Managing Famine Fire and Flood in the Desert Uplands

Graziers' experiences

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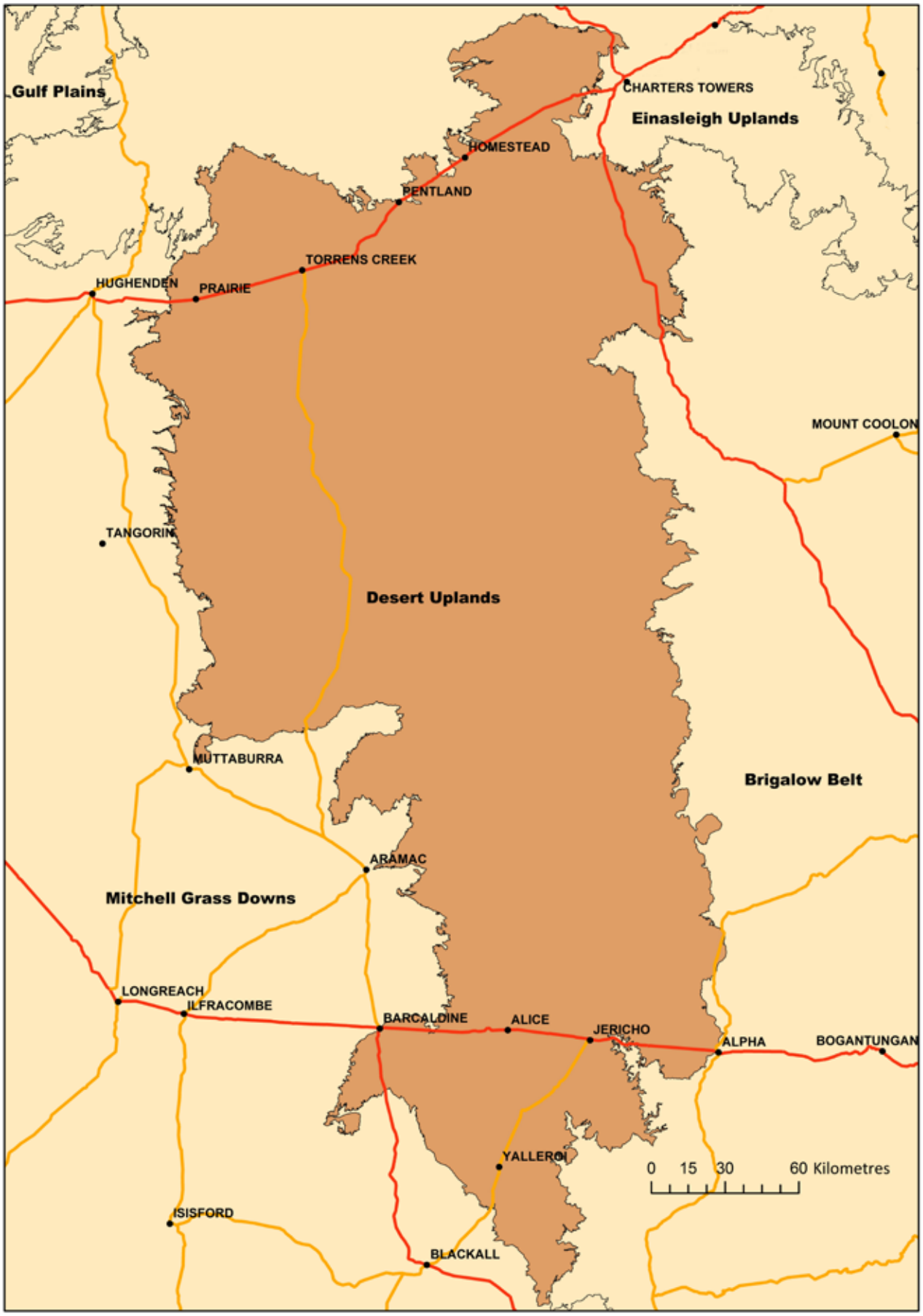
Edited and designed by Ian Partridge

for the



The Desert Uplands region

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The Desert Uplands region spans the upper reaches of the catchments of Burdekin and Cooper Basins, also extending into the Carnarvon Ranges. It occupies about 4% of the total area of Queensland.

These uplands have been described as 'desert' because of the abundant infertile, red, sandy soils, which often grow spinifex.

Most of the region is covered by open woodland on soils of low fertility with a ground cover of native perennial grasses. These woodlands are used mainly for extensive cattle production.

The relatively harsh natural environment of vegetation and soils is made more difficult by the variable climate, which brings periodic droughts, fires and floods. Successful producers have developed management systems to minimise the effects of these adverse conditions. There are many stories of economic success with appropriate management – but many also of failures from drought, fires and floods due often to inappropriate or inexperienced management.

Most properties comprise a range of land types, the most important for beef production being:

- box country – poplar box or Reid River box woodland
- hard ironbark country
- ironbark country
- yellow jacket country
- scrubs on deep clays
- scrubs on shallow clays
- downs country
- channels and swamps associated with major streams
- jump-ups.

Only a small proportion of the region, mainly on the scrub soils on clays, has been cleared and planted with improved pastures.

Some 1,200 individual land parcels have been amalgamated into about 320 properties, with an average size of between 20,000 and 25,000 ha as needed for a living income. Most land tenure is leasehold although there are large areas of freehold in the south.

The major population centres are Barcaldine and Aramac, with the smaller towns of Prairie, Torrens Creek, Pentland, Alpha and Jericho. As all these towns are around the perimeter of the Desert Uplands region, this leads to the region's isolation and also to the preservation of many unique features.

More comprehensive information about the Desert Uplands region, the land types, and the climate and its variability can be found in the Appendices.

The Desert Uplands Build-Up and Development Strategy Committee is a not-for-profit community group that has been proactively addressing regional issues for two decades. This book is a product of their initiative with funding from the National Landcare Programme.

Visit *www.desertuplands.org.au/* for more information about the work of the Committee.

Foreword

In the Desert Uplands, we know it gets dry, we know we have fires, we know we have floods. These droughts, floods and fires can at times occur sequentially to become quite disastrous.

When big floods follow long drys, the native grasses grow a lot of bulk, especially as there are fewer stock and kangaroos after the drought. This tall grass dries off to become the fuel for wildfires, often ignited by early dry electric storms. Early nineteenth century history tells of men and horses dying in attempts to control fires. Late in the first decade of this century, the trilogy played out with much loss and anguish.

