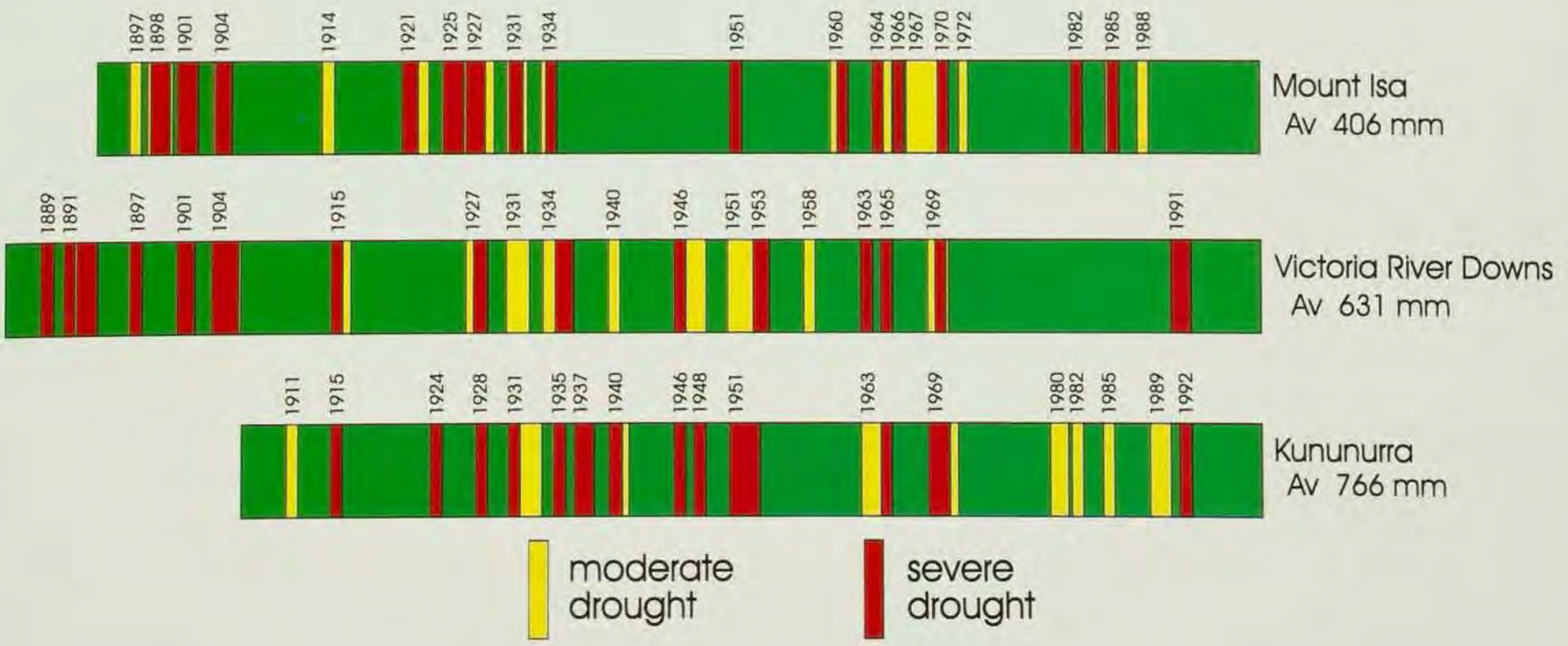
The occurrence of moderate and severe droughts for Mt Isa, Victoria River Downs and Kununurra over the last century is shown below.

Median annual rainfall over northern Australia

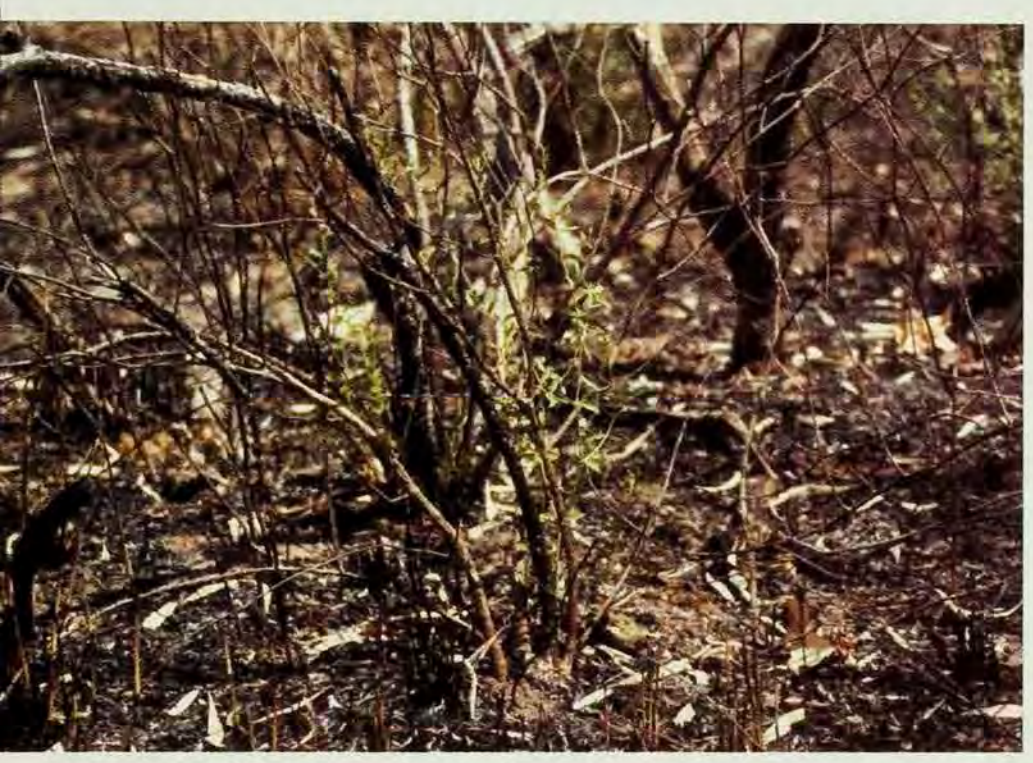


Low rainfall over several years can have more important long-term effects on pastures than a 1-year drought.





The growing points of grasses are protected against defoliation.



Broad-leaved plants have to resprout from growing points further down the stem.

Grasses of some species can live for many years if not defoliated

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

Grasses and grazing — basic ecology

The main native grasses are summer-growing species that have evolved under conditions of strongly seasonal rainfall, low to moderate fertility, light grazing and regular natural fires.

The most important grasses for the northern pastoral industry are tussock species, such as Mitchell grass, bluegrasses and ribbon grass, with each tussock made up of many separate shoots or tillers. Spinifex is regarded as a hummock species; creeping grasses invade in higher rainfall regions under heavy grazing. Some introduced grasses have naturalised over large areas, for example Cloncurry buffel and birdwood grass on red country around Mt Isa and Halls Creek.

Grasses are nature's selection of plants that can tolerate defoliation. Their growing points, at the base of each leaf, are well protected when the plant is grazed or burned.

Broad-leaved plants, on the other hand, grow from the tips of their shoots, and have to form new shoots when these are removed. Shrub and trees are woody broad-leaved plants; the non-woody ones are called 'forbs'.

Forbs may make up 20–40% of the diet of cattle on native pasture, and can be a valuable source of minerals. They include native and naturalised legumes that provide high protein feed. Some forbs are poisonous.

How long do grass plants live?

Some grasses, such as those colonising scalds or bare spots, are ephemeral or short-lived. They can germinate, flower and seed within six weeks.

Annual plants live for one growing season only; they seed heavily and then die. Some (mainly small) annuals invade overgrazed pastures from which the perennial plants have disappeared. Others are plants well adapted to the strongly seasonal pattern of rainfall; annual native sorghum grows during the intense wet season, but survives the long dry period as seed in the ground.

The most valuable grasses for grazing are the perennials which have variable life spans. Mitchell grass tussocks can live for decades whereas bluegrass plants may live for less than four years. The individual tillers and roots of a perennial may come and go, but the tussock remains. All perennials must accumulate reserves of carbohydrate so that they can send up new shoots after a period of dormancy during the long dry season.

Pastures containing perennial grasses are more stable under grazing.

What controls grass growth?

In the north, growth is obviously controlled mostly by moisture—low temperature is of minor importance.

Growth starts rapidly once the wet arrives, and grasses shoot away using their reserves or from seed. They grow rapidly on nitrogen mineralised in the soil during the dry season but, on poor soils and in very wet years, this is soon exhausted. Growth slows, and the protein levels in the plant are diluted. When the plant averages 0.6% N, growth stops. The result can be a 'green desert'—it looks good but is actually a great bulk of low-quality, poorly digested, feed.

The grass plant sends up a flower head that needs protein; from this point, protein levels in the leaf drop even more rapidly. To support the weight of the developing seed, the seed stalk lignifies or becomes woody.

The turning point for pasture growth and quality depends on the season but is often around mid-February. However with low stocking rates, cattle can select better quality shoots and continue to gain weight well into the dry season.

Great bulk, but a 'green desert' of poor quality herbage.

When do grasses flower?

Some grasses can flower at any time following a growing period. However, in many annual and perennial native species flowering is triggered by certain lengths of day in autumn—or even in late spring if there has been sufficient early rain. All native grasses must be allowed to drop seed periodically for regeneration.

Another product of dry, indigestible fibre.

How long can seed survive in the soil?

Seed of many grasses is dormant for several months after it is shed; this 'protects' the species from a late or untimely germination.

All native grasses must be allowed to drop seed periodically to regenerate.

Seeds rarely last for more than three years in the soil—usually for less than one. Some pointed seeds with twisting awns, such as those of kangaroo grass and black speargrass, can bury themselves point-down into the soil and avoid surface fires. Fluffy seeds of the bluegrasses and long-awned seeds of the wiregrasses that rest on the soil surface are more likely to be destroyed by fires. Many seeds are taken by seed-harvesting ants, while others rot under moist conditions in the next wet season.

Hard-coated seeds of forbs, including those of legumes, can survive for years. Legume seeds often have impermeable coats that allow water uptake only after they have been scratched or heated.

Annual grasses must drop seed to come back next year.

A grass is most susceptible to grazing when resprouting after the dry season or after a fire.

The root system, as well as the top growth, of a grass becomes much smaller under constant heavy grazing. This small root can not respond well to rainfall.

Changes under heavy grazing

When are grasses most susceptible to grazing?

A grass plant is most susceptible to damage when relying on its reserves to produce new green leaves—'green pick'. Until it has enough leaf for productive photosynthesis, a plant will be weakened by grazing.

In the monsoonal tropics, this stage usually lasts for only a short time because the grass grows quickly and stocking rates are low. However, pasture can be damaged if stock concentrate on a small area that has been burnt or that has received rain from a local storm. Stock can clean up green pick over a large area if it has received little follow-up rain.

Stock may also concentrate on certain 'sweeter' pasture or land, often on some lighter soils carrying annual species.

Under continued heavy grazing, the tops and root systems of palatable perennial grasses become smaller, the rate of growth slows, and fewer tillers produce less seed. Persistent heavy grazing for just two years can kill some plants; less palatable grasses or weeds will invade the open space.

The new unpalatable grasses grow larger, taking more and more of the soil moisture and nutrients, and setting more seed.

Cattle seek out the few remaining good grasses, further increasing the grazing pressure on them. The pasture gradually changes its composition with more unpalatable perennial grasses (such as wiregrass), or more annual grasses (such as Kimberley couch).

Another major change results from the lack of fuel to carry a hot fire.

How does fire affect grassland?

A hot fire will remove the old dead leaf of grasses, but generally will not destroy the growing points. Conversely if a fire destroys the top growth of a shrub, the plant loses all its growing points and has to send up new suckers from the undamaged base or roots, or to regenerate from seed.

Thus, fire tends to keep vegetation as grassland or open woodland. Regular hot grass fires will stop trees and shrubs encroaching or thickening—but they are always waiting to return.

What happens without fire?

Without periodic hot fires, seedlings of shrubs and trees tend to keep growing. They soon compete strongly against the remaining grasses for soil moisture, often resulting in bare soil under and around shrubs. This puts further pressure on the remaining grasses, and the downward spiral progresses.

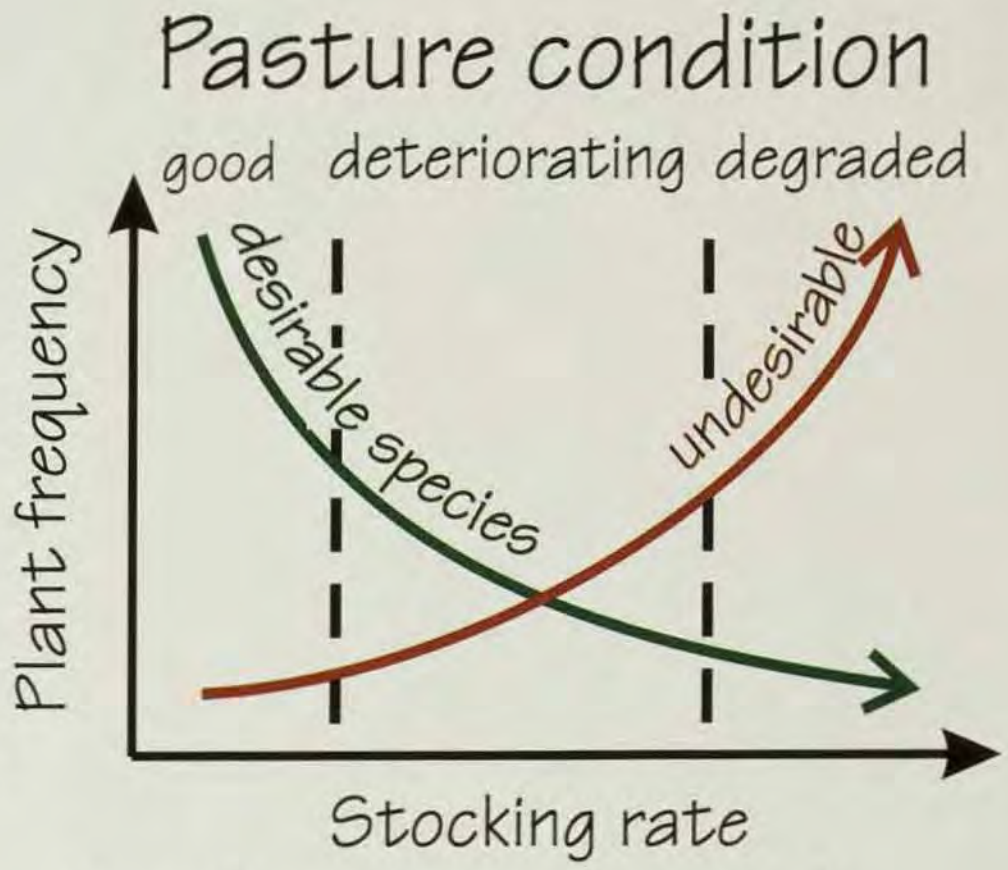
Ungrazed grass becomes rank and is avoided by stock; this old growth ties up plant nutrients so that eventually the pasture ceases to grow and becomes moribund. Cattle concentrate on the grazed areas with more green shoot.

What sort of pasture is best?

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

You tend to lose these species if you are heavily stocked; so lower stocking rates are likely to benefit the the pasture, the land and the cattle.

The best quality native pasture grazing is where good soils, moderate rainfall and few trees ensure good production, for example on the Mitchell grass downs of the southern VRD, the Barkly Tableland and the Kimberley.



The condition of a pasture declines as the 3P species are lost and less desirable species increase.

Which species do cattle prefer?

The preferences of stock may change during the year. They often prefer forbs and small annual grasses (including, in various places, chloris, limestone grass, Flinders grass) early in the season, then the taller grasses before they flower. The bluegrasses, with fine leaf and stem, and Mitchell grass are preferred during the dry season.

Cattle may graze annual grasses and soft spinifex on the hills during the wet, leaving seasonally flooded or waterlogged flats for grazing during the dry season.

Without defoliation, grass leaves become blackened and inedible after one wet season.

Savannah grassland in the Victoria River District provides some of the best grazing in the north.

Property management planning

Property management planning involves all aspects of planning—personal, financial, land, production and marketing.

This planning builds on your knowledge and expertise, and allows you to:

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

Planning often starts with the preparation of a property map of your resources of land, water and infrastructure. On large properties, these maps are based on satellite images.

Land management types

Graziers recognise that their properties are made up of different classes of land, often based on the vegetation or soil.

Typical properties may have only a few main paddocks, with some smaller special-use paddocks, on an area covering hundreds of square kilometres. Fence lines may be used to separate land types needing greatly different management, for example bluegrass flats and spinifex hills, but generally subdivision is minimal. This can make grazing management decisions difficult to implement.

Carrying capacity for sustainable grazing naturally depends on the rainfall, soil type (fertility) and the condition of the soils and pastures. Some suitable stocking rates are suggested later. In most areas, stock performance, and thus stock numbers, are limited by the quality of dry season feed rather than by the quantity of feed available.

Soils range from heavy cracking clays to deep sands.

Managing your grazing

The options for managing the grazing lands of the north are generally limited because of the extensive nature of the properties and the low potential of the land. These main grazing management options are:

- altering number of animals (stocking rate)
- burning.

Local options include:

- moving stock (spelling)
- clearing or thinning trees or woody weeds
- adding a legume to existing pastures
- sowing a new pasture on better class land.

Altering stocking rates

Stocking rate (number of beasts per square kilometre or hectares per beast) is the most important factor in grazing management. Traditionally, stocking rates have been very low, limited by the quality of feed during the dry rather than the quantity of grass during the wet.

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

Light stocking is sustainable. It permits burning, keeps the land and pasture in good condition, and allows animals to select a diet much better than the average bulk of pasture provides.

However, the continual cost:price squeeze has forced managers to increase stocking rates, while production techniques such as introducing Brahman-cross cattle and supplements have allowed them to do so.

Stocking which is too heavy weakens the valuable species, encourages undesirable grasses and weeds, exposes the soil surface to erosion, prevents hot fires, allows woody species to increase, and produces leaner cattle which are more at risk during droughts.

Nearly all the deterioration seen in pasture land has been caused directly or indirectly by over-stocking.

In many cases, the effective stocking rate is higher than the nominal stocking rate.

What is the best system of grazing?

On properties with a few large paddocks, the most practical system is continuous grazing, although preferably with the number of stock adjusted to the feed available, and with opportunistic spelling.

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

The only difference is stocking rate.

Stocking too heavily affects pastures and cattle.

Move cattle to allow palatable species to recover.

When the stocking rate exceeds the carrying capacity, pastures decline.

What is spelling?

Spelling means destocking a paddock completely or reducing stock numbers. However, sometimes even if numbers are reduced, stock continue to select their preferred species, for example kangaroo grass rather than ribbon grass.

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 the difference between carrying capacity and stocking rate?

Carrying capacity describes how many animals a pasture can carry and still remain in stable condition, for example 6–7 breeders per sq. km. Stocking rate describes how many animals are actually in the paddock, for example 10 breeders per sq. km.

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

How do I determine the right stocking rate?

Stocking rates have often been determined by financial pressures rather than by the capacity of the land.

It is not easy to *calculate* suitable stocking rates; generally they have been determined by long-term local experience.