The collection of information on the management of drought, fires and floods has come from landholders who, over many years, have successfully managed these extremes on their properties. They have lived through the troubles and have come through with healthy stock, good (enough) pastures and profitable beef grazing enterprises.

These landholders assess their cattle and pastures and make hard, but timely, decisions. Their actions give them enough control to manage the complexities of what happens under these climatic extremes and so to reduce the impacts on their property, livestock and finances.

Background science in livestock production, pasture management and related subjects is provided to help explain, reinforce and further detail this landholder knowledge.

This booklet documents the broad learnings and experiences of landholders who have survived and thrived through these excesses; it aims to help all those who will face these difficult conditions again. Yes, we can be sure that such conditions in the Desert Uplands will recur, so please read, reflect, learn, share and be proactive so you too can benefit from success and remain profitable.

Robyn Adams
Stratford
for the Desert Uplands Committee
October 2017

Acknowledgments

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The aim of this book is to pass on to all producers in the Desert Uplands the accumulated experiences of a number of successful graziers in the region. We have drawn on the knowledge and experience of the following producers, and gratefully acknowledge their time and help:

Bob Marshall of ‘Swanlea’ and ‘Bede’; Bob Murphy of ‘Everton’ and ‘Pembroke’; Ian Otto of ‘Minamoora’ and ‘Coleraine’; Dick Ferguson (formerly) of ‘Garfield’; Jason and Anne Sprague of ‘Neverfail’; Daryl Rogers of ‘Boongoondoo’; Kevin and Jess McKinlay of ‘Richmond Hills’; Peter Whip (Longreach) of ‘Royston’; Duncan Emmott (Longreach) of ‘White Hills’ and ‘Landra’ (Longreach); Richard and Dorothy Thiedeki of ‘Maryvale Springs’ and ‘Henley Park’; Dick James of ‘Glencoe’ and ‘Glenstar’; and Kim Ford of ‘Summerdell’.

Contents

The Desert Uplands
Hard country – but produces good cattle with the right management.

Summary

Famine, fire and flood are the three Fs that regularly affect the Desert Uplands. Over decades, even generations, regional graziers have developed practices that reduce these impacts of high variability in rainfall between years.

The practices of twelve leading graziers in the region have been summarised in this book as a guide to all producers. **'What graziers say' in shaded text boxes throughout the chapters are direct quotations of their advice.** Small differences in advice may depend on actual location, but the overall messages are clear.

'Famines' develop during droughts. The strongest overall message for managing droughts is to stock conservatively at all times to conserve feed in the paddocks. This will improve the condition and productivity of the pastures and hence the condition of the whole landscape.

As a drought intensifies, producers are encouraged to reduce their stock numbers in a timely and predetermined manner. This will reduce excessive short-term loss of condition of the cattle and long-term loss of the condition of the pasture.

Fire is a natural component of the woodland ecosystem, and can be used as a management tool. Wildfires can be caused by nature or by human carelessness; they burn large areas of grass, usually at a time when most experienced managers would not burn.

Wildfires can therefore damage feed reserves and property infrastructure. The key to handling any type of fire is being prepared with adequate firebreaks and reliable equipment, and to develop district plans with neighbours.

Floods are generally less of a widespread management problem, because the uneven topography of the Uplands limits the width and duration of inundation. Local fencing can be lost but stock can usually move to safer higher country where some feed is available. Floods can spread seed of weeds, which will need to be treated for years to come. Longer lasting and extensive inundation can be more of a problem on adjacent plains country but, in general, heavy flooding rain is welcomed because of the associated benefit to pasture growth.

Further chapters describe some of the general principles in the management of pastures and of cattle. While, to most graziers, cattle are their main love and the source of their income, cattle production is almost entirely dependent on pasture. Over our history, pastures in many parts of the country have been degraded, with an associated loss in productivity, by being grazed too heavily. The pasture chapter looks at grazing pressure and the restoration of land condition. The cattle chapter looks at some of the management factors relevant to reducing the effects of drought.

The final section describes the Desert Uplands region in more detail for those less familiar with the region. It covers the more important land types, the climate and its variability, and lists other sources of information for those who wish to expand their knowledge.

1. Managing for famine

Famine, or lack of feed, can be caused by natural droughts associated with lack of rain – or it can be man-made.

Man-made droughts result from persistent overgrazing, with further degradation of the pastures as expected rainfall fails. The cure for man-made droughts is obvious but does take time. Although this does not require technical assistance, it might well need help in financial management.

Successful drought management depends on early planning and decisive action.

Planning has to take into account:

- your current position in relation to
  - finances
  - family
  - livestock numbers by class, age and condition
  - pasture condition, quantity and quality
  - water supply
- the short- and long-term effect of the drought on land, pasture, finances, family and livestock
- trigger points when action will be taken
- a realistic estimate of when sufficient rain can be expected to make a significant difference to the quantity and quality of available pasture
- a clear idea of the position you would like to be in at the end of the drought.

While grazing and livestock management is the most important aspect of managing for drought and is described in more detail later, graziers should always be aware of the chance of a new drought developing by checking the seasonal climate outlook from the Bureau of Meteorology.

What graziers say on finances

"Try to develop sound financials."

"Have finances arranged early so that you can act quickly as soon as a drought breaks."

"Establish your financial credentials with lenders by compiling an honest financial profile of the business. Do this important activity when there is less stock work to do, e.g. during a drought."

"Maintain a good relationship with your stock agent to provide information on market opportunities, and with your bank manager to enable finance to be available when needed."

"Be able to demonstrate to lenders the financial credentials of a well-run business by knowing or finding out what lenders require and then investing some time in compiling a good financial profile of the business."

"Try to think 'outside the box' and not necessarily along with others."

Bare paddocks from drought or overgrazing

What graziers say on planning

"Prepare plans on how you will manage a prolonged dry season or drought."

"Have a plan."

"Stick to your plan."

"Create a buffer of pasture by reducing stocking rate by 25% to provide some flexibility."

"Develop infrastructure that will assist or contribute to strengthening your business."

Our variable climate

The problems of famine, fire and flood are created by a summer rainfall that can vary greatly between years. This variability is associated with ENSO (El Niño–Southern Oscillation). Understanding the influence of ENSO changes 'luck of nature' to probabilities for managing the three Fs. See the data presented in Table 1.1, for example.

Table 1.1. Effect of ENSO on summer rainfall at Jericho (1897–2016)

JERICHO P.O. Summer (October to March) rainfall (mm)	All years	El Niño years	La Niña years
Median rainfall	340	269	425
% yrs above median	50	41	63
Highest recorded		647	879
Lowest recorded		67	204

What graziers say on climate

"Recognise that climate prediction is improving all the time; taking consideration of the most recent predictions is an important element in management decisions."

"Watch the climate and weather forecasts. Even if they're half right it is useful information to put into the decision-making mix."

"Take the weather forecasts into consideration – they are becoming better and more reliable."

What chance of another drought?

Normal dry seasons that become droughts with the failure of summer rain are relatively common. There have been 26 moderate and 12 severe droughts over the last 120 years in the region – all associated with El Niño years; you can compare the severity of the worst droughts in history with your recent experiences to see how you might manage the next big one. Table 1.2 shows the worst 12-month and longer droughts at Jericho between 1897 and 2016.

Whatever the possible effects of climate change, droughts are going to recur in the future, and they could be more frequent and more severe.

You can reduce herd and financial risk associated with drought by following the broad seasonal climate forecasts from the Bureau of Meteorology.

Check BoM's ENSO outlook regularly

At present, seasonal forecasts for summer rain become reliable only by August/ September – which is too late for decisions at a first muster in April or May.

Seasonal climate forecasts show the chances of rainfall, not its certainty; they offer much more help in making decisions than just hoping that 'it might rain'.

Table1.2. The most severe and longest droughts recorded at Jericho between 1897 and 2015

Jericho – average annual rainfall (1897 to 2015) = 521 mm			
Droughts of at least 12 months			
Period	Duration (months)	Total rainfall (mm)	Driest 12 months (mm)
Jan 2002 to Jan 2003	13	209	106
Feb 1914 to Dec 1915	23	478	109
May 1901 to Nov 1902	19	268	118
May 1968 to Nov 1969	19	339	121
Droughts of at least 24 months			
Period	Duration (months)	Total rainfall (mm)	Driest 24 months (mm)
June 1900 to May 1903	36	1,002	421
July 1913 to June 1916	36	936	483
May 1968 to Nov 1970	31	725	488

As the dry season worsens

Reducing livestock numbers

Reducing livestock numbers to match the amount of feed available is a major part of any drought management plan. This is much more important than any visual assessment of cattle body condition; you would already be six weeks too late to arrest their decline.

There are three key decision dates when planning stock management based on pasture in the paddock.

1. Middle of the growing season – about mid-February for the Desert Uplands. Pick a date that is easy to remember, say Valentine's Day, 14 February. If the growing season has not started by then, it is unlikely that later rains will grow enough pasture to sustain your stock through the rest of the year. Now is the time to consider stock numbers and the options for reducing them.
2. End of the growing season – about mid-April. Lower temperatures are reducing grass growth. You should do a forage budget and match stock numbers with pasture supply. Feed will have to last from now until a few weeks after the start of the next growing season – about the end of December.
3. Middle of the dry season. Do another forage budget to see whether you are on track for having enough feed to last until the next growing season. Check the seasonal climate forecast for the likely break of season.

Keep cattle in good condition by reducing their numbers before feed runs out.

What graziers say on reducing herd size

"Assess season, feed and cattle in early April. If summer rain has been poor, reduce numbers (older cows first) to match available feed."

"Continually monitor pasture and cattle and sell if necessary to match cattle numbers to available feed."

"Start reducing numbers gradually to maintain as much ground cover as possible."

"Keep assessing season and available feed and reduce numbers as necessary."

"Act soon if the season is poor."

"Have an orderly destocking plan e.g. selling steers or empty cows. Some – mostly young heifers – could go to pre-arranged agistment."

"Reduce herd numbers by either selling or agisting. Estimate the cost of agistment for each group; sell those animals with the least ability to 'value add', i.e. pregnant cows and heifers or cows and calves or steers at a heavier weight."

"A balancing act between retaining a base herd and reducing numbers. We keep almost all of our heifers – heifers "do" better than steers and eat less than cows. We routinely keep our herd young – very few cows older than 7 years old.

"Sell older breeders first. Keep plenty of heifers to build up breeder numbers after a drought."

"Young dry cattle are easier to manage in a drought and the heifers have a long breeding life ahead of them while steers are next year's sale cattle/income."

"Sell steers straight off the cow. Sell heifers later if season continues to be poor. Next sell older cows (culled-for-age at 10 years)."

"Sell old cows to reduce numbers."

What graziers say on cattle disposal

"View livestock as an asset that can be liquidated, rather than something that has to be kept at any cost."

"Implement any planned intervention early – for example whether to destock, sell or agist."

"In March: brand calves and sell any fat cow that does not have a calf. Sell any weaner heifers so cows can be spread out."

"Pregnancy test and wean in June/July. Sell all empty females. If conditions are dry, sell all weaner heifers straight off dam, keep weaner steers if possible. Sell any old cows even if they are in calf."

"Sometimes we put replacement weaner heifers on agistment so we have enough females when it does rain."

When will the season break?

If 50 mm of rainfall over 7 days is considered as the end of the dry season, over the last 100 years this has occurred three weeks later than average in an El Niño year or nearly four weeks earlier in a La Niña year.

Table 1.3 below shows the effect of ENSO and the SOI on the break of the wet season at Jericho over 100 years.

Table 1.3. The effect of ENSO on the break of the wet season at Jericho

JERICHO P.O. historical data (1896–1996) Date of first event (50 mm rain over 7 days)			
Average SOI (Sep to Feb)	All years	SOI <–5	SOI >+5
Average date of first event	19 Dec	10 Jan	23 Nov

Supplementary drought feeding

Any supplements should be tailored for specific groups of cattle, taking into account the production target for that group, the nutrients that are limiting production, and the cost. Phosphorus supplements should be provided to all stock throughout the year with additional protein supplements during the winter.

Cattle can be fed additional supplements during a drought to keep them alive, but this should not be a way to keep too many stock on a property irrespective of the effect on pastures and cost.

Some grazing during a one-year drought is much less destructive than constant overgrazing year after year. Grasses can still recover under light grazing once rain returns, whereas pastures that have been consistently over-grazed will take years to recover having already lost the most productive species. Productivity and profitability are reduced over the medium and long term.

Normal supplementing with phosphorus and protein should not be used to keep too many stock on the property during drought.

What graziers say on supplements

"High energy and protein supplements such as fortified molasses are too dear and have been used to keep cattle on a property long after the feed has gone, thus damaging the pasture. Don't feed energy supplements such as molasses or whole cottonseed."