In some areas, groups of local graziers and managers have been asked what they consider to be 'Best Local Practice' for sustainable stocking rates or 'carrying capacity' for each land type.

What is the safe stocking rate for my paddock?

The stocking rates recommended by producers are fairly broad; they may range, for example, from 6 to 10 breeders per sq. km within a land type depending on the condition of the pasture.

Suggested sustainable stocking rates for native pastures are shown below. An Animal Equivalent (AE) represents a 420 kg dry cow or a 455 kg steer.
(1 breeder = 1.2 AE)

Pasture type	stocking rate (AE/sq.km)	Steer growth rates (kg/head/yr)
Wiregrass under woodland	6	80–110
Mitchell grass	10	100–130
Bluegrass–browntop	10	100–130
Spinifex	2–4	80–100
Tallgrass (sorghum)	8–	80–100

You should refine these stocking rates for your paddocks by monitoring your pasture each year to see whether its condition is improving or deteriorating.

Check how much feed is left over at the end of summer or check the botanical composition of the pasture, remembering that significant changes in the condition of pastures may take 2-3 years to become apparent. Monitoring is explained in a later chapter.

In very large paddocks, your effective stocking rate may depend on the distribution of watering points which allow stock to utilise the whole area.

What is an 'effective' stocking rate?

Stock may not graze over the whole of a large paddock but will concentrate within a few kilometre radius of water. This concentration on a smaller area gives a higher 'effective stocking rate'.

The effective stocking rate may also have to take into account native and feral herbivores—roos, brumbies, camels, donkeys and mickies.

In many paddocks, pasture condition deteriorates as one gets closer to a watering point. Land immediately around a water point may have to be considered as a sacrifice area because stock will always be hanging around.

The effective stocking rate can be reduced by positioning new watering points in distant regions, by additional fencing to prevent stock constantly grazing 'sweet' land or by burning the ungrazed areas to entice stock onto greener pasture.

However, under-grazed areas well away from the water do help to maintain some country in good condition and to maintain biodiversity.

Overgrazing near supplied water may be less noticeable in broken country because numerous creeks and waterholes are filled during the wet season and stock can disperse.

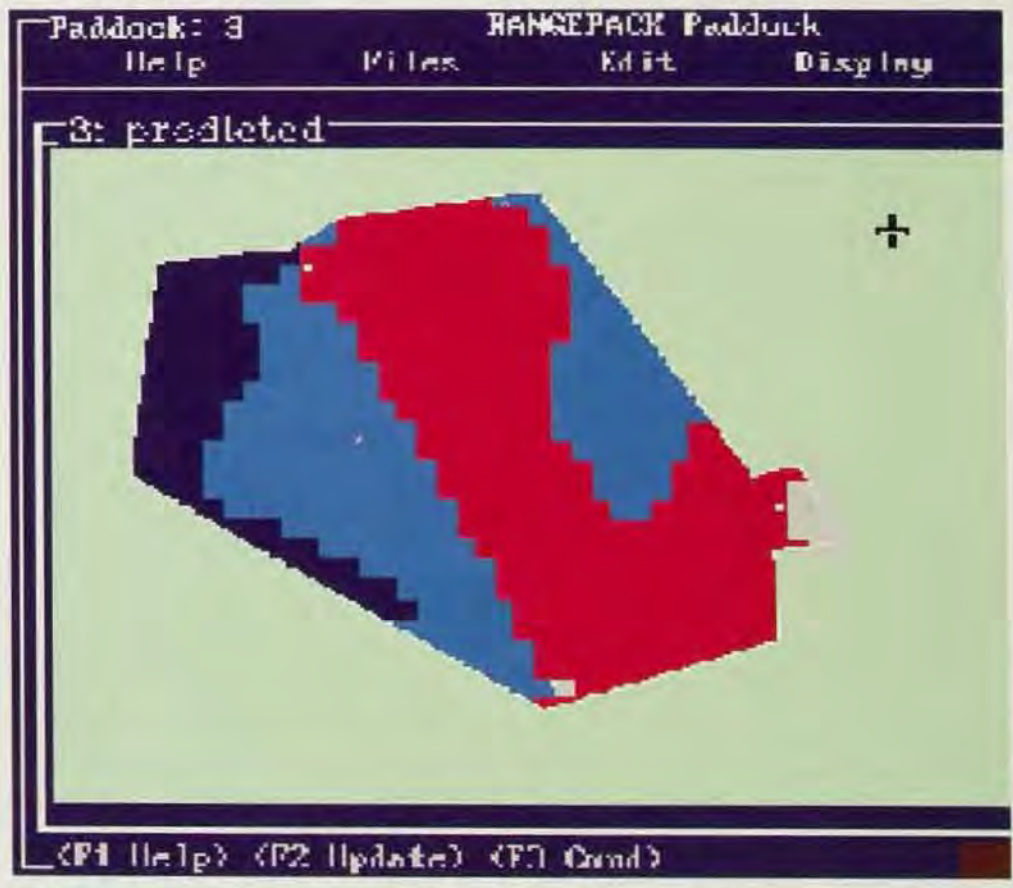
I can't alter my stock numbers greatly every year!

It is usually not practical to greatly alter breeder numbers on extensive properties every year, although companies owning several properties may be able to move stock around. More often a safe, slightly variable, stocking rate has to be set; one that is suitable for 7–8 years out of 10.

Effective stocking rates depend on the distribution of water points.

Your effective stocking rate may depend on the distribution of watering points.

Effective stocking rates include native and feral animals.

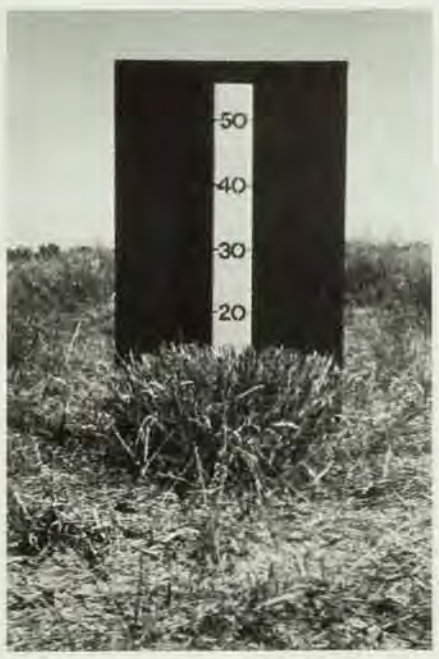


The best location of watering points can be planned with the help of the HerdEcon computer model

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

0% eaten– a complete rest for some months can allow the plant to strengthen

10% eaten– you can aim for 15–20% utilisation for most species



30% eaten– too heavy for persistent grazing of most of your native grasses

50% eaten– will soon lead to the loss of many native species

These photos are of leafy Mitchell grass. It looks much worse with more stemmy species

If the stocking rate is set for the average year, it will lead to over-grazing during the 5 years with below-average rainfall, and the pasture will probably not have time to recover during the good years. It can take a couple of years for pasture to recover from the effects of over-grazing that are bound to occur during a drought with fixed numbers.

You cannot profitably set a fixed stocking rate to allow for all droughts and may have to reduce number in exceptional years. In the good years, you can spell paddocks opportunistically or buy in extra animals.

Besides longer-term variability in rainfall, there is large variation between years (see page 7).

How can carrying capacity be calculated?

A scientist's approach is to calculate the amount of grass that grows (which depends on the soil type, rainfall and tree/shrub cover), and to allow only a small proportion of this to be eaten.

The erect clump species in native pastures cannot stand being grazed heavily year in, year out.

Pasture scientists have worked out that, overall, 10–20% of the summer growth in this region can be utilised (eaten) during summer without damaging the pasture.

Suggested levels of maximum utilisation of summer growth are:

Pastures on light country	10%
Pastures on heavy soils	15–20%

How much grass does grow each year?

Grass growth can be estimated from a formula developed by pasture scientists. They have calculated, for many soil and pasture types, the amount of grass (kg of dry matter) that is produced per hectare for every millimetre of rainfall (or more accurately of transpiration). This ranges from 5 for the best Mitchell grass on black cracking clays to 1.5 for spinifex on deep sands (as an example, RUE of 3 X 700 mm rainfall = 2100 kg/ha/yr).

Rainfall Use Efficiency, as used here, is a very rough guide to potential pasture growth. In wet years, available nitrogen in the soil is soon used up and later rainfall may produce little extra growth.

Typical values for Rainfall Use Efficiency

Community	Grasses	Soil	RUE
Mitchell grass plains	Mitchell, ribbon	cracking clay	3.1–5.0
Bluegrass plains, NT	Blue, ribbon, mitchell, white	cracking clay	3.1–3.5
Bluegrass-Browntop, Qld		cracking clay	4.5
Tall grass, NT	Ribbon, white	red earth	2.7–3.5
Arid short grass, NT	Limestone, fairy Kimberley couch	red earth	2.8–3.5
Spinifex, Qld		deep sand	1.5

You could calculate grass growth using average rainfall; however, but since there never is an average year, it is preferable to incorporate a safety factor by calculating based on rainfall likely in 70–80% of years.

Deciles of rainfall (Oct to Feb) at Katherine	
Highest on record (mm)	1324
In 70% of yrs, at least	647
In 80% of yrs, at least	572
Lowest on record (mm)	307
Average rainfall (mm)	758

Basing stocking rates on the average year can lead to overgrazing.

Using only 15% of the grass doesn't sound much?

The recommendation is to use no more than that percentage of summer growth during the summer.

The animals may eat and trample another 15–20% of the dry feed during the dry season without doing any damage to the dormant grasses. Thus the total 'taken' over a whole year is 20–30%.

How do I check a stocking rate for the dry season?

You can check whether there is enough grass at the end of the growing season to feed your stock through the dry.

You need also to take into acount the condition of the pasture. If you have plenty of grass and the paddock is in good condition, you could buy in more stock. If there is a big bulk of undesirable species, think about an opportunistic burn at the end of the dry season.

Run that number of stock that will eat only say 15% of the standing feed at the end of the wet season (see box).

A more detailed calculation could be based on the amount of feed in the paddock at the end of summer and the amount needed for ground cover or a hot fire at the start of the next wet.

These calculations are done before the first weaning muster to allow excess stock to be drafted for transfer to other paddocks, agistment or sale.

Ribbon grass is very resilient but this plant will need a couple of years to recover.

How much grass do I need at the start of the wet?

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

Soil erosion increases greatly when there is less than 40% ground cover. Although this 40% includes weeds, fallen leaves and sticks from trees and stones, it still represents 1000 kg of dry grass per hectare. If you want a good fire in early summer, you will need even more dry matter for fuel, at least 1500–2000 kg/ha.

Even stones will provide cover against raindrops, but grass is much more effective.

Checking your stocking rate for the coming dry season

Stocking rates can be adjusted at the end of the wet 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 the pasture condition is poor, consider burning at the start of the wet.
- If the bulk is low, consider moving stock off.

1. 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.
2. Calculate your stocking rate by allowing 15% of the standing feed for your stock.

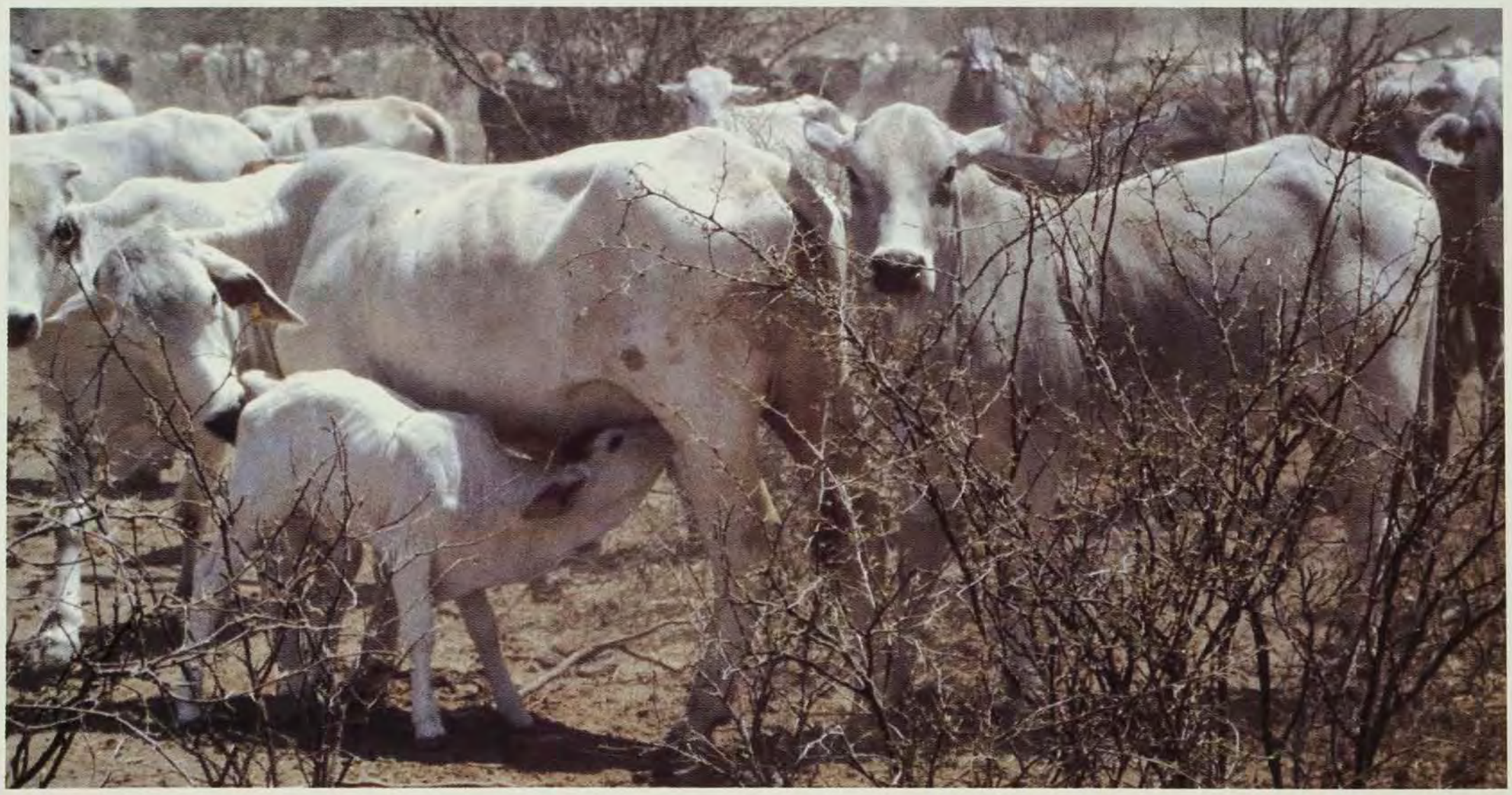
Note that a breeder on dry season supplements can eat only about 8–10 kg of poor quality feed per day, or 1900–2400 kg over an eight-month season.

Example with 15% utilisation of the standing feed at the end of summer

Standing feed (kg/ha)	15% utilisation	Dry season stocking rate (AE/sq.km)	
500	75	3.75	– destock
1000	150	7.5	– lighten off
1500	225	11.25	– about right
2000	300	15	– buy in or burn before next wet

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

Check your property records or use a program such as Australian Rainman (see examples on page 7) to see how often a good year is followed by a poor one or vice versa. This should deter you from changing stocking rates wildly each year based solely on the standing feed at the end of summer.



Burning

Burning is the second main option for managing northern pastures—after adjusting stocking rates. For this region, there are few other options which can be applied cheaply and effectively on a broad scale.

The reasons that graziers give for burning their native pastures range from increasing green pick to safeguarding against wild fires. In this section, we will concentrate on the benefits to the pasture.

Much of the northern grazing country is naturally woodland, and is trying to stay that way. There are nearly always tree seedlings or suckers present in the grassland, but they are suppressed by the mature trees or by fires.

Remove the mature trees or take away fire—either deliberately or because stock have eaten too much of the fuel—and woody plants are going to increase or invade.

Even some open grassland plains of Mitchell grass or bluegrass are under threat from woody plants such as gutta-percha, rosewood, prickly acacia, and whitewood. Only the salt flats are totally treeless.

Fire is a basic management tool for maintaining the northern grasslands in good condition.

Woody saplings waiting to grow.

Do not burn indiscriminately – work out why, when and where you need to burn.

Why should I burn my grass?

Fire is an integral part of grassland management whether the land is timbered or open.

Fire can be used to:

- control woody weeds and regrowth
- even up patch grazing and encourage stock into new areas
- improve the condition of pasture because the shoots of normally undesirable species will also be grazed
- improve the quality of feed accessible to stock
- make mustering easier by concentrating stock
- reduce fuel to prevent wild fires.

How often should I burn the same country?

There is enough fuel to burn every year in the higher rainfall regions, but this may not be desirable as it tends to favour annual species.

Annual sorghum pastures are often burned two years out of three.

Too frequent burning may give a patchy fire in the mid-grass pastures if there is insufficient litter between tussocks, and may harm 3P species. Burn once every 3–4 years.

In shorter pastures, burn less frequently—once every 5–6 years.

The top two signs apply to the public—graziers need fire.
The bottom sign applies to everyone.

Cypress pine can be devastated by hot fires.

If you have insufficient fuel to burn in an average year, you are stocking too heavily.

Early fires (above) are too cool to do much damage to woody plants.

Late hot fires (below) give more effective control.

Except for spinifex, fuel does not accumulate much after 3–4 years, especially under grazing, because the rate of decomposition is high during the wet season.

Burning to control woody plants

Seeds of eucalypts and many other woody plants do not survive for many months in the soil. They germinate when conditions are right, with good rainfall and open pasture, but grow only slowly in the first year while they put down a strong taproot.

Fire will kill most of these seedlings in this first year; thereafter it will kill the top growth up to a couple of metres but not the whole plant.

Fire may not kill eucalypts and shrubs but it will help to control them.

Cypress pine, common on some of the lighter soils around the western Gulf, Arnhem Land and north Kimberley, is different. Saplings up to 3 metres high are highly susceptible to fire, and whole stands of adult trees can be decimated by uncontrolled fires.

When should I burn?

When to burn depends on the reason for the fire. Some managers burn at the end of the wet to encourage green pick from soil moisture, some burn early (June–July), others burn late in October–November.

Early dry season fires

Early fires are cool and safe, and 'burnt windbreaks' reduce the danger of uncontrollable late fires. Early fires tend to be more patchy and so to maintain more diversity in both plants and small native animals.

But early fires do not control woody regrowth and extensive early burning could leave you short of feed for the next 8 months.

Late dry season fires

Late fires, occurring when the fuel is extremely dry and the wind strong, are hot and destructive. They can be extensive, on a front tens of kilometres wide, devouring all the grass. These late fires may be ignited naturally by lightning in dry storms or be deliberately lit.

Fast-moving fires have little impact on the dormant grass plants, but will control or kill woody regrowth and weeds. This may be useful in grazing land where woody vegetation is increasing, or highly undesirable in areas with, for example, cypress pine forests.

Moreover, late fires can be difficult to keep under control. At this time of year, the direction of the prevailing wind is fickle; a steady south-east trade wind can veer 180 degrees to a north-wester overnight making prepared fire-breaks ineffective.