"Don't wait until cattle have lost condition before starting to feed supplements."

"Good annual supplement program to keep cattle in good condition."

What to sell?

Make the decision on what classes of cattle to sell, and the order and timing of sales early in a drought as part of the pre-prepared drought plan. If you are forced into late sales as a 'last resort',

market prices will have fallen, cattle will generally be in poorer condition and they may even present an animal welfare issue when transported.

What to sell should be decided only after carefully considering:

- the short- and long-term effects on cash flow and business income
- the marketability of each group.

What graziers say on markets

"Act early."

"Watch the markets. Be open to opportunity."

"I have finances arranged early so that I can act quickly – as soon as a break in the drought occurs."

"Maintain a good relationship with my agent to provide good information on market opportunities and with my bank manager to enable finance to be available when needed."

The first cattle to be sold are usually the current year's sale animals; these may be sold earlier and lighter than normal. Older breeders are usually the next choice.

The older breeders are at greatest risk and have only one or two more productive years. Younger cattle are less of a drought risk, being easier to manage than old lactating breeders. Steers will provide next year's income while heifers are at the start of their productive life and can be used to replace breeders that were sold.

Most producers prefer to 'breed up' their herd back to normal numbers rather than buy in expensive stock after the drought. This also gives pastures time to recover.

Thus many producers plan to sell older or less productive breeders rather than young dry animals. Breeders heavily pregnant at the key decision dates – about mid-April and the middle of the dry season – could be considered for sale. Dropping a calf in the middle of the winter or when a drought is likely puts the lives of both calf and cow in danger.

Programs such as BreedCow/Dynama and BBSAFe (Breed, Buy, Sell, Agist, Feed evaluator) can be used to assess the long-term effects on cash flow and economics.

Recovering from drought

When a drought breaks, it doesn't rain grass, and pasture needs time to recover.

When the season or drought breaks, grasses should, if possible, be spelled from grazing in the early, leafy stages of growth, or even allowed to set and drop seed. This is aided by gradually increasing the herd rather than by rapid restocking.

What graziers say on restocking

"Breed to build up numbers and allow pasture to recover. If breeder numbers have been reduced significantly, keep extra replacement heifers to make up numbers."

Perennial grasses that have been dormant during the dry season or drought have to draw on energy reserves in the crown and lower parts of the stem for the first week of regrowth. After this, the plant relies on photosynthesis from new leaves.

Pastures should be spelled for at least 6-8 weeks early in the growing season to improve land condition.

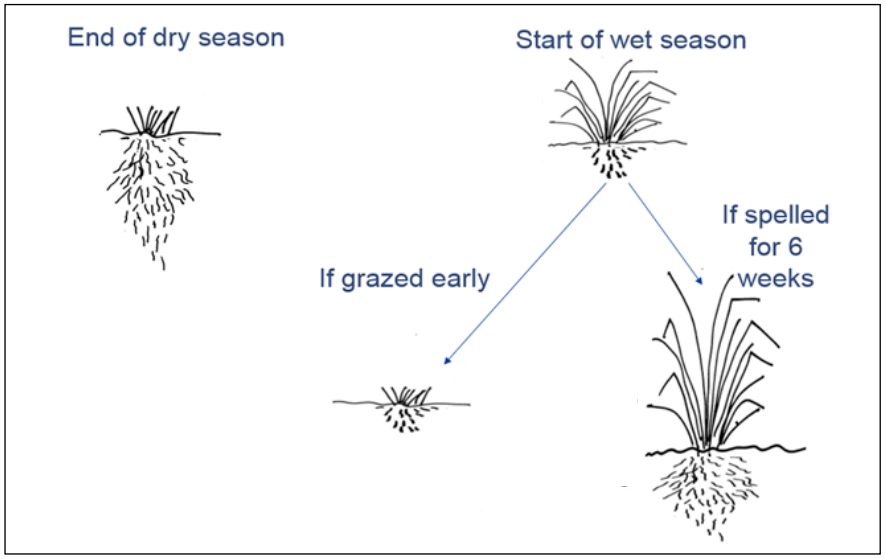


Figure 1.1.Wet season spelling allows the grass plant to recover energy reserves and to develop a robust root system.

If these new leaves are grazed too heavily and too early, the plant cannot develop or expand a new root system.

Figure 1.1 illustrates the effect of grazing too early compared with spelling for 6–8 weeks of the growing season.

The image below shows how the roots of a grass plant are reduced under constant heavy grazing. The small root system is less efficient at extracting water and nutrients from the soil.

This is what happens to the roots of a grass plant under constant heavy grazing.

Building the herd up to normal carrying capacity over a number of years will allow pasture to recover, and may also be the best strategy to manage cash flow.

Reviewing your drought management

While the drought is still fresh in your mind is a good time to review its effects and how you managed problems with cattle, pasture and finance.

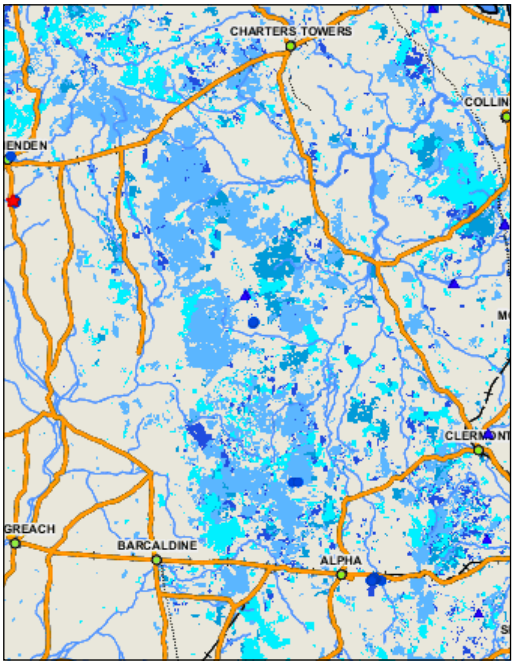
Look at your management in terms of:

- what worked well for the business and for all of the family involved
- what you could do better next time.

Then start working on your new plan for the next drought – which will surely come!

2. Managing for fire

Fire is a natural component of a eucalypt woodland ecosystem. It can be disastrous to livestock, infrastructure and income, or it can be a useful management tool.



Fire scars (shades of blue) show the large proportion of the Desert Uplands burnt over the years 2008–12 (from NAFI)

Managing wildfires

Wildfires can be caused by dry lightning strikes or by human carelessness; they burn large areas, usually at a time when most experienced producers would not burn. They will destroy existing feed supply, and will cause damage to property infrastructure.

The worst fires follow a good wet summer with heavy pasture growth; these hot fires burn much of the protective litter on the soil surface.

Preparing for and preventing wildfires

Have property maps on hand that identify key locations as well as paddock fences, gates, access tracks and water points for refilling firefighting equipment; regularly update maps to include any new infrastructure. Laminate or place the maps in a sealed plastic sleeve with full neighbourhood contacts, mobile and house phone numbers and UHF channel, listed on the reverse.

What graziers say on preparation

"Prepare property maps showing fences, firebreaks and water refill points for everyone who comes to help on fire."

"Prepare a list of people, with contact details, who have machinery (dozers, graders) that can be used on fire."

- Make sure all firefighting equipment is well maintained and ready to use at short notice. This includes every thing from graders and dozers to mop-up units.
- Start planning for the next fire season at the end of the growing season (around April).
- Prepare and maintain firebreaks early in the dry season.
- Clear and maintain wide firebreaks (up to 30 m wide) along boundary fences and strategically throughout the property.
- Use fire in the cooler months to burn broader breaks, especially in fire-prone areas where wildfires more commonly originate.
- Where possible, burn some country every year to reduce fuel load.
- Use grazing to strategically reduce fuel loads wherever possible, but leaving enough fuel for any planned fires. Place lick troughs to 'graze out' around isolated infrastructure or at planned rescue areas.

Severe fires cause loss of feed supplies and damage to infrastructure.

What graziers say on fire breaks

"All roads and most boundary fences cleared and graded 3-4 m wide every year to use for back-burning during a fire."

"Breaks on boundary and on all tracks and roads. Breaks need to be clear and allow grading at least two blade widths wide."

"Grade one blade width firebreaks annually but have much wider clear area that can be graded easily in the event of a fire."

"Clear firebreaks along all fences so they can be graded easily and under bottom wire of fences (24 in high)."

"Clear 10 m each side of all fences. Clean rake and grade 5–6 m wide."

"Breaks need to be 25–30 m wide."

"Clear 20–30 ft either side of fences; slash breaks annually to keep clear. Spray suckers and grass under fences."

Burn between break and fence; possibly have a double break and burn between."

"Would like to clear 40 m each side of fences but this requires a permit – which can be a problem."

"Extensive network of firebreaks kept clear but not graded each year. Often slashed to make it easy to grade when necessary. Grade so that firebreaks don't end up as drains."

"Grade breaks as required; too much grading (annual) will cause erosion."

"Problem with breaks becoming drains and causing erosion. Put in plenty of 'Whoa boys' to prevent water flowing down the break."

"Grade firebreaks in different directions each year to prevent them becoming drains."

- Breaks need not be graded every year as this can cause erosion. Slash so that they can be easily graded when necessary.
- Put plenty of 'Whoa boys' in the breaks to help prevent erosion.
- If conditions allow, burn the grass under the fences along firebreaks.

Good wide firebreaks with the right equipment ready to go

What graziers say on equipment

"Ensure all firefighting equipment is easily accessed (graders) and in working order."

"For fast refilling of firefighter tanks, have fittings on tanks and pumps on water storage."

"Need good water supply to fill firefighting tanks."

Key points for managing a wildfire

- Get onto the fire as soon as possible before it gets too big.
- Work with your neighbours.
- Be realistic about your ability to control the fire. Sacrifice some country if it gives a better chance of controlling the fire.
- Back burn from well in front of the fire, up to 5–10 km, depending on the direction and speed of the wind.
- It is often better to work on the sides of the fire rather than the front.
- Stay on the fire well after it appears to be under control, mopping up burning dead trees.

What graziers say – during fire

"If you haven't made prior preparation for wildfire, when the fire occurs you may as well go to the pub!"

"Get to fire early before it becomes too big."

"Get going as soon as fire is seen; work on the sides rather than in front of fire. Start burning back and, if wind drops, burn back from well in front of fire. If fire is not on our place, assist neighbours as best possible."

"If you are going to burn off a break, you have to be 5-10 km in front of the fire. Not unusual for a fire to travel at 10 km per hour."

"May just have to contain sides of fire, rather than the front."

"Back-burn well in front of the fire. "

"Sacrifice some country in the interest of controlling the fire; back burn from a point where there is a good chance of controlling the fire."

"Burn from a break well ahead of fire."

"Keep watching fire well after it appears to be under control."

Fire as a tool for pasture and timber management

Used carefully and strategically, fire can be a useful pasture management tool.

A timely and strategic burn can promote good land condition and improve the diet quality of grazing stock by:

- controlling regrowth of woody species that compete strongly with pastures for moisture and nutrients.
- favouring some productive, perennial and palatable (3P) grasses, such as bluegrasses or black speargrass
- reducing the less palatable species such as wiregrass
- promoting some native legumes
- promoting green pick and improving diet selection by stock
- reducing patch grazing by evening out the stage of growth of pastures across a paddock
- burning old and moribund pasture that can smother the growing points of tussock grasses.

Always have a goal for the use of fire and plan carefully to achieve the goal. For example, if you want to control woody regrowth with a hotter fire, burn the higher fuel loads after a wet summer or accumulate fuel by lighter grazing.

Fires used to control woody regrowth must have sufficent fuel load.

Fire has reduced wattle regrowth on the left of the track compared with the unburnt area on the right.

What graziers say on prescribed burning

"Have a regular burning program to reduce fuel load."

"On wattle country (where most of the lightning strike fires start), burn some every year to reduce fuel load."

"Would like to pull wattle country every three years to reduce the height of the fuel – and hopefully the height of the flames when it does burn."

"Burn some wattle country each year in August after rain (for a cool fire) to reduce fuel load. Most lightning strike fires start in wattle country."

"More wildfires in recent years as regular burning can be hampered by regulations – need to get permits etc. and the fear of prosecution if there is a problem."

"In past years when more stock work was done on horses and there was less regulation about lighting a fire, property owners would burn smaller areas as they were mustering. This patch burning reduced the fuel for wildfires."

"Rotational grazing does give some paddocks with shorter grass that can help control a fire."

"Make 'safe' areas for cattle i.e. pulled country for them to move to in case of wildfire."

"For the past few years, wildfires have been confined to rough (spinifex) country and have done a good job in providing fresh feed. This rough country should be burnt every 5–10 years but few are game to light it as a fire in this country can easily get out of hand."