Early wet season fires (after the first rains)

Burning at this time removes old rank leaf, but may not do much damage to even small woody plants. There is less risk of fires getting out of control, for example in old spinifex or Mitchell grass, but post-fire management is very important.

Mid-wet season fires

Least damage is done to the sward when the grasses are dormant; most damage is done when they are growing actively or, for annuals, when they are seeding. This knowledge can be used to alter the type of grassland in areas dominated by annual sorghum.

Annual sorghum comes back from seed each year; if there has been no fire in the previous dry season, a mid-wet season burn will destroy the seed in the seedhead before it drops. In the next wet season, the stands of annual sorghum will be thinned, allowing more desirable grasses to invade (if a source of seed is present).

However, suitable dry spells may be few and far between, so decisions about burning in the mid-season have to be opportunistic.

Can I integrate early and late season fires?

One way to safely use late hot fires to control woody regrowth is to burn firebreaks early in the dry season around the paddock or area to be cleaned up. The central area is burned for maximum intensity on a hot dry day.

This still needs careful preparation and sufficient men and equipment on the land.

What about fires on black soil pastures?

Traditionally, pastures on black soil have not been burned deliberately. Mitchell grass and bluegrass pastures were once almost treeless, and the grass is considered too valuable. However, there are times when a fire can be beneficial.

Burning at the end of the dry season (after a previous good wet) will remove old blackened leaf unattractive to stock. Parts of a paddock that are far from water points can be burned to encourage stock to use them.

Burned Mitchell grass pastures recover well within two years (unless a poor season follows), although there may be more annual grasses between the clumps in the first year.

Tradition may not always be the best guide to the future. Gutta-percha, whitewood, prickly acacia, parkinsonia and prickly mimosa have invaded some once treeless black soil plains and are spreading. In parts of the NT, native species such as rosewood and bauhinia, are increasing under less frequent fires.

Annual sorghum pastures (above and below) are kept clear by frequent hot fires.

Lack of fire has allowed gutta-percha to take over this bluegrass plain.

Two fires cleaned up this black soil paddock.

There will be no regeneration next year if you burn poor annual grasses

What about burning spinifex?

In lower rainfall areas, burning old stands of spinifex late in the season can kill the hummocks, which then recover from seed in the soil. In wetter areas, the burnt hummocks may resprout. Seedlings should be allowed to grow to a height of 15 cm before grazing otherwise they can be uprooted by grazing stock.

Early-season burning curly or soft spinifex will get rid of much of the rank old material. Regrowth of soft spinifex provides nutritious feed for at least one season.

However, you will need a strong wind and good leaf fall on the ground for a fire to spread between hummocks or to control stands of wattles. Spinifex can be burned every 4–6 years depending on rainfall.

Is burning good for all pastures?

On some soil types with pastures in poor condition, fire can have an adverse effect. For example, the light fragile red limestone soils in poor condition with annual grasses should not be burned. If the seed of these annual grasses is destroyed, there will be no new grass the next year, and bare areas and scalds will spread. Similarly pasture dominated by annual Flinders grass should not be burned.

Too frequent burning and too heavy grazing of any pasture after a fire can result in the decline of the 3P species.

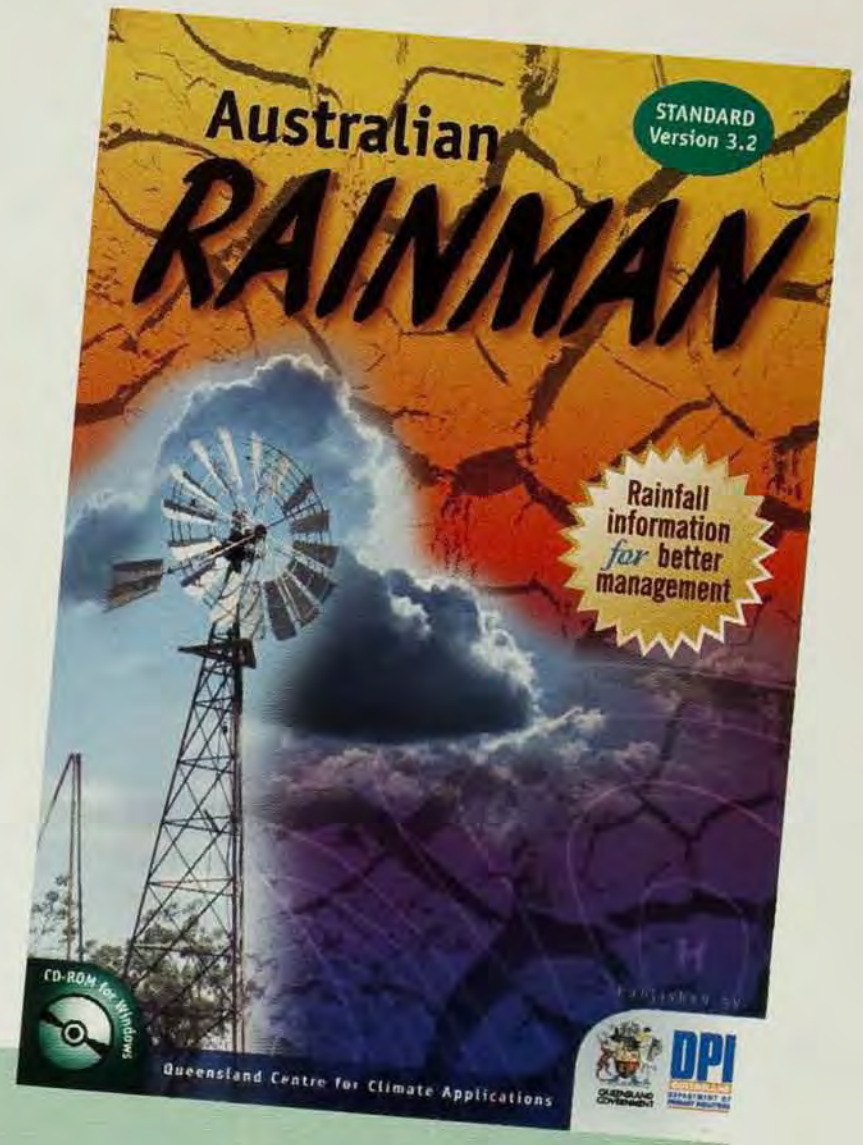
The hot fires of dense spinifex will reduce stands of wattles.

What if it has not rained?

Monsoonal rainfall, once it starts, is reasonably reliable, but there is still considerable variation in the amount of rainfall between years (see figure on page 7), especially in the month when the wet starts.

If the rains have not arrived by January, do not burn because this could leave you short of feed.

Check whether the SOI has any relationship with rainfall in November–December in your district. If it gives you extra skill in forecasting the coming season, you can make more informed decisions.



What's the SOI this month?

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

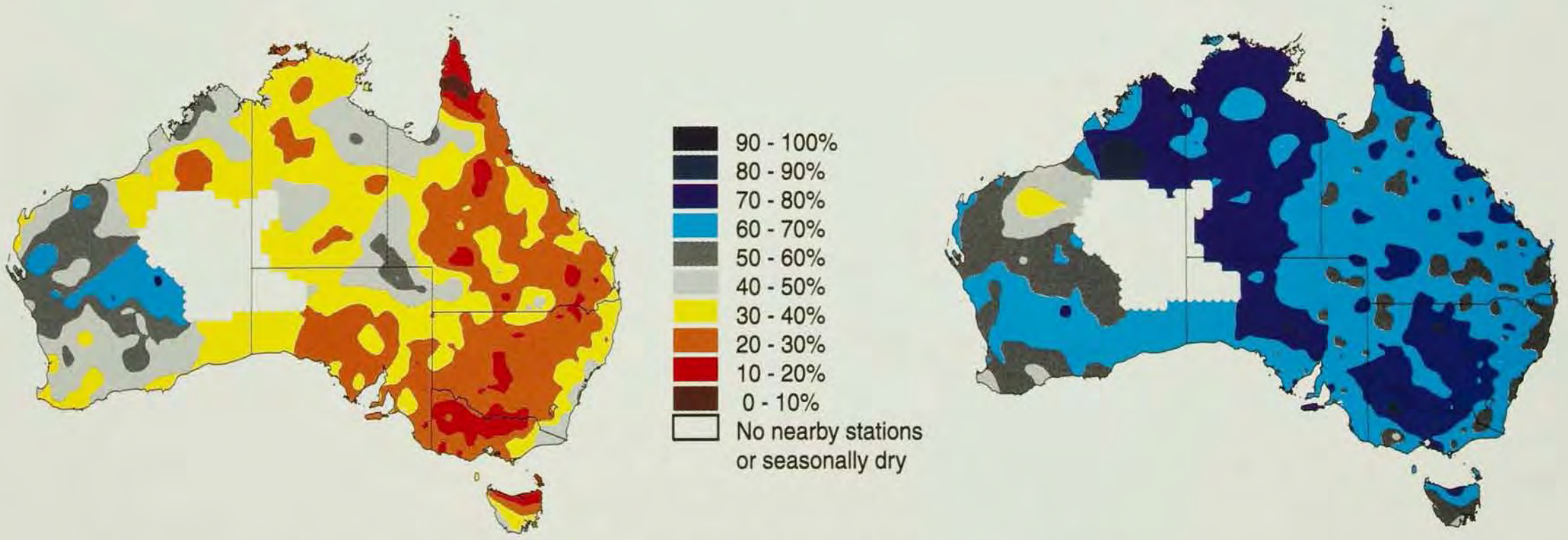
From any state, you can check the latest values for the SOI by phoning the Queensland DPI Hotline on (07) 389 69602 or the Fax Hotline on 1902 935 301. A recorded message gives the updated value on the first and fifteenth day of each month, and a comment on the implications for the coming season.

Other sources of information through the Internet include :

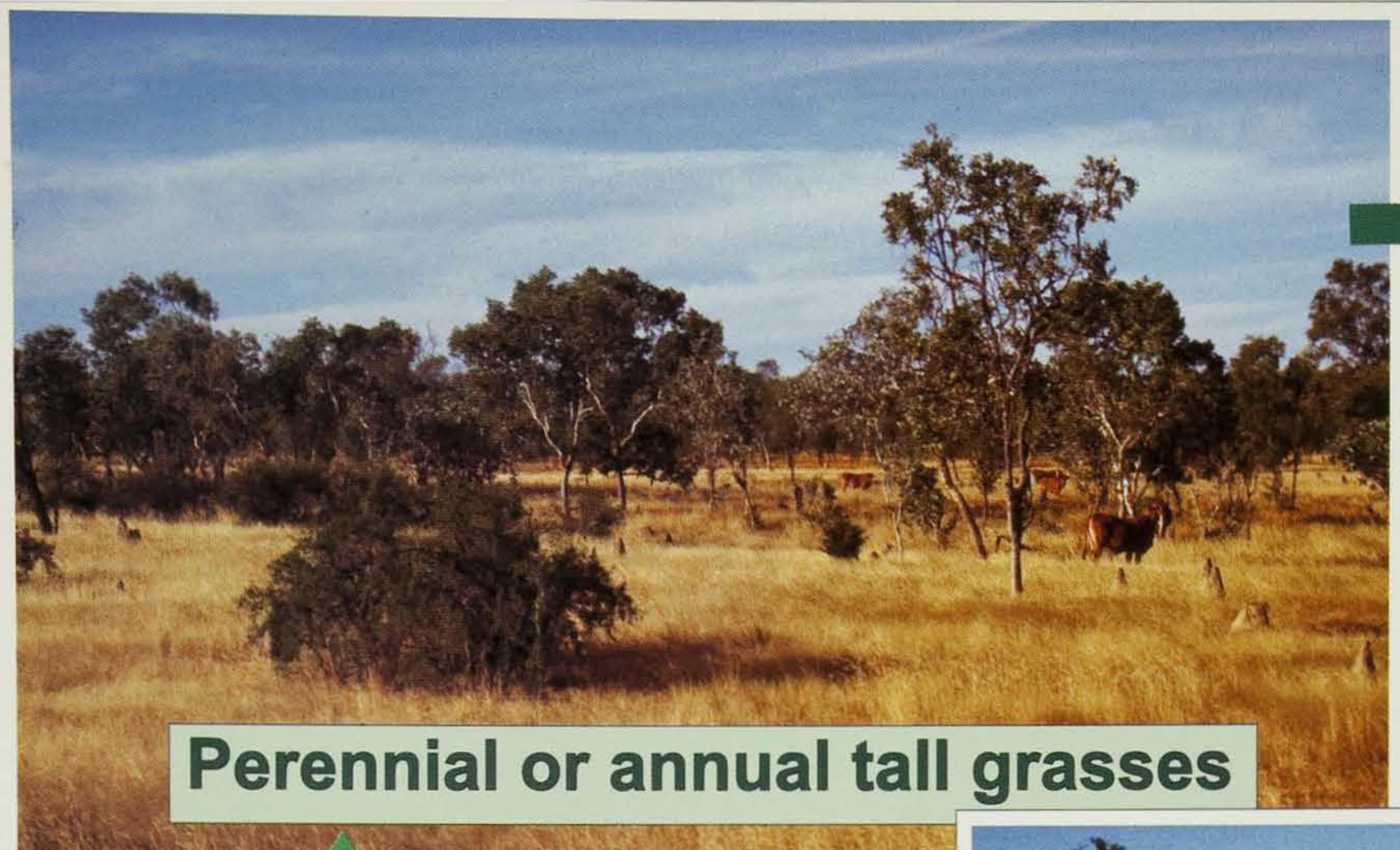
The Long Paddock site at: http://www.dnr.qld.gov.au/longpdk/

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

The AUSTRALIAN RAINMAN decision support program can show you whether the SOI or the sea surface temperatures of the Indian Ocean can provide any extra skill in forecasting rainfall over the coming season—for nearly 4000 locations in Australia.



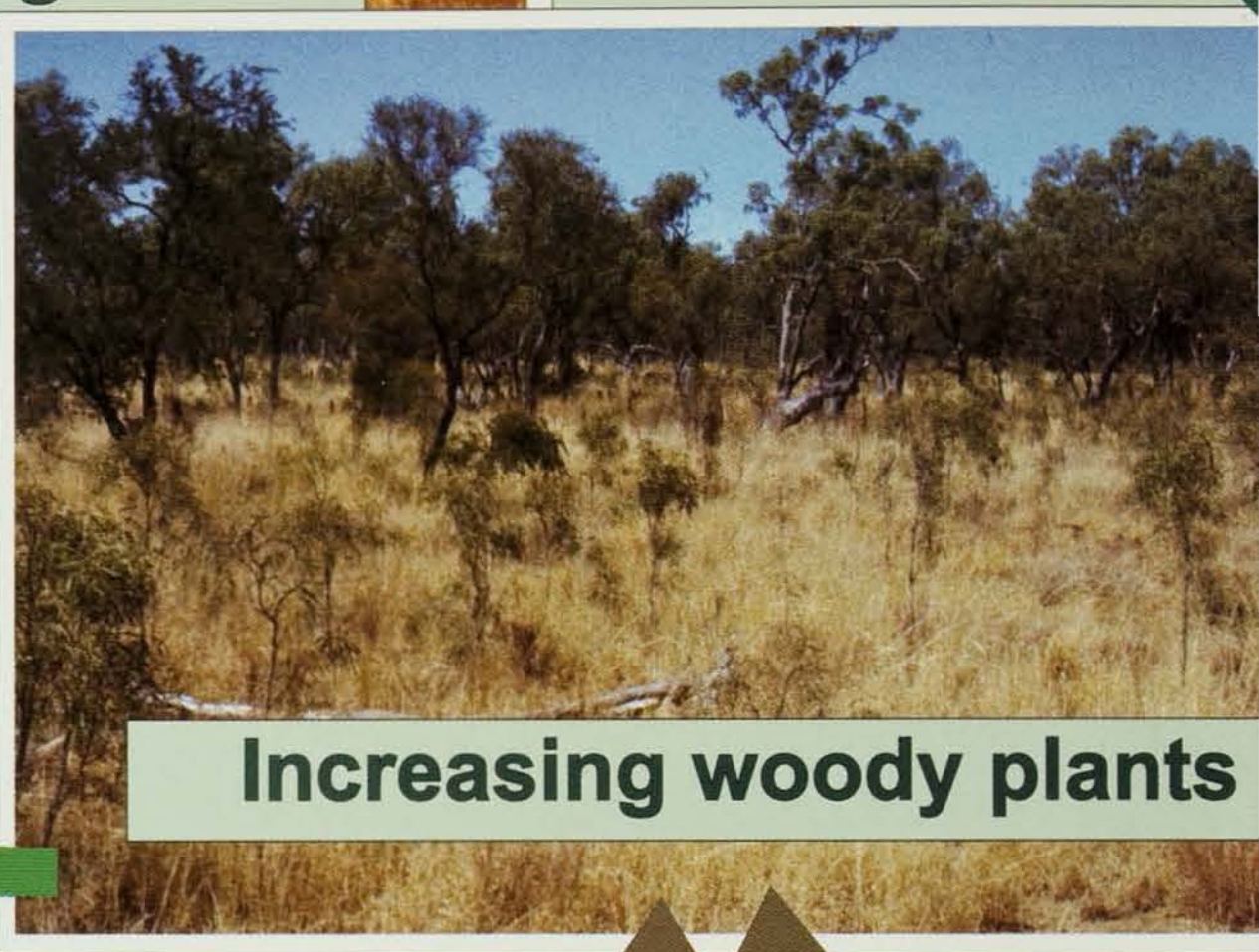
Chance of exceeding median rainfall from September to November when the SOI has been in a negative (left) or positive (right) phase over July–August.