Spinifex benefits from burning every 5–7 years to reduce excessive fuel load and to remove old indigestible leaf but it can be killed by too hot a fire, and may not recover from seed. Spinifex should not be burned during the dry season because it is a valuable drought reserve.

Burning in the early wet season when there is sufficient soil moisture for pasture growth after the fire gives best results. Burning after 30-50 mm of rain in spring reduces the risk of feed shortages from subsequent dry spells: it also protects the roots of spinifex. Check Bureau of Meteorology forecasts for the likely start of the wet season.

Burn in the evening when it is cooler and the wind has dropped.

Burning small areas of large paddocks can encourage stock into normally ungrazed areas. If fire results in undesirable selective grazing, burn the entire paddock and then stock lightly or spell grass regrowth for a time.

Land condition before burning is more important than the effect of fire itself. Land in good condition will be little affected by a grass fire, as grass tussock bases remain and the soil is more receptive to rainfall – unlike persistently overgrazed land.

A stable soil surface with many grass tussock bases and high infiltration rate reduces run-off even after a fire has removed standing herbage. Rainwater will infiltrate much more readily, with less run-off than from a bare overgrazed soil.

This is illustrated in Table 2.1 which shows that heavy rain produces much less run-off from a burnt pasture that is in good condition pasture than from unburnt pasture in poor condition.

Table 2.1. Ground cover and run–off on unburnt country in poor condition compared with burnt country in good condition

Land condition	Ground cover (%)	Run–off (% of rainfall)
Poor (not burnt)	50	18
Good (burnt)	40	3

When using fire as tool

- Assess when seasonal conditions (rain and temperature) will promote significant pasture growth.
- Do a pasture budget to assess how much feed is available, particularly in paddocks that have been burnt.
- Where only part of a paddock has been burnt, consider burning the rest of the paddock when conditions are suitable to reduce patch grazing of the burnt area.
- Reduce livestock numbers to match available feed. See notes under 'Famine' on which livestock to sell.
- Rest pastures from grazing where possible until they have grown to about 20 cm or until they have set seed. This may need at least two 50 mm falls of rain.

Managing pastures after fire or drought

Paddocks or properties burnt by wildfire or affected by long periods of drought require different management to speed up their effective recovery.

Tall grasses burned by wildfire are generally in good condition and will recover quickly with rain; droughted grass plants that are small and weak will take considerably longer to recover.

What graziers say after the fire

"Reduce stock numbers to match feed still available."

"With conservative stocking, always have some paddocks spelled so cattle can be moved into these paddocks."

"Reduce numbers by moving some cows to another company property; sell cull heifers."

"Move replacement heifers to another company property"

"Don't start restocking for 6-8 months after fire, to allow pasture to recover."

Rest the paddock after a fire to allow the grass plants to recover and, if possible, to set seed.

3. Managing for flood

Floods can be caused by heavy continuous rainfall during a La Niña wet season or by exceptional downpours, as when a tropical cyclone crosses the coast to become a rain depression over land.

Seasonal climate forecasting based on ENSO can alert producers to the chance of an exceptional wet season (see the section on climate variability). But the paths of cyclones over the ocean, and hence where they cross the coast, are currently too unreliable for long-term forecasts.

Immediate flood warnings are well announced by the Bureau of Meteorology through television and radio.

Floods do not appear to be a major problem in many parts of the Desert Uplands, probably because the uneven topography limits the width and duration of a flood, while hills provide safe refuge for cattle for a time.

However, floods are a major cause of the spread of weed seeds from further up the catchment.

Most graziers have more of a personal problem with restricted road access than with their stock. Many regard heavy rainfall as a benefit to their pastures.

Floods can damage fencing and cut off communications, but the rain is generally welcomed for growth of pasture.

Preparing for a flood

- Use existing flood mapping information to map flood-prone areas and the associated risk profiles (i.e. flood frequencies).
- Ensure infrastructure (fences and yards) in these areas is located and built to minimise the impact of a flood.
- Ensure equipment such as pumps can be removed quickly and easily in the event of a predicted flood.
- Remove stock from flood-prone paddocks or ensure they can access higher ground during the flooding event.

Listen to the weather forecasts and move cattle from flood-prone areas.

Recovery after flooding

- Pastures may be killed by floods, depending on their duration and time of year. Buffel grass can be killed by 2-3 days under water whereas Bambatsi panic can survive for a couple of weeks.
- Plan to rest pastures from grazing to enable remaining seeds to germinate and establish an effective pasture.
- Longer duration flooding leaves no viable seed in the soil and pasture may need to be resown. Follow established principles for sowing pastures to reduce the risk of failure.
- Monitor flooded areas for weeds for several years after the flood and act accordingly.

4. Pasture management – general principles

Good grass and land management is the key to good, productive cattle.

Managing for good land condition will help to minimise the effects of the next drought while ensuring the sustainability of both the land resource and the grazing enterprise.

The key is to maintain a healthy proportion (80% or more) of 3P (perennial, productive and palatable) grasses in pastures. These grasses have a high proportion of green leaf relative to stem, with 30-40% of their weight as leaf; less palatable species, such as wiregrass, may grow only 10% leaf.

3P grasses are productive with high rainfall use efficiency; they also help to keep soils healthy. Their large fibrous root systems help maintain high soil organic matter levels which, in turn, allow high rates of water infiltration. Rain water runoff, along with valuable soil and nutrients, is reduced. Pastures in good condition can be twice as productive as those in poor condition.

3P grasses in the Desert Uplands include desert bluegrass, black speargrass, kangaroo grass and buffel grass. Even soft spinifex growing on its respective land type can be regarded as almost 3P, as it provides good forage if grazed lightly, being especially valuable during droughts. Soft spinifex regenerates vegetatively rather than by seedlings, so is susceptible to overgrazing and frequent fires.

Overall grazing management

Grazing management has the most impact on land condition. Retaining pastures in good condition with a dominance of 3P grasses keeps them more resilient to the effects of drought, wildfire and floods.

There are three principles for managing grazing, irrespective of the grazing system:

- **Stock to long-term carrying capacity**. Each land type, paddock and property will have a safe long-term carrying capacity that will allow land to remain in good condition for at least 10 years. Moderate stocking rates are the most profitable strategy in the long term. Stocking rates should take into account the smaller grazing area available if paddocks are to be spelled regularly, and feed shortages in dry years. A forage budget at the end of the growing season in April gives an early indication of whether the feed on hand will last until the season breaks in spring or summer.
- **Periodically spell pastures from grazing**. If land is in good condition, pastures can be spelled during their early growth every 3–4 years; pastures in poor condition may need spelling until seeding for recovery. Rotational grazing systems, *with appropriately reduced stocking rates*, can aid recovery, as each paddock will be spelled for some period of the growing season – as long as kangaroos do not invade.
- **Encourage even grazing of pastures and reduce patch grazing**. Fencing to land type, good water distribution, spelling from grazing, shifting supplement points and controlled burns will help to even out grazing across paddocks.