Perennial or annual tall grasses

Grazing, no fire

Spelling
light grazing
fire



Increasing woody plants

Mechanical clearing,

The state of a tall-grass pasture

depends on past seasons
and on your management:

- stocking rate
- fire
- spelling

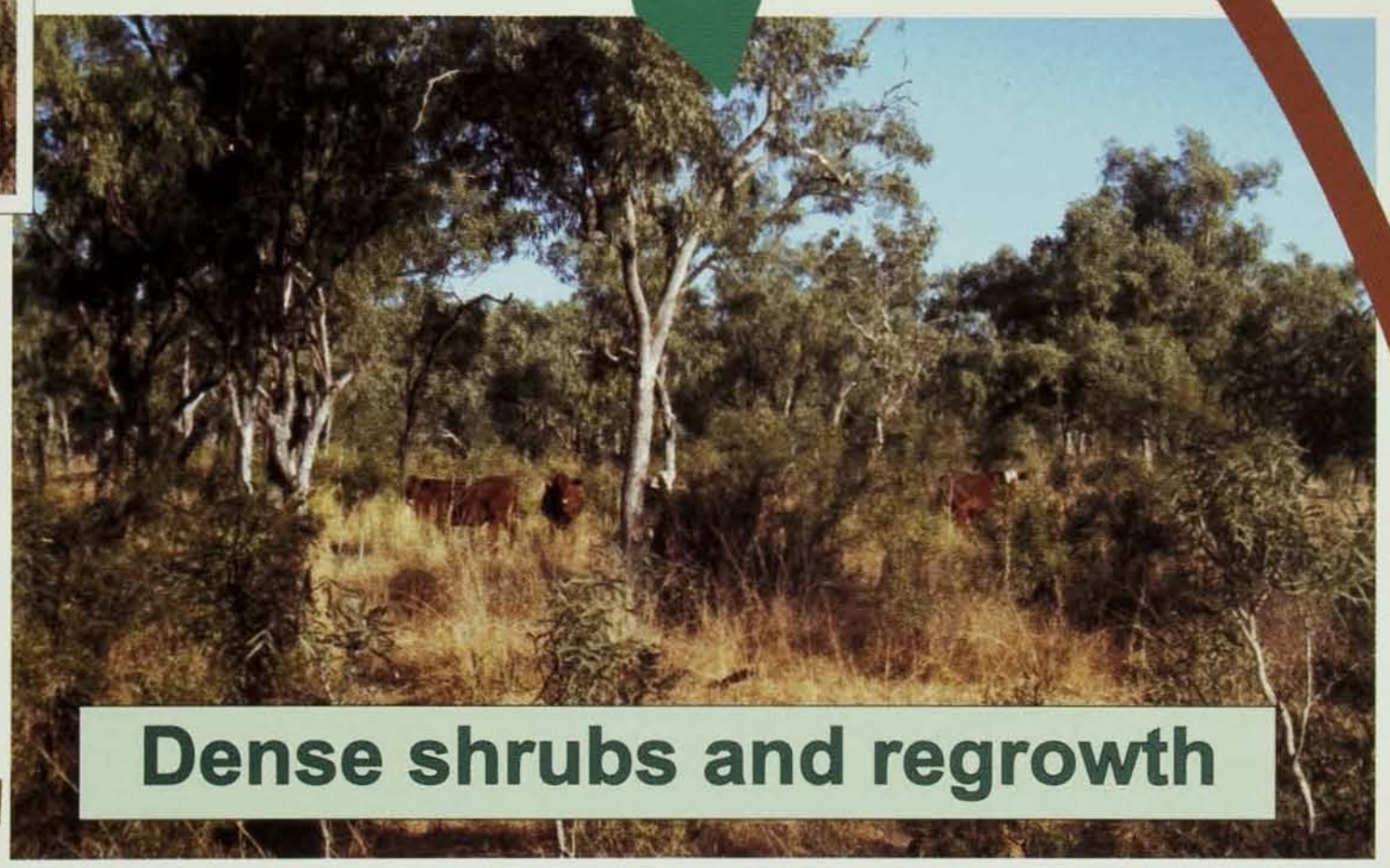
Good

going

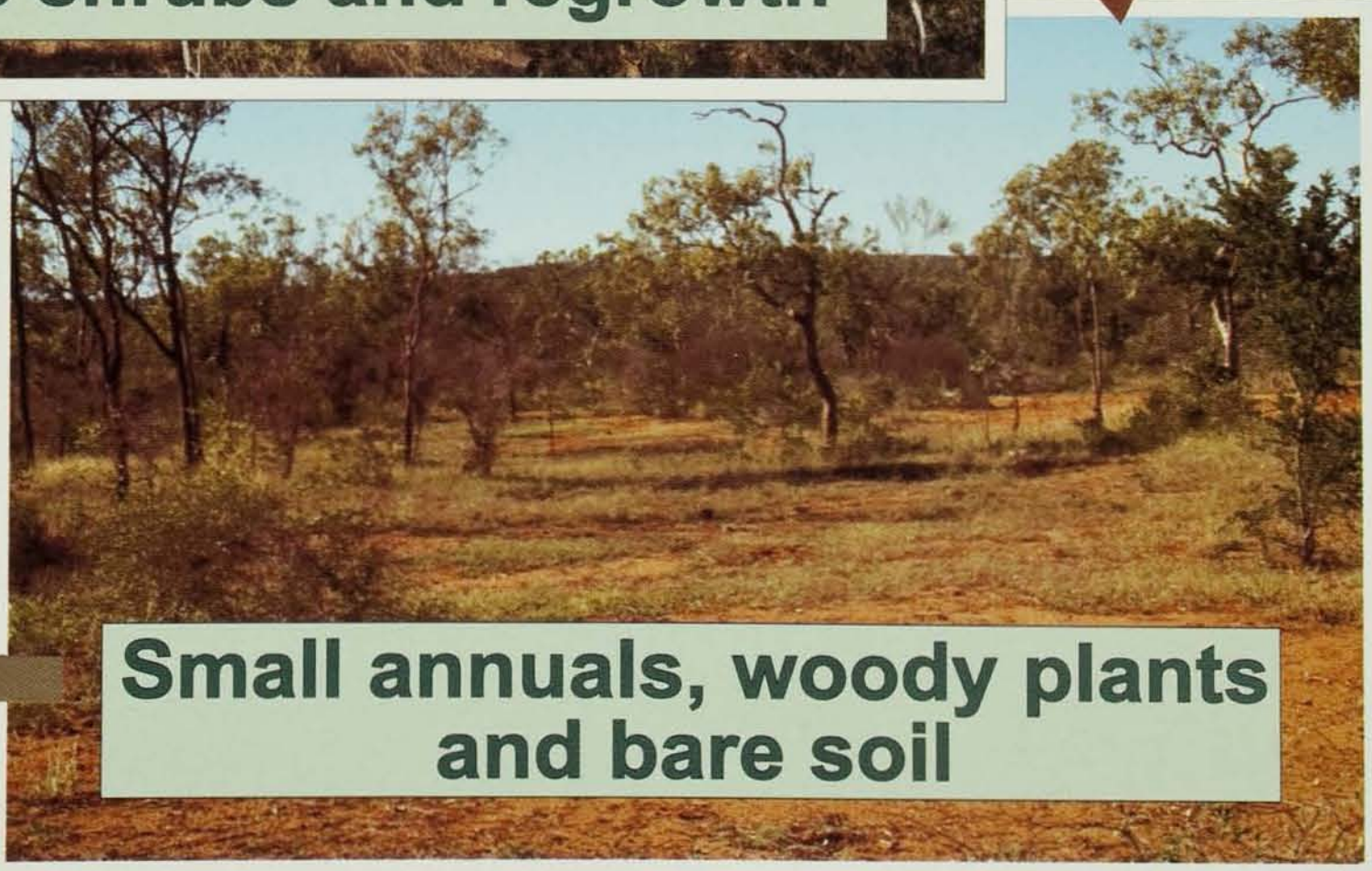
gone

Heavy grazing, no fire

Grazing, no fire



Dense shrubs and regrowth



Small annuals, woody plants and bare soil

erbicide

You need about 2000 kg/ha of fuel for a hot fire.

A hot fire will damage woody saplings to 2 metres height.

The mosaic of early cool fires helps to maintain biodiversity and to reduce the chance of wild fires.

How much fuel is needed to control regrowth?

A hot fire needs at least 2000 kg of dry matter if it is to damage woody saplings up to 2 metres in height, or to kill seedlings in their first year. The larger the woody plant, the more fuel is needed.

Pasture growth in an average year ranges from about 1200 kg/ha on the lightest country to 2500 on Mitchell grass. Without fire or grazing, standing fuel can accumulate to more than 4 tonnes/ha over a number of years, although this is often limited by the high rate of decomposition during the wet season.

Use a head-fire or a back-fire?

A head fire (travelling with the wind) is more intense but of shorter duration than a back fire (against the wind). Head fires do more damage to woody plants and less damage to the grass.

Back fires are more slow moving and concentrate heat close to the ground for longer. This may damage some grass plants.

What if I have sown legumes in the paddock?

Once the legumes have been allowed to set seed, they will re-establish from seed after a fire. Fire can be used to encourage grasses in a legume-dominant pasture.

Allow legumes to seed well before you burn.

What about burning part of the paddock?

You should burn at least 15–50% of the paddock so that stock will not concentrate on the burnt areas and so weaken the new regrowing grasses. Leave the light fragile country.

If a fire has gone through a small part of a stocked paddock, it could be better to burn off a larger adjacent area.

Partial 'mosaic' burns can lessen the risk of wild-fires by breaking up continuous stands of fuel.

Fire can be used to even up patchy grazing by encouraging stock into the burnt areas.

When can I restock after burning?

Perennial grass plants are susceptible to grazing immediately after a fire (or drought) when trying to grow from new tiller buds.

If possible, keep stock off newly burnt pasture until the grass is over 15 cm high.

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 had to have had large healthy plants the roots of which maintain the soil structure and its ability to infiltrate water.

What nutrients are lost in a fire?

Plant nutrients that are released as gases are lost to the atmosphere. These are mainly nitrogen and sulphur—smoke stings your eyes because of the ammonia present. Potash remains unchanged, but some phosphorus can be vaporised with a very hot fire.

Some nutrients lost in smoke may return to another part of the property as ash, and you may get someone else's sulphur when sulphur dioxide gas dissolves in raindrops.

The levels of nitrogen, and sulphur, in dead leaf and stem are very low (0.5–0.7% N and less than 0.05% S), so burning 1500 kg of dry matter per hectare will lose less than 10 kg of nitrogen. This is small compared to the 3–6 tonnes of total nitrogen in each hectare of soil, some of which is mineralised during each dry season. Equivalent amounts of nitrogen can be replaced by nitrogen-fixing native legumes and by bacteria and fungi in the soil.

What about greenhouse gases?

Most of the dead grass will be burned to form carbon dioxide—a greenhouse gas. However, dead grass would decay to carbon dioxide over the next wet seasons or be consumed by termites which also produce carbon dioxide—and methane. Thus, burning merely changes the speed of oxidation.

Under a stable grazing system, an equivalent amount of carbon dioxide will be incorporated into new vegetation in the next year, so there is no net change in carbon dioxide emission.

A vigorous pasture will lock up much more carbon than a degraded pasture, part in the tops, but much more in the roots. Good native pasture will hold several tonnes of carbon per hectare in the soil.

Healthy pastures reduce atmospheric CO_2.

If fires are so useful, why do we 'declare' as noxious some grasses that encourage fire?

The NT government departments have 'declared' some grasses as undesirable species because they can build up high fuel loads and so carry very hot fires. Both gamba grass and mission grass are palatable when green but mature with heavy seed stems. Without heavy grazing,

Allow grasses to recover to 15 cm height before grazing.

The soil under a pasture with enough grass to burn is in much better condition than that under an overgrazed pasture.

Water vapour from a fire condenses on smoke particles in the cool evening air.

they form a serious fire danger, especially in rural residential areas.

Mission grass is also considered undesirable because it can colonise new areas rapidly from wind-blown seed. This stand of mission grass can alter the natural vegetation through very hot fires which can destroy habitats of native birds and animals.

Heavy fuel loads of mission grass create very hot fires.

Smoke in the atmosphere creates spectacular sunsets in the Gulf country at the end of the dry season.

Clearing or thinning trees

Grasslands in the north range from treeless black soil plains to thick woodland of eucalypt and paperbark.

Stands of mature eucalypts are not as dense as they appear from an oblique view, and still allow good growth of grass.

Trees would be expected to compete with grass for water, with competition greatest in low rainfall areas and on shallow infertile soils. However, during the intense monsoonal wets, there is usually enough moisture for both grass and trees while, during the intense dry seasons, there is precious little for either.

Despite this, investigations in the VRD and at Katherine have shown short-term increases in grass growth of 30–50% when stands of trees have been killed experimentally.

This is **not** to suggest that you should clear trees, rather that you should realise the adverse effects of a thickening stand of regrowth.

Think very carefully before clearing any mature trees. Besides the landcare considerations, any potential benefit will be offset by the cost of controlling regrowth.

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.

Almost half of the total population of eucalypts or paperbarks 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 saplings start to grow and seedlings establish. At the same time, suppressed shrubs start growing.

If the soil has been disturbed by pulling, seed of other species may germinate. Seeds of conkerberry or currant bush may have been lying in the soil, while seeds of exotic species such as rubbervine can blow in from frontage country.

Do trees provide any benefit to grazing stock?

Animal production may be slightly higher under a light canopy in higher rainfall districts where there is less competition for water.

Woodlands of mature trees are fairly open and permit good grass growth.

Tree clearing is not generally recommended in the north for ecological and economic reasons.

Any clearing should be on a small scale and for a definite purpose.

A few years after indiscriminate pulling and regrowth is a worse problem than the original stand.

Even Brahman stock appreciate shade from the summer sun.

If you can burn every few years, your stocking rate is about right.

Buffel grass thriving on nutrients recycled by deep-rooting trees.

Potential problems—whitewood saplings.

Shaded green grass may be more digestible, and stock suffer less heat stress in summer. Even Brahman-cross cattle seek shade on treeless plains during summer.

Organic matter is higher under the tree canopy and some plant nutrients may be cycled from greater soil depth by the tree roots. This effect can be seen in naturalised buffel grass under eucalypts in the red soils of the Mt Isa Highlands. The overall effect of nutrient cycling on pasture growth is usually offset by the competition for moisture.

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 keep saplings up to 2 metres tall under control by destroying the top growth.

Fire should become an integral part of managing your grazing especially in areas prone to thickening of woody species.

What are the other methods of control?

Quarantine may prevent introduction of seed.

Eucalypt saplings can grow out of reach of fire after about 3 years, become small trees in about 10 years, and mature trees after 20 years. If the regrowth gets away from you, the young trees and shrubs will probably have to be killed in some other way besides fire—all will involve major expense.

Departments in each state or territory can provide advice. In Queensland, the DPI computer program *Woody Weed Adviser* and DNR Pestfacts notes can advise on the best chemicals and most practical methods for controlling various woody weeds.

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 against new invasions of parkinsonia and prickly acacia.

What are the potential weeds to watch out for?

The main woody weeds to beware of on black soils include prickly acacia, parkinsonia, mimosa bush, mesquite, whitewood (*Atalaya hemiglauca*) and gutta-percha. Other weeds include rubbervine, belly-ache bush (*Jatropha gossypiifolia*) and rubber bush (*Calotropis procera*).

Are some of these potential weeds useful?

Some managers regard prickly acacia and mimosa as useful top feed for the dry season. A few plants may be useful for shade and feed, but it is often difficult to prevent 'a few' becoming an infestation.

Rubber bush is also often eaten by stock during the dry season in the north, as is whitewood—apparently without harmful effects although it is often regarded as poisonous.

Trees aren't my problem, rubbervine is!

Rubbervine has become one of the most serious weeds in northern Queensland, having invaded and taken over much of the best frontage country, and has spread out along smaller watercourses and open country.

An introduced leaf rust will defoliate the vine and so weaken it. Individual plants can be attacked with a basal bark spray, but fire is the best broad-scale control in open pasture.

To prevent rubbervine entering the NT, there is an eighty kilometre quarantine zone inside the Queensland border.

What is the ecological approach to weed control?

The ecological approach is to periodically burn and to minimise bare ground by keeping a healthy vigorous pasture. A fire every few years will keep rubbervine under control.

Are there controls on tree clearing?

In Queensland, tree clearing must be carried out in accordance with an approved tree management plan under the guidelines of the Lands Act.

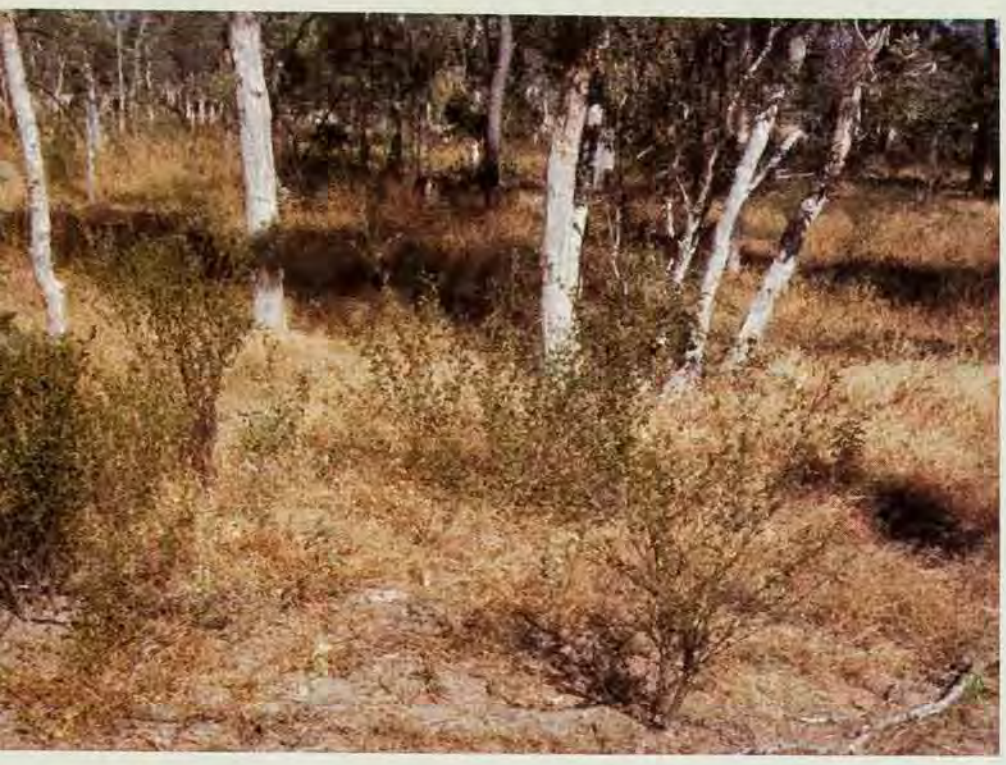
Woody weed control does not need a government-approved plan, but should obviously be part of property management plan. For example, it is pointless killing weeds in one area until the source of seed further up the watershed is cleaned up.

Belly-ache bush, seen here in the NT, has spread over large areas of north Queensland.

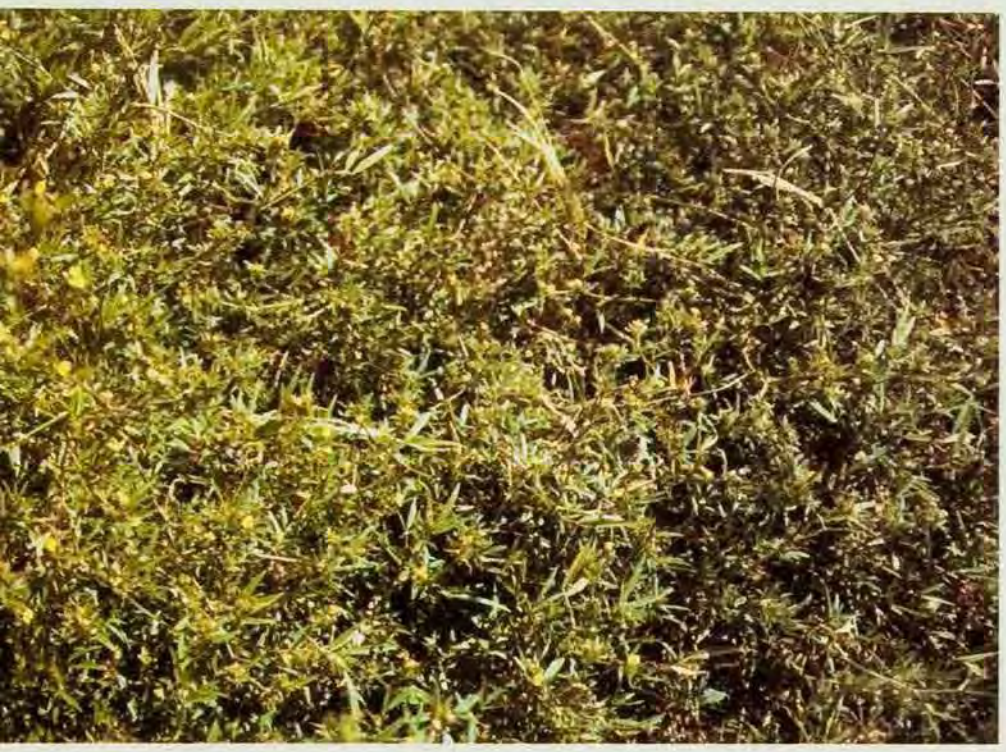
Prickly mimosa—a native that can get out of control.