A high proportion of 3Ps (Perennial, Productive and Palatable) such as this kangaroo grass

What graziers say – waters

"Keep putting in more waters to spread grazing."

"Develop waters to allow best use of as much of the property as possible."

Pasture utilisation rates

Utilisation relates to how much of the total weight of pasture *grown over the year* is grazed, not to the height of standing feed.

Most of the weight of perennial grasses is found in the crown and stem at the base of the plant. Utilising 30% of standing pasture means eating off 30% of the weight of that plant, not the top 30 cm off a 1 m high grass plant. This is illustrated in Figure 4.1.

If stock graze only a certain proportion of the annual pasture growth, the land will remain in good condition over the longer term. A safe utilisation rate could be between 5% and 30% of the annual pasture growth.

Safe utilisation rates vary with land type. They are generally higher on more fertile soils with good soil moisture-holding capacity, and lower on poorer soils. Grazing strategy can also influence the safe utilisation rate. Strategies that include regular spelling during the growing season and methods to improve the evenness of grazing will improve pasture condition and allow higher utilisation rates in the dry season without harming pastures.

Lower utilisation rates allow the grazing animals to select a higher-quality diet; individual animals gain more weight but the production per hectare may be reduced, and vice versa. The overall aim for long-term economic stability is to have enough marketable stock while maintaining land condition.

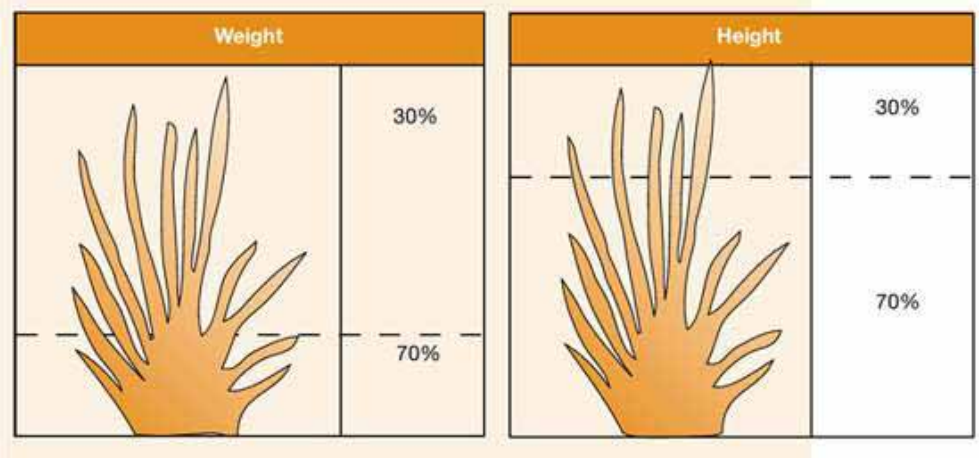


Figure 4.1. The bulk of the weight of a perennial pasture plant is in the crown and stem.

Utilisation rate: 50+%

Utilisation rate: 25% on left of fence, 0% on right

What graziers say on safe utilisation rates

"Stock conservatively all the time."

"Keep cattle in good condition by stocking conservatively and by supplementing with phosphorus throughout the year and with protein from early in the dry season."

"Stock conservatively."

"Manage to keep cattle in good condition."

"Stock conservatively – don't flog your country."

"Assess the amount of pasture in the paddock at the end of the growing season (usually April)."

"Plan to reduce cattle numbers to match available pasture."

Monitoring pastures

Monitoring land and pasture condition allows you to check whether your management strategies are on track.

The condition of your stock is not a good indicator of the condition of your land.

Land condition could be suffering years before you start to see a decline in stock production. Set up a few monitoring sites on different land types across the property to pick up changes over time.

Detailed monitoring of botanical composition can be useful, but is time-consuming and complex – so use your camera and make a few notes on dominant species and any weeds. Photos taken at the same spot each year once pastures have set seed can be a useful way to see any gradual changes.

Photo monitoring can show changes in timber density and pasture cover over time. These examples were taken in 2004 (above) and in 2013 (right).

What Dr Bill Burrows said – his 3-point summary for pasture management

"Always come out of the dry season with good stubble on the ground."

"If you have enough pasture to burn in most years, your stocking rates are about right."

"A little bit of patch grazing is good for cattle and pasture but if patches expand, back off the stocking rates."

5. Cattle management – general principles

Matching your production system to the production capability of your property is the key to successful cattle management and an economic enterprise. A highly productive system may not be the most profitable if it is achieved at too high a cost.

To match your system, you need to know the different land types on your property and the capability of each of these land types.

In the Desert Uplands region, most production systems are based on breeding and turning off younger steers and cull heifers, often at weaning. Some properties are able to finish cull females and steers on improved gidgee country.

Optimal (but not necessarily maximal) calving and weaning rates are the key to an economic business. The aim for optimal conception rates (Table 5.1) should be to have breeders in body condition 3 or better (on a 1–5 scale) at calving.

Table 5.1. Relationship between a cow's body condition score and her next pregnancy rate

BCS (1-5 scale)	Description	Expected pregnancy rate in next mating
1	Poor	0-25%
2	Backward store	25-50%
3	Store	50-80%
4	Forward store	80-90%
5	Fat	90-95%

Cow condition determines conception rates.

Breeder condition is managed by:

- stocking to long-term carrying capacity
- weaning according to seasonal and breeder condition
- year-round supplementation with phosphorus
- early supplementation with protein (urea) in the dry season
- reducing stock numbers early according to pasture availability and seasonal conditions.

Weaning

Weaning is done to maintain the condition of the dam rather than for the calf. Stopping lactation is equivalent to giving the cow a supplement of 3 kg of molasses or 2 kg of grain per day.

In good years, weaning may be able to be delayed; in poor years, calves can be weaned earlier down to 100 kg. These younger and lighter calves will need special and more expensive management but are still cheaper to feed than a larger group of breeders and calves.

Calves down to 100 kg can be weaned during droughts but will need special rations.