Rubber vine is a major pest in Queensland; these vines have been defoliated by an introduced leaf rust.

Parkinsonia thrives in dry conditions.



Stylos (Seca above, Verano below) are the hardiest forage legumes—for the lighter soils.



The condition of your stock is not necessarily a good guide to the condition of your pasture.

Stylos can allow higher stocking rates, with the resultant loss of 3P grasses.

Improving native pastures

Most native pastures are moderately productive when managed well; some, such as Mitchell grass, provide as good feed as any other species under the same conditions of soil and climate. The nutritive value of a grass depends greatly on the soil in which it grows.

On most northern soils, young palatable native grass is good feed for only 4-6 weeks after the start of the wet—until the plant runs out of nitrogen and phosphorus because of the infertile soil.

The concentration of nitrogen in the plant 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. Even green kangaroo grass may not provide enough protein or minerals for cattle to grow well. Quality begins to drop further once flowering is initiated.

Quality of grazing can be improved and extended into autumn if legumes can be sown into the existing pasture.

What are the main benefits from sowing legumes?

The animals benefit through improved diet from higher levels of protein and minerals, and from the better digestibility of the legume leaf. Steers can gain an extra 40 kg a year, and stocking rates can be increased.

An area of improved pasture gives the manager more flexibility. Calves can be weaned earlier and different markets may be available.

What is the main risk from sowing legumes?

The main risk is legume dominance and loss of the 3P grasses, but this is usually a result of inappropriate management rather than due to the legume itself.

Many managers increase their stock numbers on the improved paddocks because the animals will still grow well even when the legume becomes dominant. Old trials near Katherine showed that stock could still grow well in improved paddocks when stocking rates were increased 10-20 fold—from the very low base level.

The desirable 3P native grasses cannot stand these high grazing pressures; they are soon eliminated and replaced by unpalatable perennial or annual grasses, or an almost pure stand of legume. If the legumes increase soil nitrogen, broad-leaved weeds, such as hyptis (*Hyptis sauveolens*) and *Sida*, invade.

As stock prefer to eat grass in the early wet season (when it is most susceptible to grazing) even moderate stocking can lead to legume dominance if no introduced grass is sown.

Which are the best legumes for my country?

You need well-adapted species that will naturalise and spread over your paddocks; pasture specialists recommend different legumes for different soil types, so seek local advice.

The most widely adapted legumes for the light soils of the north are the Caribbean stylos (Verano and Amiga) and the shrubby stylos (Seca and Siran), with Wynn cassia in the higher rainfall regions.

There are good stands of Verano along the table drains of many roads across the Top End, even as far south as Halls Creek. However, there seems to be little in the adjacent paddocks. This could be because of the better roadside moisture or because cattle have little or no access and hence cannot spread the seed in their dung.

The shrub legume, leucaena, may have a place as a permanent high-quality fodder on specifically managed sites with deeper, more fertile soils, but these must have good drainage during the wet. Leucaena needs special care during establishment, and should be planted, and managed, like the valuable crop that it is.

How useful are the native legumes?

There are many native legumes growing throughout different pastures; a couple are illustrated here, others can be identified using local plant identification books.

The most common species (native glycines, rhynchosia, and desmodiums) are eaten by stock and are probably beneficial. However some may contain alkaloids—Birdsville indigo (*Indigofera linnaei*) can cause Birdsville disease in horses.

Pea bush (*Sesbania cannabina*) is a common annual on black soils in higher rainfall areas; it is unpalatable but fixes nitrogen actively through its root nodules.

Native legumes rarely comprise more than about 10% of the total herbage, but may form a higher proportion of the diet during the late part of the growing season.

Which country should I improve first?

Improve your best country first. 'Better country' for oversowing legumes has soil with a loose surface and at least 4 ppm of available soil phosphorus.

What area should I sow?

Most paddocks are very large. Scattering a few seeds of stylo over thousands of hectares is unlikely to give much visual effect on pasture or stock for many years, and you may feel there is little economic benefit for your dollars.

The annual Verano stylo is common along many roadsides.

Native legumes are common, but many are not very palatable.

Annual pea bush grows well on seasonally waterlogged clays and nodulates vigorously.

A fully prepared pilot area increases the chance of successful establishment and later spread of legumes.

Cattle spread stylo seed in their dung.

Spear-trap gates into an improved block can facilitate mustering.

An alternative system is to sow 'pilot' or 'mother' plots on part of the paddock. Put all your money, seed and effort into a smaller area so that you can see the improvement.

How do I plant a 'pilot' area?

Fence off a corner of a paddock to enclose a few hundred hectares. Clean up any woody weeds and cultivate (with discs or chisel plough) to check the existing native grasses and to provide a better seedbed for both legume and sown grass.

Apply some phosphate fertiliser (5-10 kg/ha P) if the soils are very deficient (below 4-6 ppm).

Sow your chosen legume seed (Verano, Seca, etc) at a good seed rate (2-3 kg/ha) and add 10% by weight of seed of a suitable improved grass, such as Sabi, just before the rains.

Keep stock out until the legumes and sown grasses are well established (that is, for most of that wet season) to allow them to set seed.

Put in stock when the legume seed is set but leave the gate open so that animals can wander back into the main paddock to spread seed in their dung. Although only 30% of the seed in dung is viable, there will be a large amount of seed to spread.

What other advantage does the 'pilot' paddock have?

Stock are always going to prefer to graze the improved area especially if some phosphorus has been applied. Putting in spear-trap gates allows for self-mustering of stock.

How should I sow the legume seed?

Oversowing after a burn generally gives reliable establishment of legumes on soils with a loose surface. Some form of cultivation is needed on hard-setting soils and when sowing an introduced grass.

If planting early (October–November), sow hard seed, but have it scarified if planting after the wet has started.

Do not destock oversown paddocks as grazing will reduce competition from the existing native grasses. This is different from managing a new pasture of legume and introduced grass sown into a cultivated seedbed where the native grasses have been ploughed out.

What about feeding legume seed to stock?

Putting a few kg of seed in molasses-based supplements can be a waste of time. At that time of year, most of it ends in cattle camps when and where seedlings cannot survive. And it's a very slow way of making any improvement.

Do I need fertiliser?

Extensive areas and long transport distances make fertiliser much too expensive to use on a broad scale. However, it is worth applying some phosphorus in pilot plots where the soil phosphorus levels are below 4 ppm.

The hardy legumes may not need fertiliser to establish and survive, but will grow more vigorously and set more seed with it, and so will spread more quickly.

If the soil phosphorus levels are between 4 and 8 ppm, the legumes will grow well and will provide the animals with protein. However, phosphorus levels may still be too low for the animals.

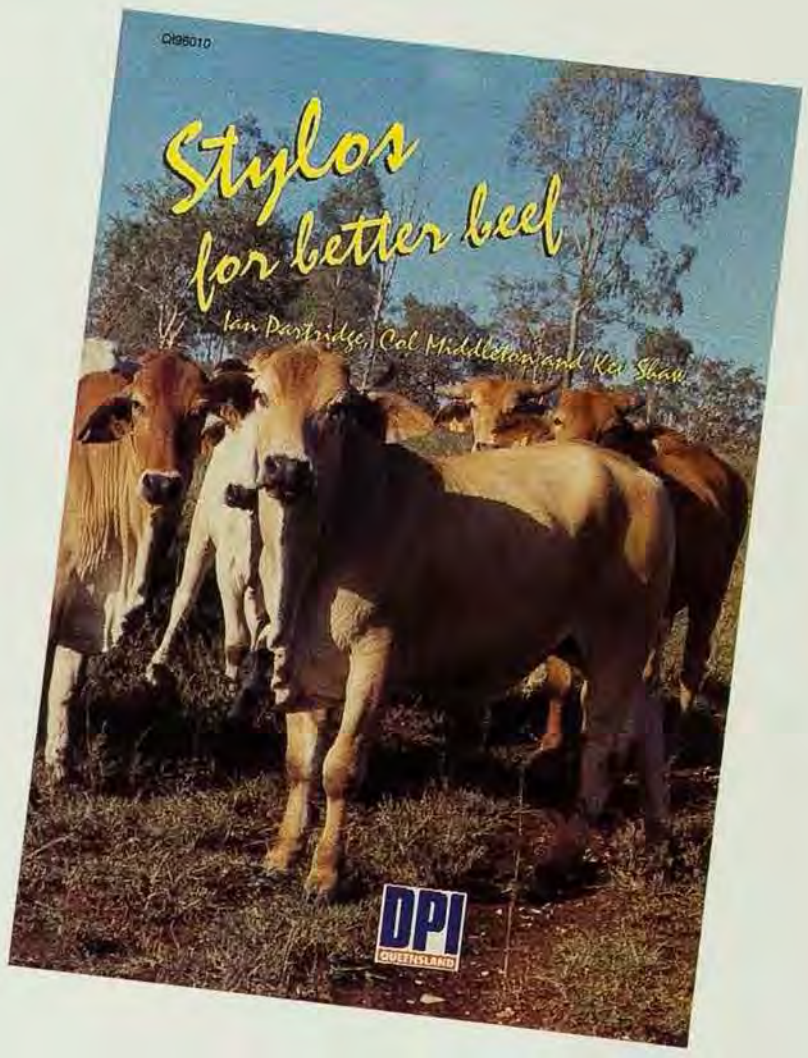
If the soil is above 8 ppm, there is enough phosphorus for both plant and animal.

Steers on a stylo-native grass pasture.

What about feeding phosphate supplement?

Feeding supplement P is the only practical way to supply phosphorus on extensive properties with large paddocks, and is now done routinely on many of those properties.

Phosphorus feeding systems are well described in the QDPI book *Phosphorus nutrition of beef cattle in northern Australia*, or in advisory leaflets from other agricultural departments.



When should supplements be fed?

Cattle on low P soils need extra phosphorus during the wet season when they are growing, and when there is adequate nitrogen in their diet from grass or sown legumes. The supplement is usually left in the paddock throughout the year as it is often impossible to put it out during the wet.

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.

What problems arise from dry season supplements?

Dry season supplements are now part of routine stock management in the region although they may be needed less with early weaning or lower stocking rates.

Dry season supplements allow an animal to increase its intake by 30–40% over the dry season, and so effectively to increase the stocking rate. This could put excessive pressure on the native pasture.

Cattle on P-deficient soils perform well with phosphorus supplement.

Seca stylo can recover from the stem or from seed after a burn.

Leucaena is highly productive, but grows well only on cropping-type soils.

Drought-resistant buffel grass can be planted on better soils.

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 if burnt after early storms.

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 fodder crops?

Forage sorghum can give a great bulk of feed, though generally at the same time as the native pasture. Forages can be grown for special purposes, maybe for baling to feed yarded weaners or other stock. These forages should be planted only on good soils.

(Note that Silk sorghum is prohibited in WA.)

What about fully sown pastures?

Buffel grass has been sown on soils with reasonable levels of phosphorus. It is drought-hardy and persistent but the area has to be cultivated before sowing seed.

A 'pilot' legume plot with its sown grasses becomes a fully sown pasture. Urochloa and buffel grasses are the most commonly planted species, but the recently released Jarra and Strickland digit grass have shown promise on poor country.

Fully sown pastures with improved grasses and legumes are outside the scope of this short book on native pastures, so seek local advice.

A permit is required before exotic pasture species can be planted on pastoral leases in WA.

Should I make hay?

Hay is made in the north from both native and improved pasture.

Native pasture hay for bulk is made from pastures on the black soils—Mitchell/Flinders grass or bluegrass. Yields are high, but cutting and baling over the hummocky ground is hard on machinery.

Purchasers of Mitchell grass hay from the Kimberley region should check on the presence of the fungal bodies that can cause 'black soil blindness' and death of stock.

Good quality hay for weaners and horses is produced by specialised growers from irrigated farming land.

Species used for hay include rhodes grass, forage sorghum, Cavalcade centro and butterfly pea.

Are any other species useful?

Cattle can eat as much as 40% of forbs (non-woody broad-leaved plants) in their diet. These forbs can have higher levels of protein and minerals than the surrounding grass.

One forb introduced as dry season feed is the kapok bush (*Aerva javanica*).

How good is kapok bush?

Kapok bush has high protein levels in its leaves—much higher than the local grasses. It thrives on poor red soils in open pasture along with bottlewashers and spinifex — country too poor to be invaded by buffel. Kapok bush cannot stand much competition from vigorous pasture, but has spread along many disturbed roadsides in the Mt Isa Highlands and can be seen throughout the north.

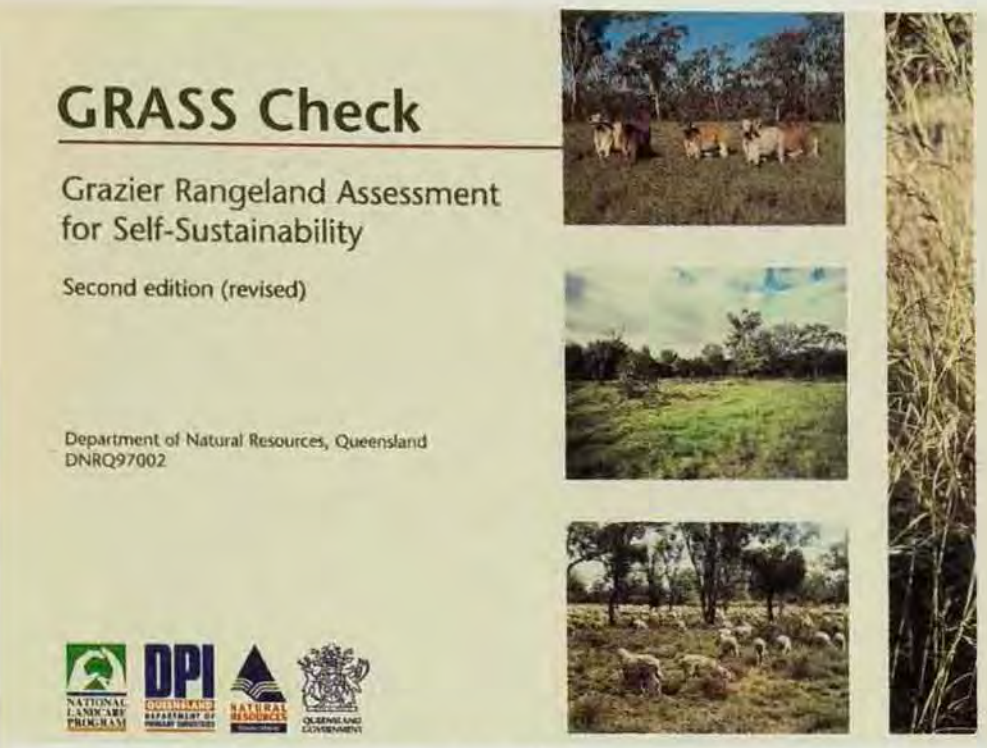
Kapok bush is drought-tolerant and holds its leaf during the dry season. It is not very palatable, but once cattle acquire the taste, they do eat it during the dry.

Kapok bush is unlikley to become an environmental weed because it is not aggressive and cannot stand competition.

Native pasture hay is cut off bluegrass flats.

Kapok bush can provide good quality feed during the dry season.

At the end of a day in the yards...



Grass Check is Queensland's monitoring guide.

Monitoring provides a record so that you can detect whether changes are occurring over the years.

Learning to monitor can be easier in a group.

Grasses are much easier to identify when they have seed heads.

Monitoring pastures

Traditionally, graziers have monitored pastures through the condition of their cattle. Nowadays it is recognised that pastures should be monitored in their own right to obtain early notice of any changes that are occurring.

Monitoring is one of the three basic parts of managing a native pasture.

This book does not tell you how to monitor pastures. The various techniques are described, for example, in a QDPI publication – **Grass Check.**

What is the best way to monitor pastures?

Queensland, Western Australia and the Northern Territory have different policies on the intensity of monitoring done by property managers, although all encourage you to monitor your own pastures.

Agriculture WA reports on the 'condition trend in the rangelands', and encourages managers to monitor their paddocks. The Northern Territory DPIF has a two-tier monitoring system; in Tier 1, the property manager takes photographs of the pasture at selected sites, while in Tier 2, government officers do more detailed work with quadrats.

Monitoring and recording species may seem a little daunting at first, but once you have learned most of the key pasture grasses, it is quite simple—and very interesting as records start to show some changes.

Queensland's Grass Check offers a number of techniques, with varying levels of detail, for looking at the amount of dry herbage in the paddock, at ground cover, at desirable and undesirable species, individual species and at the density of mature or regrowth timber.

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, grass identification is easier because seed heads are present and it also allows you to make decisions on stocking rates based on the amount of grass in the paddock.

You can estimate the amount of feed standing in the paddock either by comparing with the photo-standards shown in this book, or by more direct measurement.

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

Estimating feed in a paddock

The weight of herbage (total dry matter, not wet green leaf) allows you to assess your stocking rates and to get an idea of how much fuel is available to carry a fire. The herbage weight can be measured directly by cutting, drying and weighing or estimated by comparing against photo-standards—photographs of typical pastures where the amount of feed is known.

Photo-standards of tropical tall-grass pastures

– composed of plume sorghum, whitegrass, kangaroo grass, black speargrass

1000 kg/ha

2000 kg/ha

Tall grass pastures

– composed of plume sorghum, whitegrass, kangaroo grass, black speargrass

3000 kg/ha

4500 kg/ha

Recognise the important grasses

Desirable perennial grasses

Black speargrass	*Heteropogon contortus* –
Birdwood buffel	*Cenchrus setiger*
Buffel grass	*Cenchrus ciliaris*
Cloncury buffel	*Cenchrus pennisetiformis*
Desert bluegrass	*Bothriochloa ewartiana* –
Forest bluegrass	*Bothriochloa bladhii* –
Giant speargrass	*Heteropogon triticeus* –
Gulf or curly bluegrass	*Dichanthium fecundum* –
Indian couch	*Bothriochloa pertusa* +
Kangaroo grass	*Themeda triandra* –
Mitchell grass, barley	*Astrebla pectinata*
Mitchell grass, bull	*Astrebla squarrosa*
Mitchell grass, hoop	*Astrebla elymoides*
Plume sorghum	*Sorghum plumosum* +
Sabi grass	*Urochloa mosambicensis* –
Silky browntop	*Eulalia aurea (E. fulva)* – +*
Wild rice	*Oryza australiensis*

Intermediate value grasses (perennials and annuals)

Barbwire grass	*Cymbopogon refractus*
Bottle washer or limestone grass	*Enneapogon polyphyllus* +
Early spring grass	*Eriochloa procera* +
Fire grass	*Schizachyrium* spp.
Flinders grass	*Iseilema* spp.+
Ribbon grass	*Chrysopogon fallax*
Liverseed	*Urochloa panicoides* +
Love grasses	*Eragrostis* species +
Pitted bluegrass	*Bothriochloa decipiens*
Annual sorghum	*Sorghum timorense*
Red natal grass	*Melinis repens (Rhynchelytrum)* +
Rice grass	*Xerochloa imburbis*
Salt water couch	*Sporobolus virginicus*
Spinifex, soft	*Triodia pungens*
Spinifex, curly	*Triodia bitextusa (Plectrachne pungens)*
Spiny mud grass	*Pseudoraphis spinescens*
White grass	*Sehima nervosum*
Wanderrie grass	*Eriachne* spp.
Native millet	*Panicum decompositum* +

Annual and less desirable grasses

Asbestos grass	*Pennisetum basedowii*
Button grass	*Dactyloctenium radulans* +
Desert or Kimberley couch	*Brachyacne convergens* +
Fairy grass	*Sporobolus australaticus* +
Feathertop	*Aristida latifolia*
Five minute grass	*Tripogon loliiformis* +
Leafy nine-awn	*Enneapogon polyphyllus* +
Purple top grass	*Chloris inflata (C. barbata)* +
Mission grass	*Pennisetum polystachyon**

Rat's tail grasses	*Sporobolus* species
Reed or cane grass	*Arundinella nepalensis*
Sedges	*Cyperaceae* +
Slender chloris	*Chloris divaricata* +
Small burr grass	*Tragus australianus* +
Rottboellia grass	*Mnesithea formosa*
Spinifex, hard	*Triodia intermedia*
Pigeon grass	*Setaria apiculata, S. pumila*
Wiregrass	*Aristida* spp.+
Woodland love grass	*Eragrostis sororia* +
Comet grass	*Perotis rara*

+ indicates that this species increases under heavy grazing; – indicates this species decreases under heavy grazing.
* considered an environmental weed because of the hot fires

Other important plants

Native legumes

Birdsville indigo	*Indigofera linnaei*
	Indigofera colutea
Glycines	*Glycine tomentella*
	Glycine tabacina
Rhynchosia	*Rhynchosia minima*
Buffalo clover	*Alysicarpus vaginalis*

Browse herb

Kapok bush	*Aerva javinica*

Broad-leaved weeds indicating heavy grazing

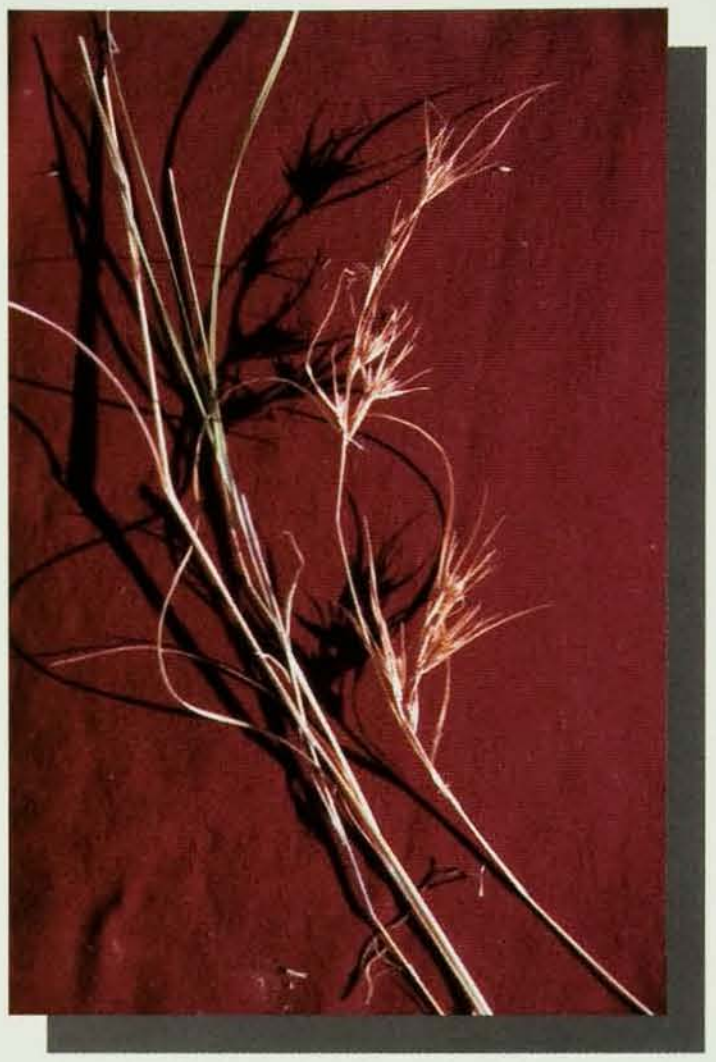
Fruit salad plant	*Pterocaulon redolens*
Pigweed	*Portulaca* spp.
Paddy's lucerne, broom weed	*Sida acuta, S. cordifolia*

Other problem plants

Bellyache bush	*Jatropha gossypiifloia*
Birdsville indigo	*Indigofera linnaei*
Calotrope/rubber bush	*Calotropis procera*
Chinee apple	*Ziziphus mauritiana*
Conkerberry/currant bush	*Carissa lanceolata*
Mimosa bush	*Acacia farnesiana*
Parkinsonia	*Parkinsonia aculeata*
Prickly acacia	*Acacia nilotica*
Rubbervine	*Cryptostegia grandiflora*

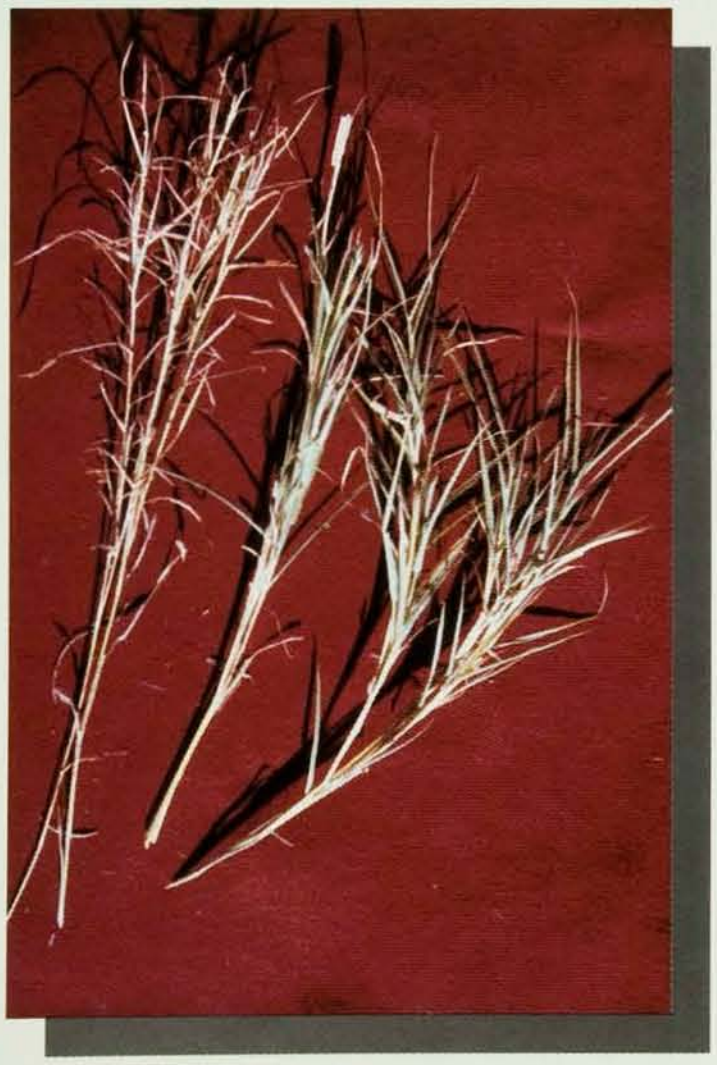
See the book list for plant identification books.

Black speargrass



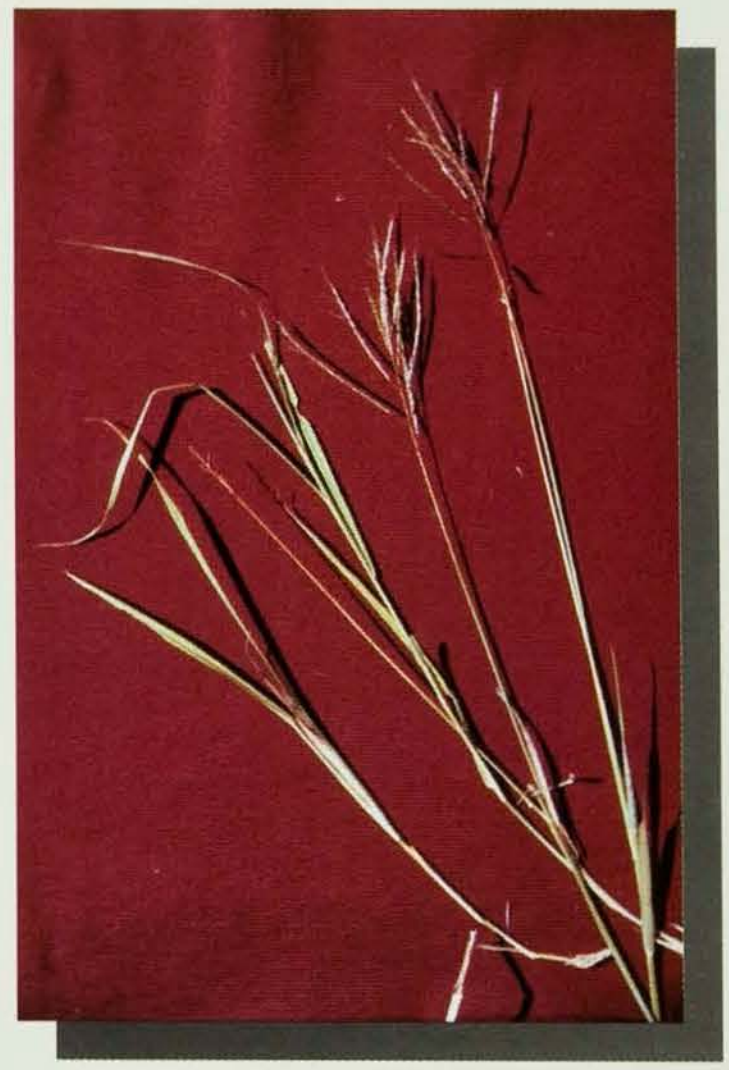
Kangaroo grass

Silky browntop

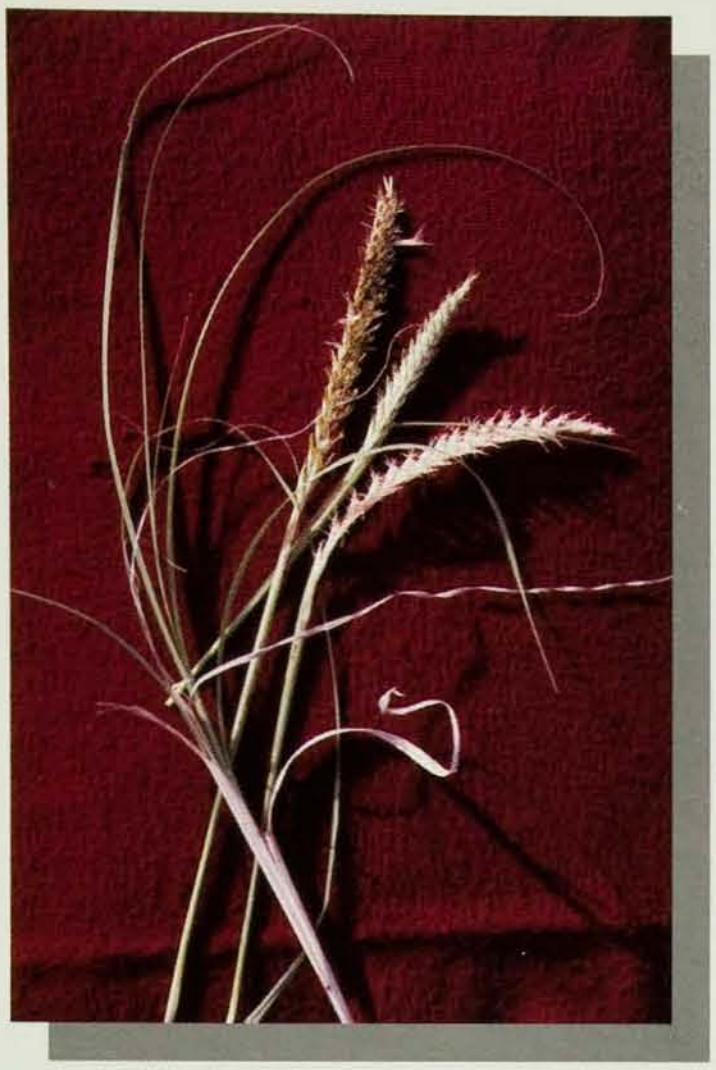


Gulf bluegrass

Desert bluegrass



Indian bluegrass or couch



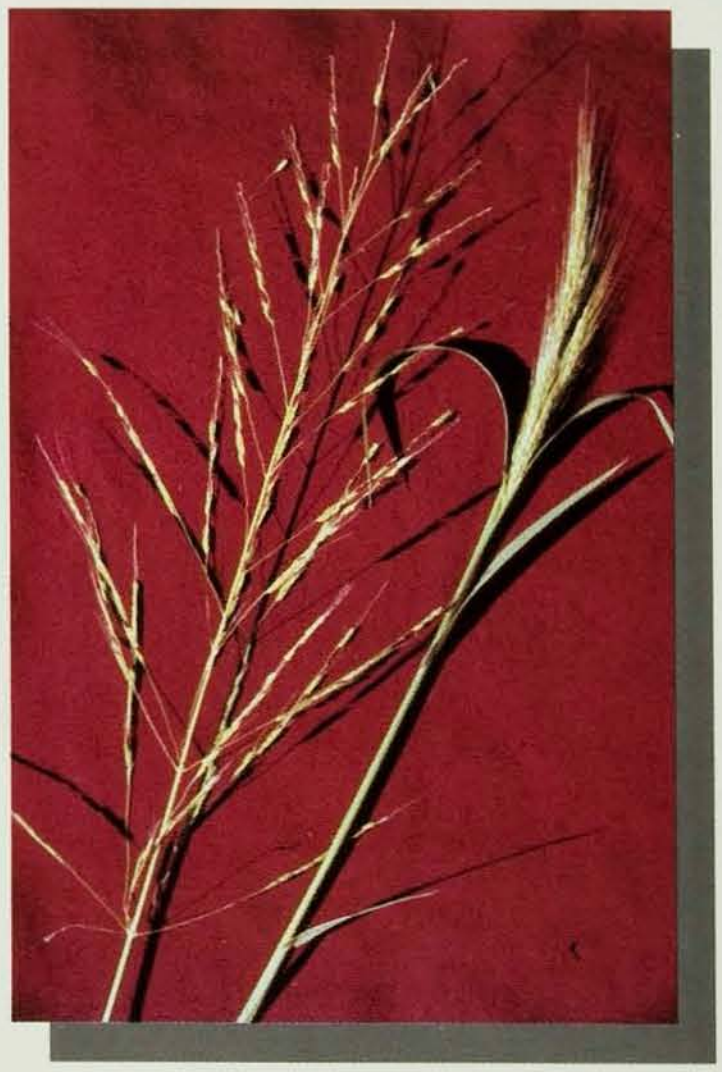
Bull Mitchell

Barley Mitchell

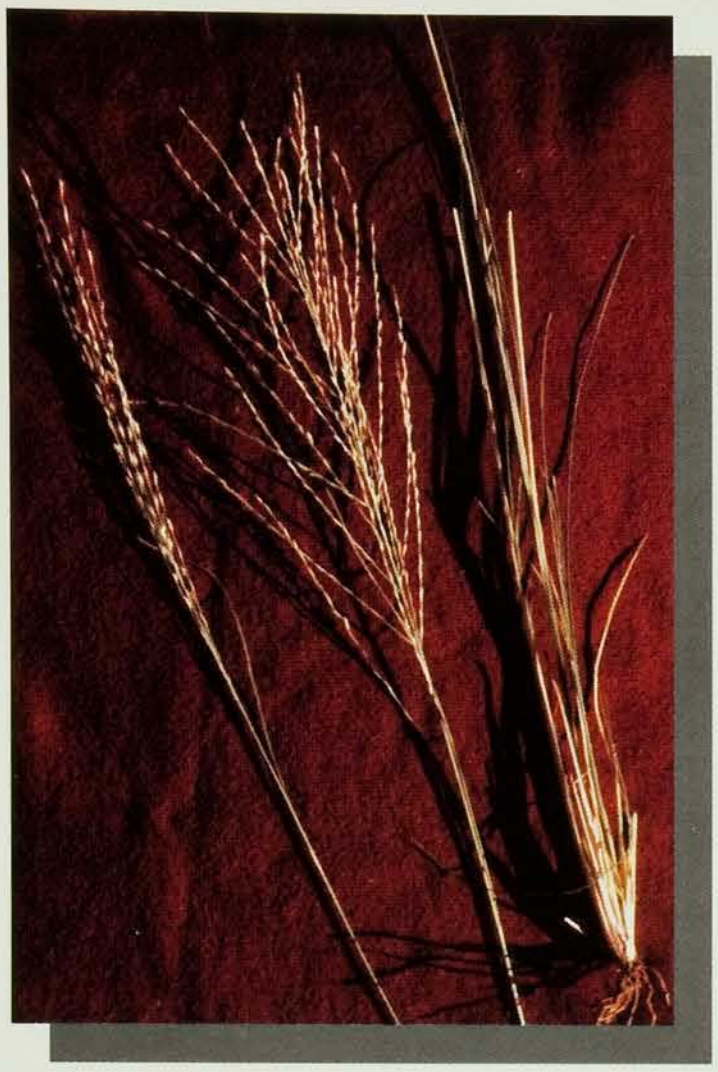
Hoop Mitchell

Plume sorghum

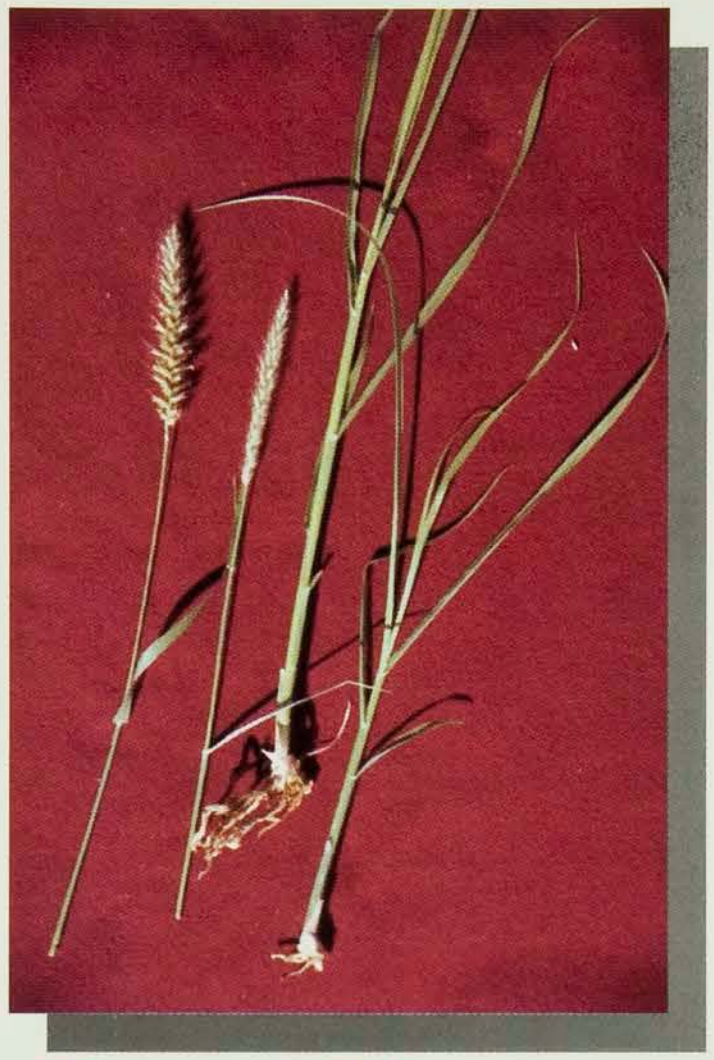
Annual sorghum



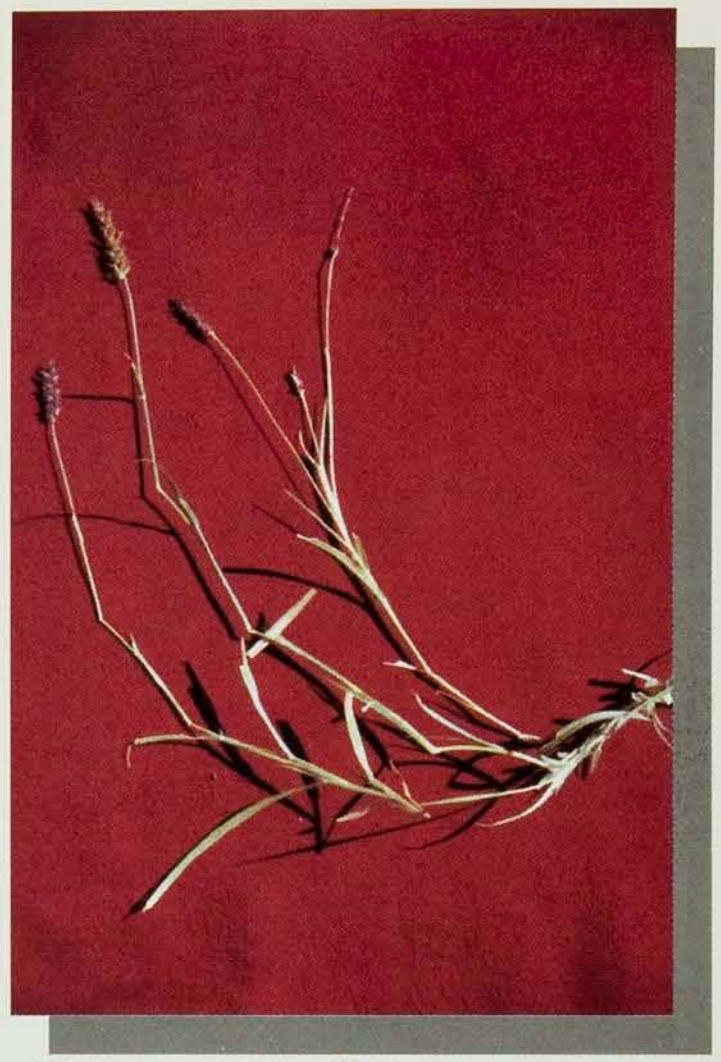
Wild rice



Rice grass



Cloncurry buffel

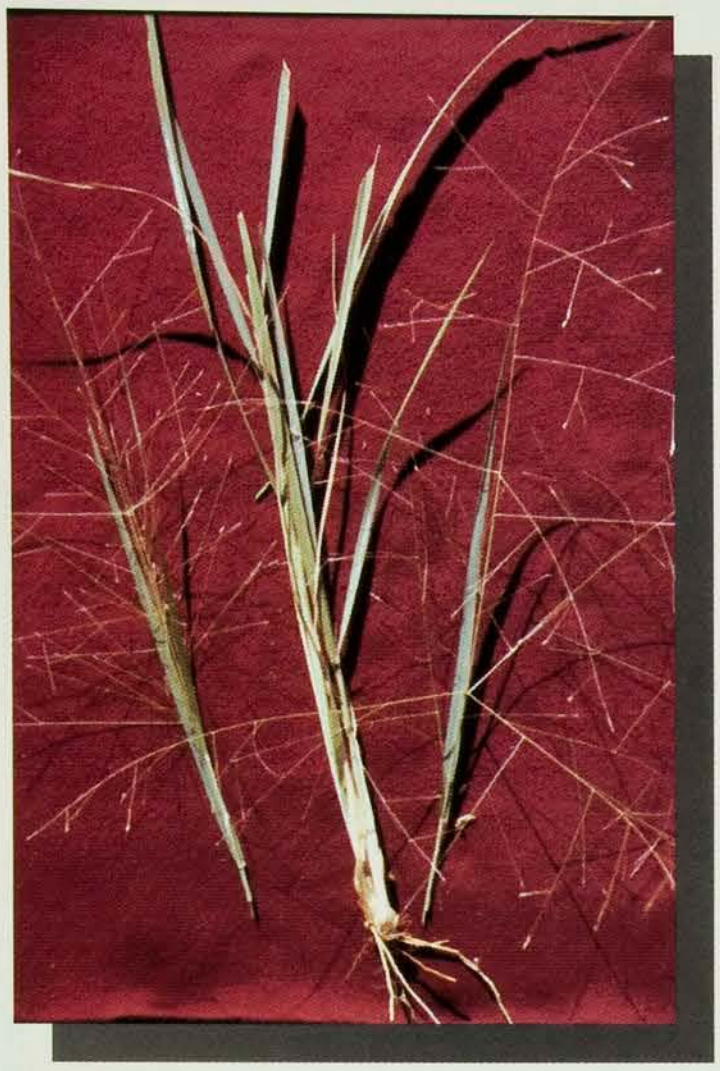


Birdwood buffel

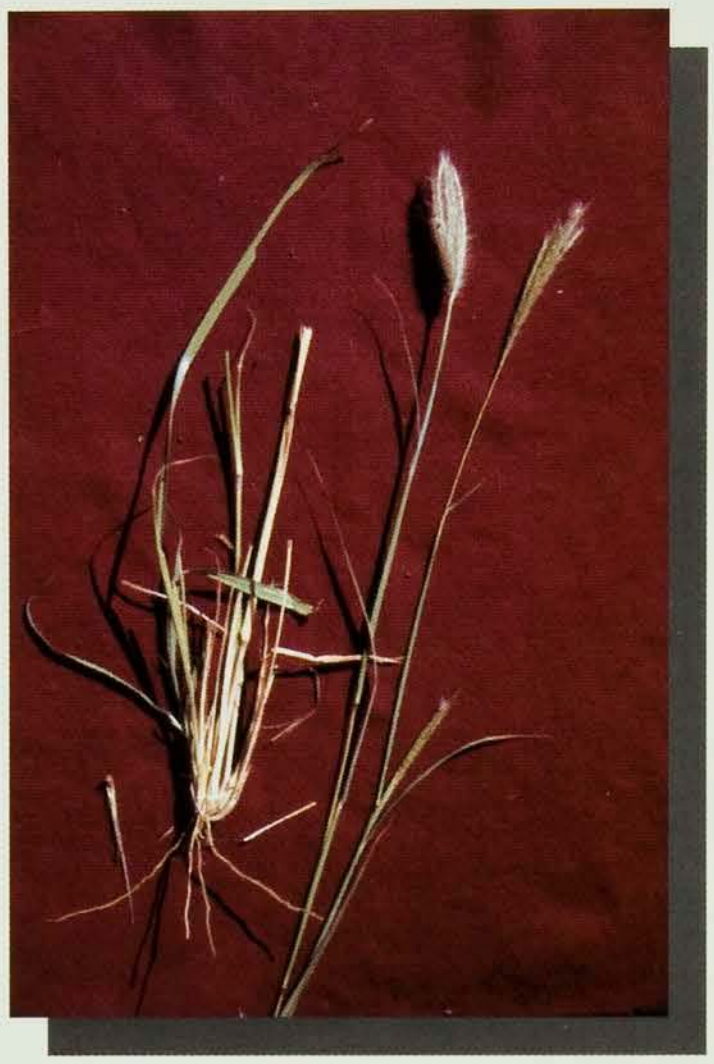
Ribbon or golden beard grass

Flinders grass

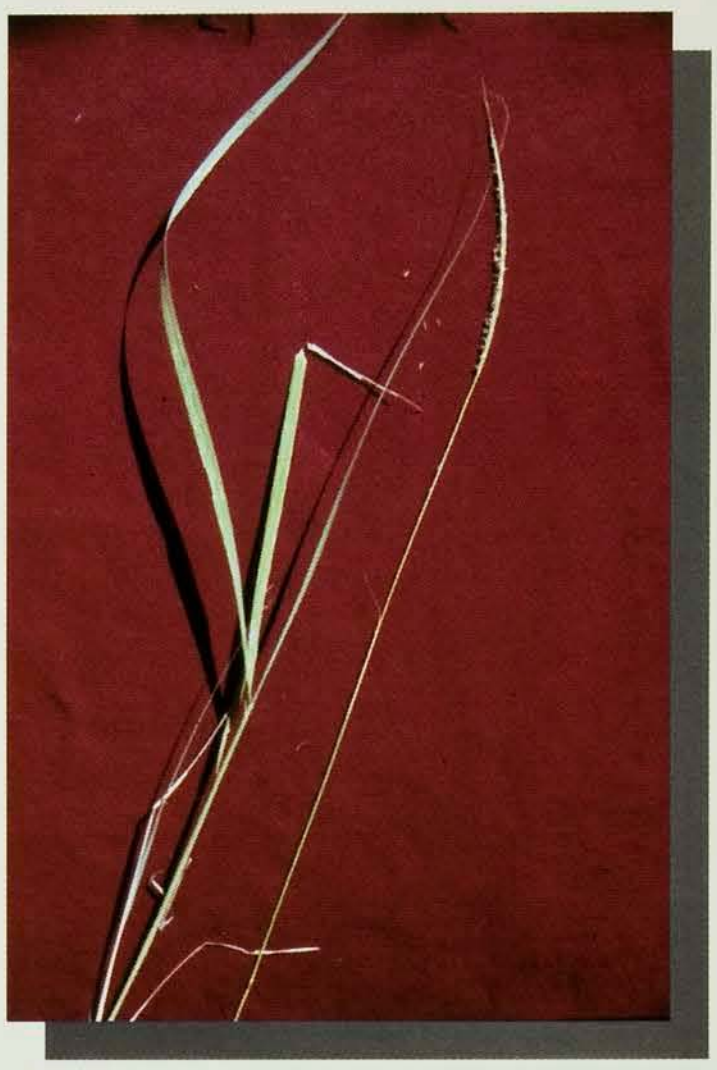
Fire grass



Native millet



Pitted bluegrass



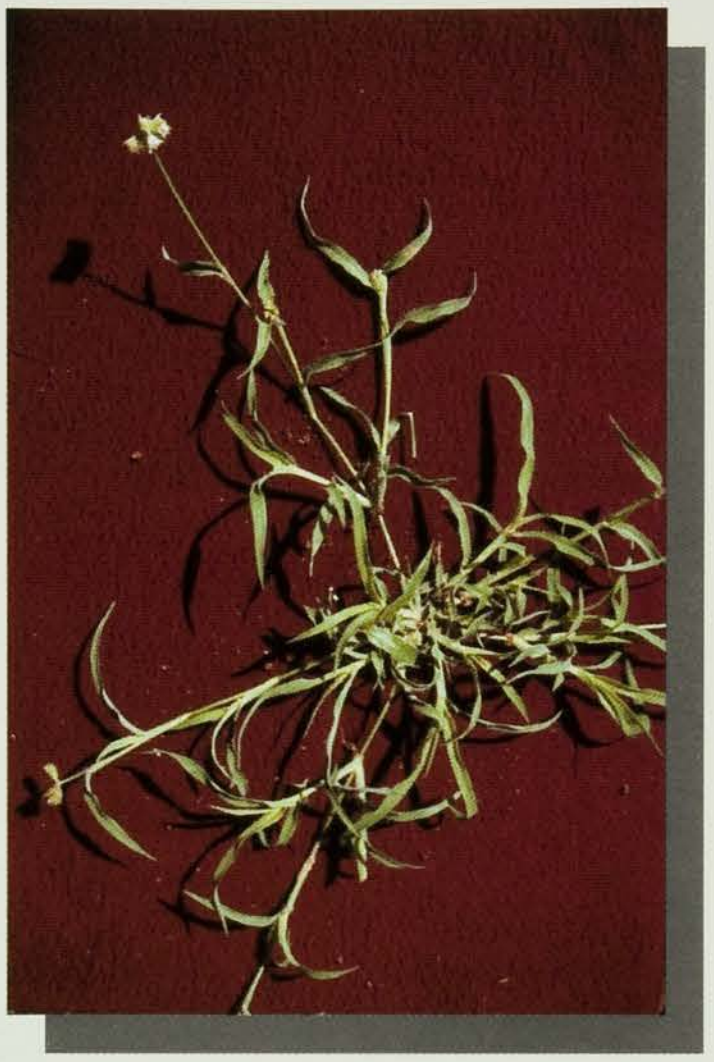
White grass

Wanderrie grass

Love grass

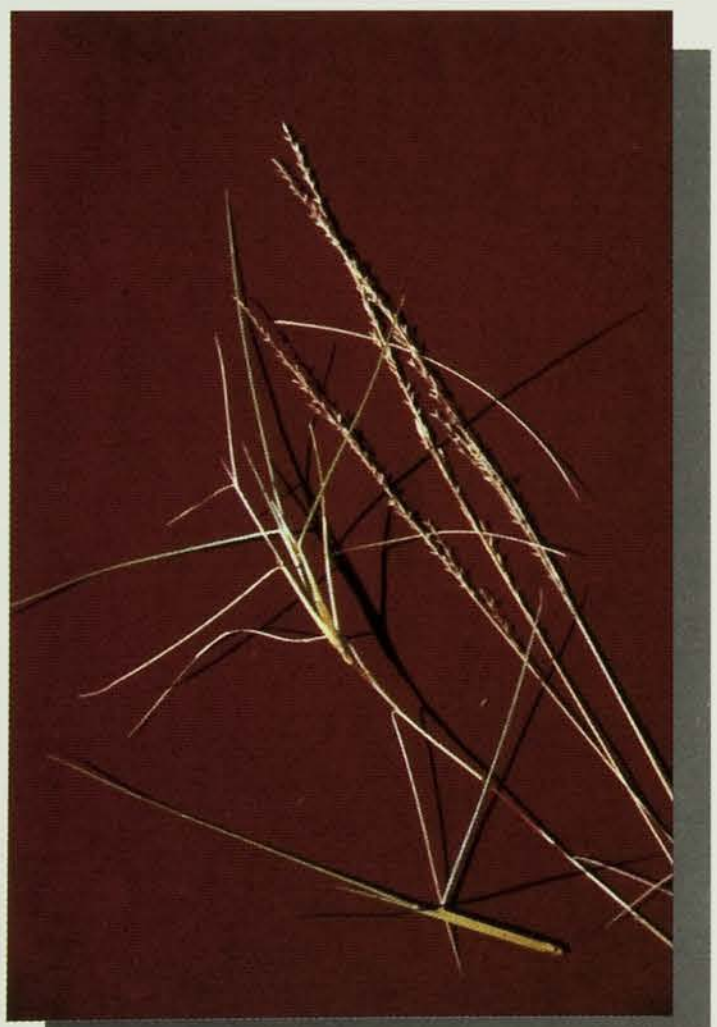
Bottlewasher/limestone grass

Desert/Kimberley couch

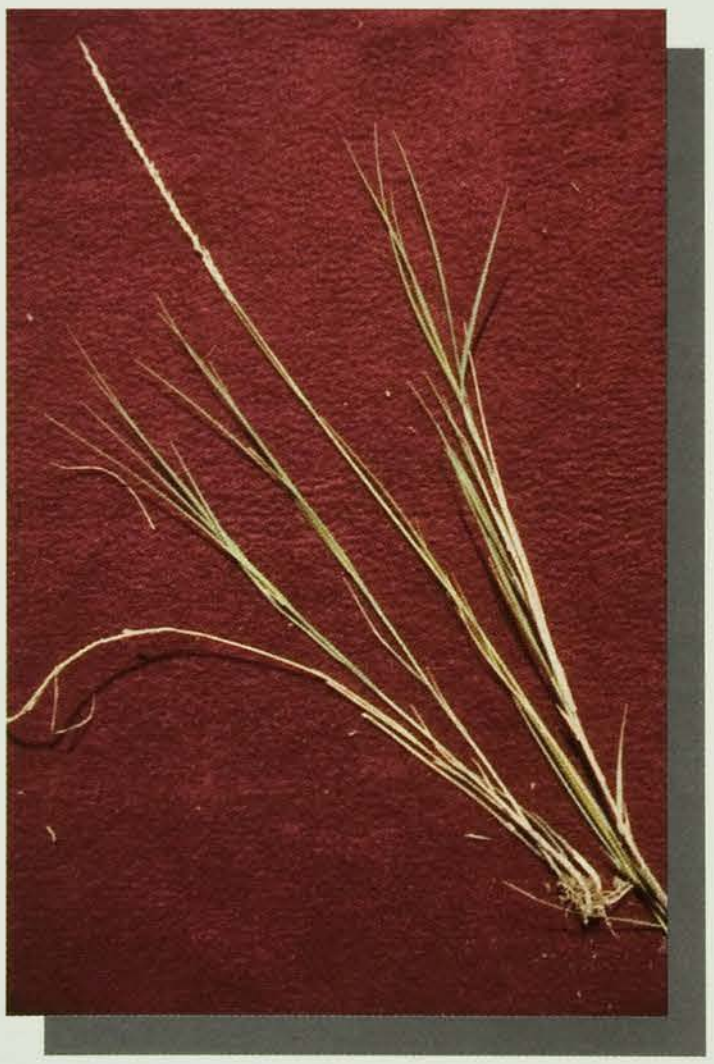


Button grass

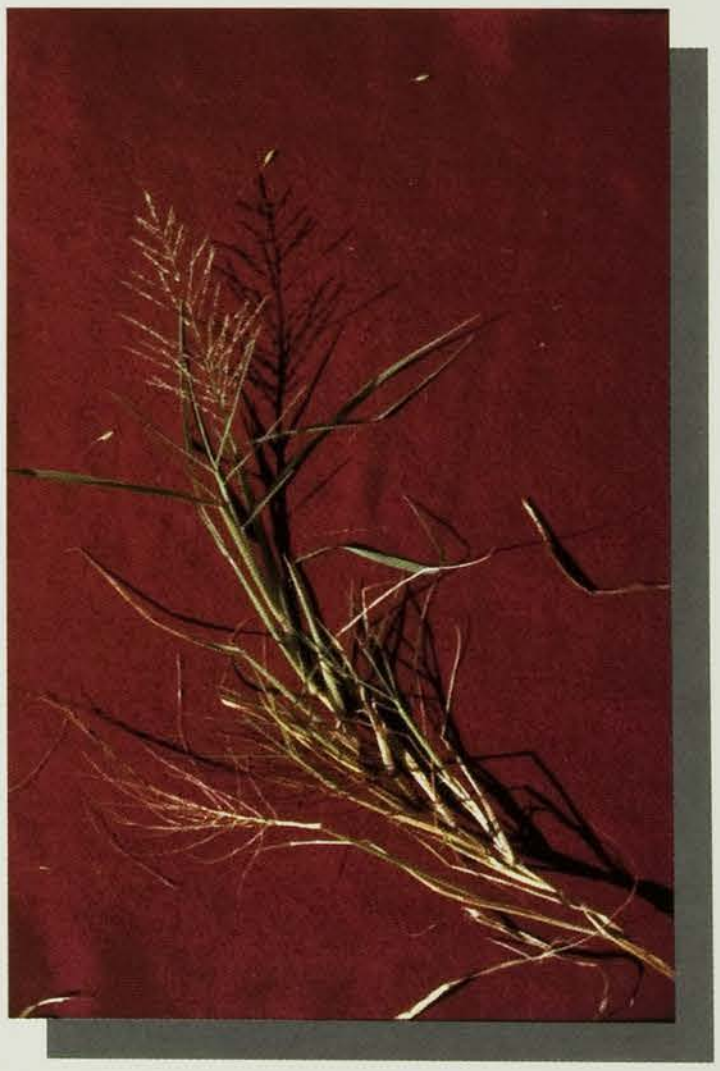
Liverseed grass



Spinifex



Salt water couch



Spiny mud grass

Comet grass

Mission grass

Asbestos grass

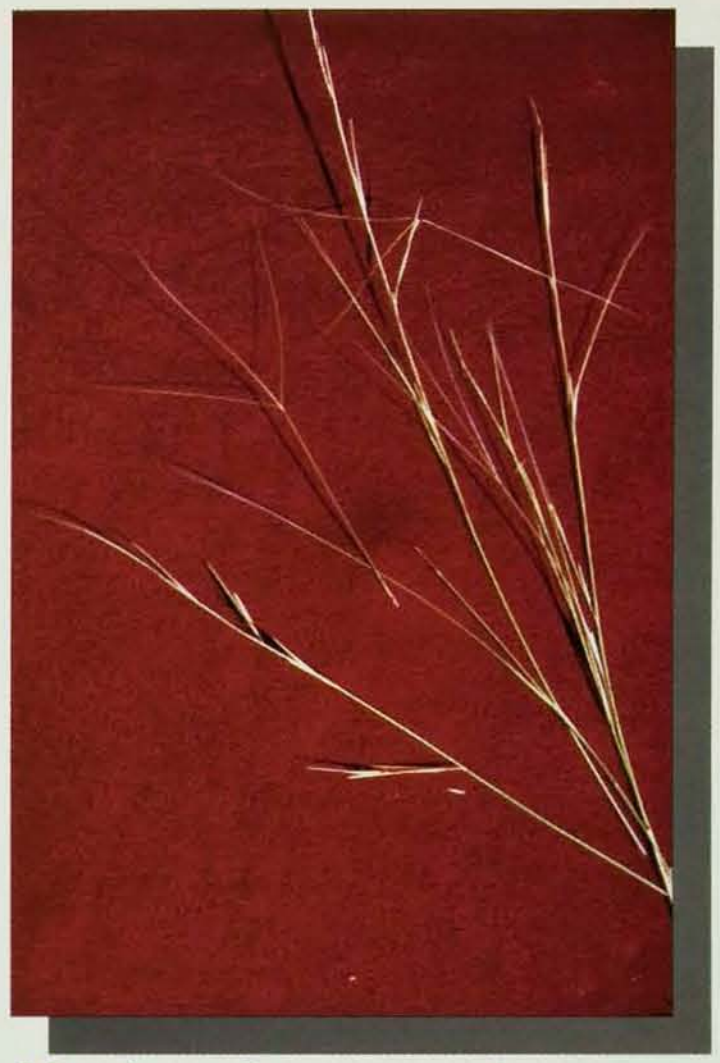
Fairy grass

Pigeon grass

Chloris

Feathertop wiregrass

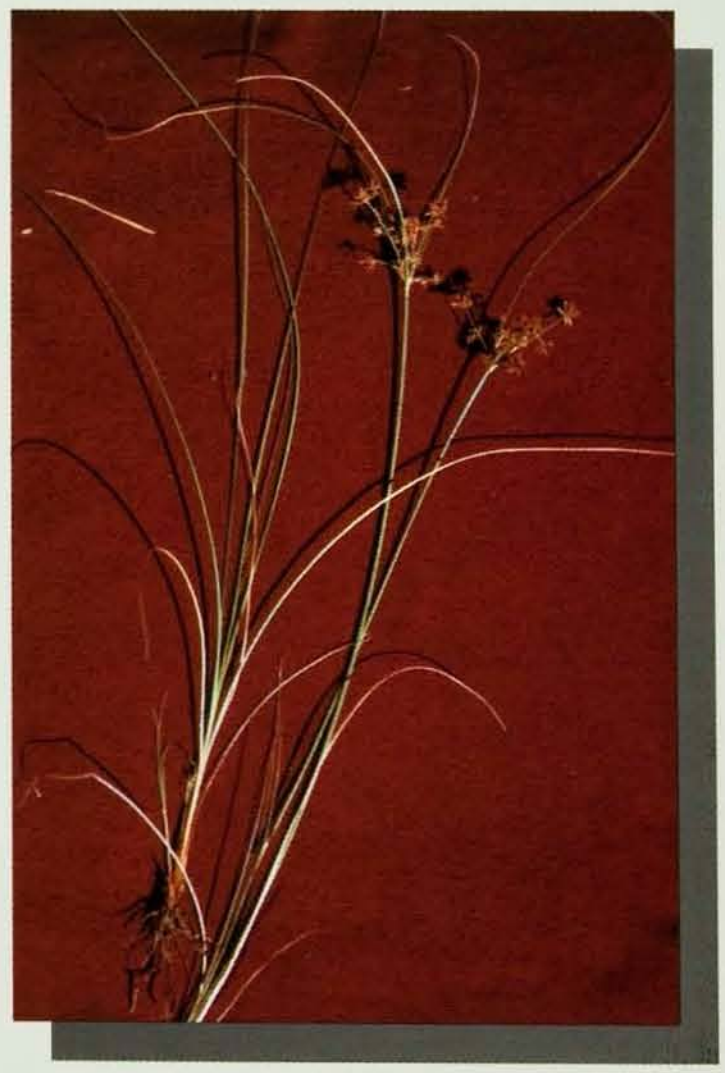
Northern feathertop



Northern kerosene wiregrass

Another wiregrass

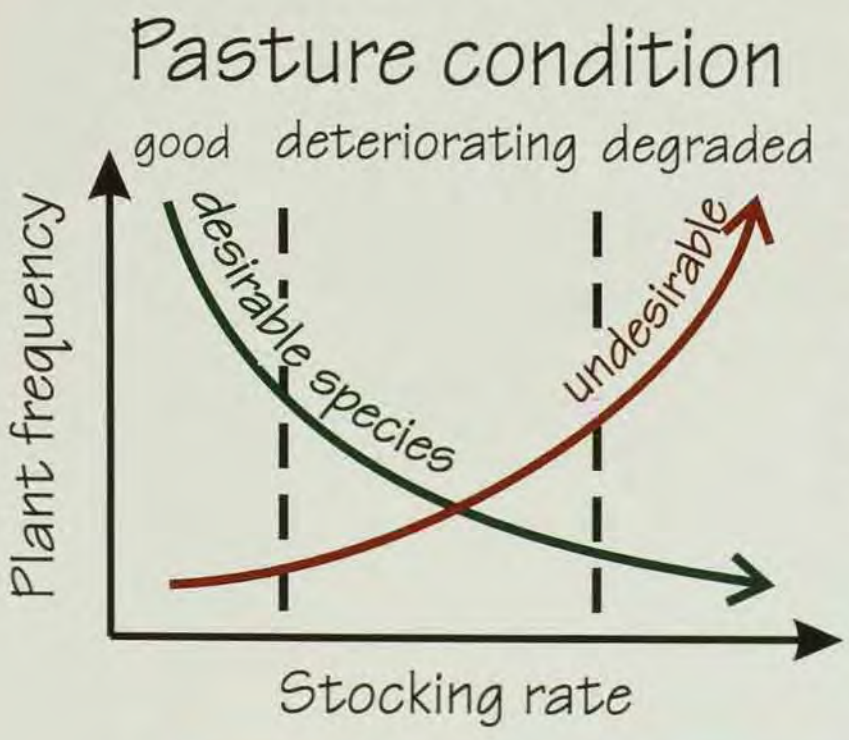
Silky oil grass



Sedge

How are your pastures?

You can check the condition of the grazing in your paddocks as part of monitoring. Condition can be categorised (on the proportion of the different species present and on the soil condition) into three classes—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.

Deteriorating

Totally degraded

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 and expensive inputs, for example mechanical clearing of regrowth, once they have gone too far.

The very general 'states' for tropical tall-grass pastures are described on the opposite page.

'States' recognised in northern tall-grass pastures:

State 1. Perennial and annual tussock grasses.

Good condition pasture dominated by palatable native perennial tussock grasses such as kangaroo grass, perennial sorghum, ribbon grass and bluegrasses, and annual tallgrasses such as annual sorghum, under open woodland of mature trees.

State 2. Perennial–annual grasses

Deteriorating pasture with grazing-tolerant native perennials for example, ribbon grass and wiregrasses, and increasing annual short-grasses and forbs, and woody plant seedlings.

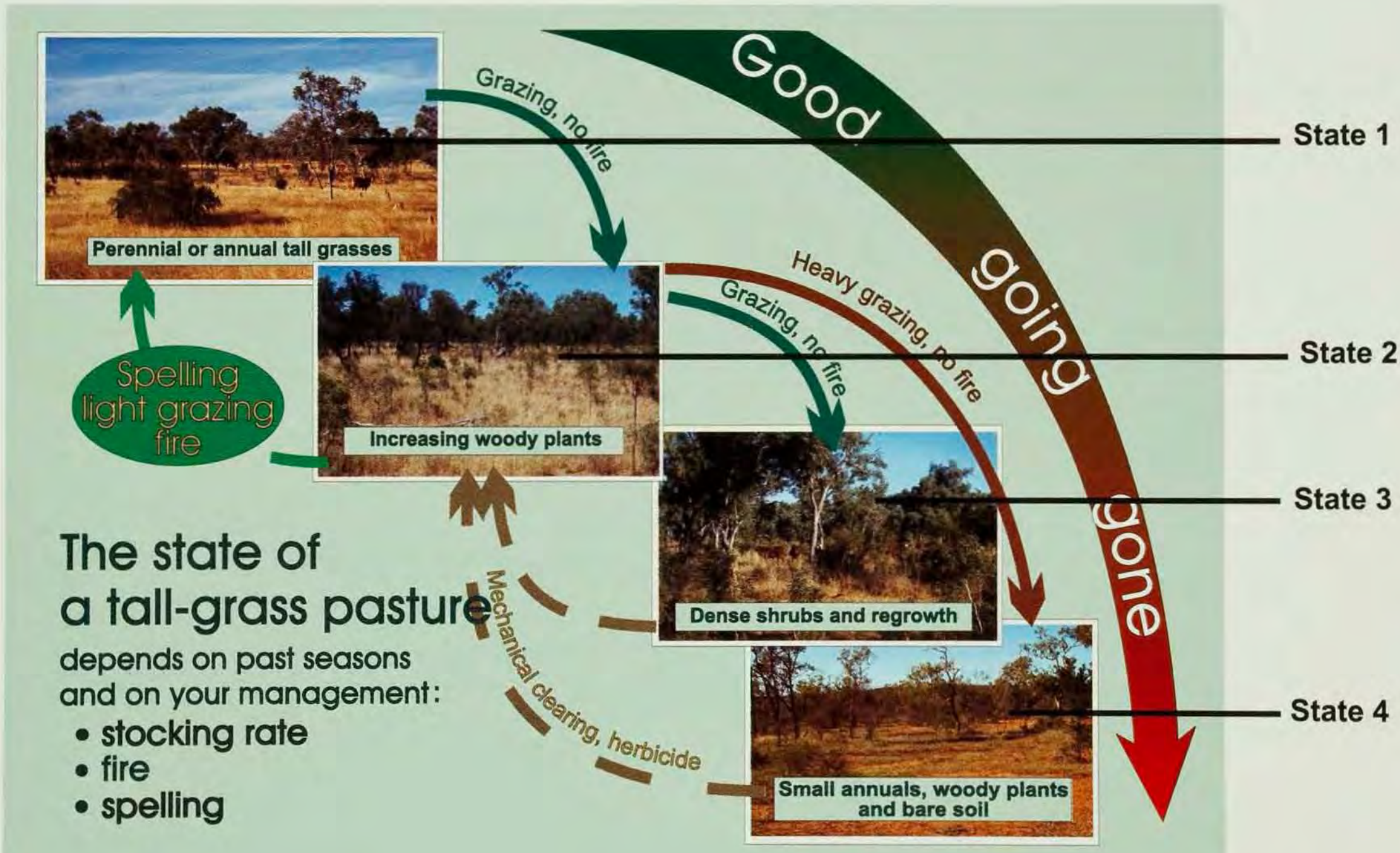
State 3. Woody vegetation

Vegetation dominated by native woody plants. Typical species include eucalypts, paperbark, conkerberry and rubbervine. Grasses dominated by unpalatable perennials such as wire grasses and by annual short-grasses.

State 4. Dense woodland, annual grasses and forbs

Degraded pastures, under woody regrowth and weeds, dominated by wire grasses and annual grasses, for example, desert or Kimberley couch, bottle washers and forbs. Poor ground cover with increasing clay pans and scalds.

These states, and the management conditions that cause pastures to move from state to state are illustrated in the centrefold.



Further reading

General

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Managing Mitchell grass: a graziers guide — by Ian Partridge (1996) DPI Queensland.

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Monitoring and plant identification

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Shrubs and trees of north-west Queensland — by Jennifer Milson (1999) DPI Queensland.

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

Decision support programs

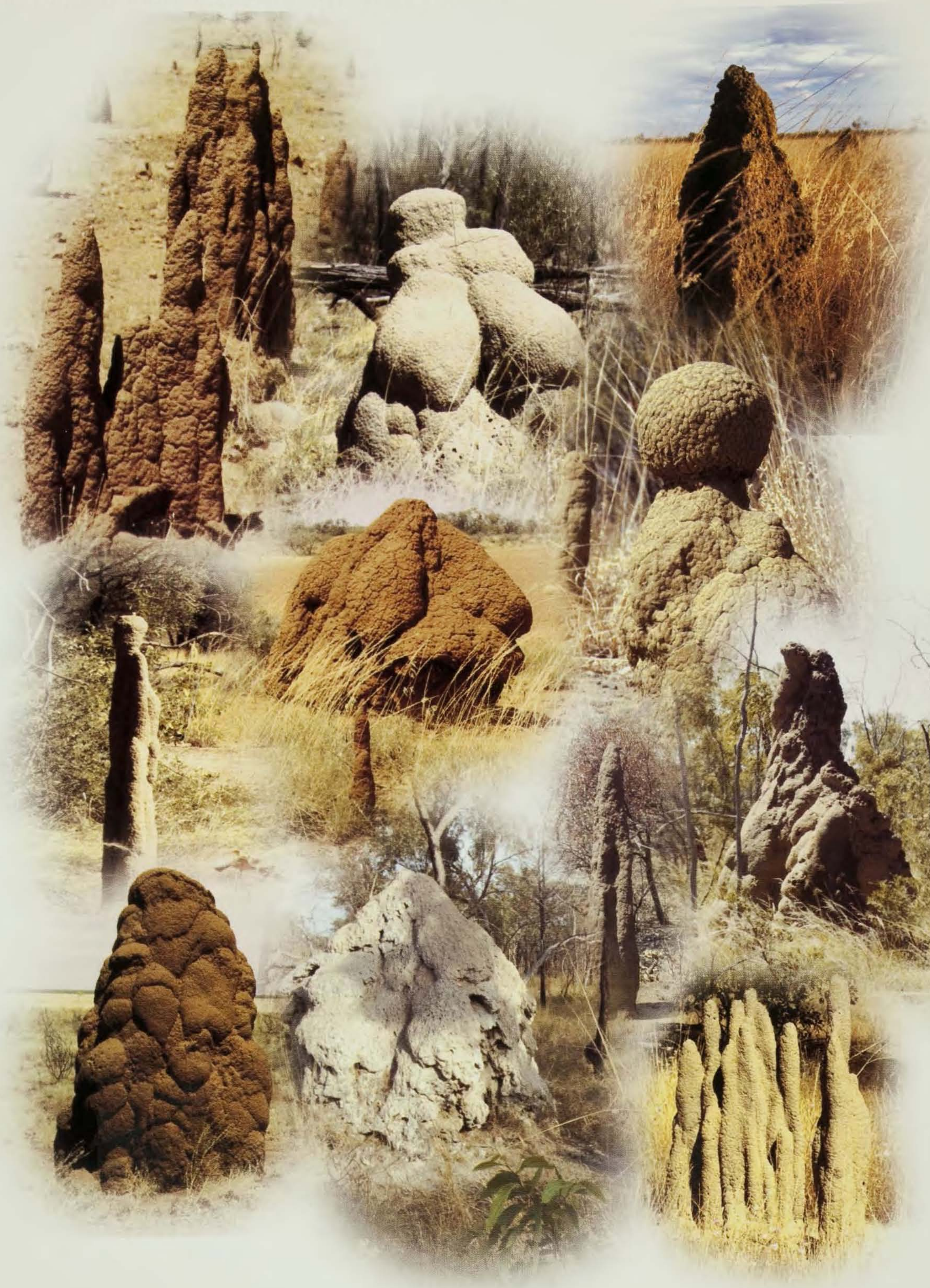
AUSTRALIAN RAINMAN: rainfall information for better management. Version 3.1.— J. F. Clewett, P. Smith, I.J. Partridge and D. George (1999) DPI Queensland.

Woody weed adviser: options for woody weed management — by 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 — by David Cobon and Jeff Clewett (1999) DPI Brisbane.

Ant hills (termite mounds) display a great range of shapes, sizes and colours.



Snappy gums and spinifex

Smoko time

The end

Managing grazing in northern Australia provides guidelines for the vast area of the grazing lands that stretch from 'Karumba to the Kimberley'.

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

These options include:

- **setting stocking rates**
- **burning**
- **moving stock and spelling**
- **woody and shrub weed control**
- **improving the grazing.**

The booklet describes how monitoring can be used to assess the condition of pasture, allowing timely alterations to grazing management.

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