In severe droughts, calves can be weaned considerably lighter than 100kg but they are going to need very good management, which may include feeding with liquid milk replacer.

Calves weighing between 100 kg and 150 kg will need a supplement meal high in protein (18-20%) plus access to good quality pasture or grassy hay.

Parasites such as lice must be controlled.

What graziers say on weaning

"Wean to manage cow condition; wean early if season is poor."

"Look after breeders – keep weaning."

"Wean earlier down to 100 kg."

Weaners over 150 kg may need only a protein and phosphorus supplement if they have access to pasture that has been spelled through the wet season; otherwise they will need a supplement of protein, phosphorus, and energy such as fortified molasses.

Supplementary feeding

Supplementary feeding is a tool to be used in an overall property management plan. Supplements are costly; so need to be designed to meet a specific deficiency.

In the Desert Uplands where most land types are deficient in phosphorus, all classes of cattle need year-round supplementing with phosphorus for optimum animal performance. Cattle need that phosphorus when the grass is green and their bodies are growing – and especially if lactating.

In the dry season, a protein-based supplement will help cattle to digest mature grass and maintain body condition.

What graziers say on supplementing

"Feed phosphorus all year and protein (urea) and phosphorus in dry season to keep cattle in good condition."

"Feed a loose lick regularly with up to 500 g/head/day. We decrease the urea content and increase the protein meal especially as cows get closer to calving."

"We feed dry lick and, in really bad times, feed fortified molasses. We try to not feed M8U at the same water within a few years. We now use custom mixes of salt-based urea licks based on the 'desert' lick."

"No high level (energy) feeding."

Supplements during drought

Supplements high in energy and protein should be used only in extreme situations, but never as a 'last resort' to keep cattle on a property when pasture is eaten out. Besides the high cost of fortified molasses, grain mixes and whole cottonseed and the transport distance, this can severely affect the viability of pasture and its recovery after drought.

Cattle on the phosphorus-deficient soils of the Desert Uplands need phosphorus supplements throughout the year – but especially when the grass is green. Protein (as urea) is added as the grass hays off with the dry season.

6. Appendices

6.1. The Desert Uplands

The Desert Uplands is a semi-arid region of some seven million hectares in central-western Queensland – about 4% of Queensland's area.

It extends roughly between the Flinders Highway near Torrens Creek to about 50 km north-east of Tambo. The area is bounded by a line from Blackall to Hughenden through Barcaldine in the west and the Belyando River in the east.

The region is characterised by ancient, deeply weathered plateaus forming sandstone ranges of the Great Dividing Range and by large areas of deep infertile sand plains.

The dominant sandstone ranges and sand plains of the Desert Uplands contrast with the clay soils of the Mitchell Grass Downs to the west and the more fertile soils of the Brigalow Belt to the east. The north of the region abuts the granite ranges and basalt tablelands of the Einasleigh Uplands. To the south, the sandstone ranges continue into the wetter Carnarvon Ranges in the central part of the Brigalow Belt.

These uplands are described as 'desert' because of the predominant hard, red sandy soils of relatively low fertility and the abundant spinifex that is normally found in more arid inland areas. Traditionally, graziers on more productive downs country retained a property with spinifex in the Desert Uplands as a drought reserve.

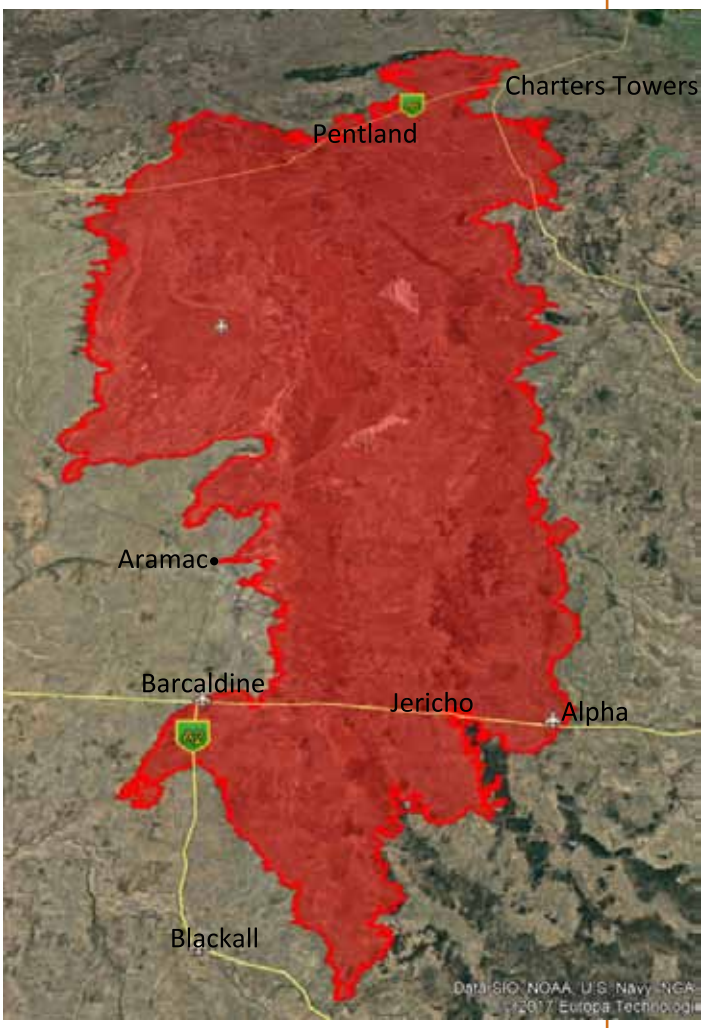
Sandstone ridges and sand plains dominating the landscape support woodlands with an understorey of native pastures. Most of the area is heavily timbered with eucalypts such as box (*Eucalyptus populnea*), ironbark (*Eucalyptus melanophloia*), yellow jacket (*Eucalyptus similis*), with desert oak (*Acacia coriacea)* on poorer sandy soils, gidgee (*Acacia cambagei*) on more fertile clay-loams and many shrubby wattles (*Acacia* spp.) under eucalypts.

The native grasses include desert bluegrass (*Bothriochloa ewartiana*), kangaroo grass (*Themeda triandra*), wiregrasses (*Aristida* spp.) and soft spinifex (*Triodia pungens*) with small patches of Mitchell grass (*Astrebla* spp.) in the west and on narrow patches of brigalow in the east. Buffel grass (*Cenchrus ciliaris)* can be found on the better soils such as after gidgee has been cleared.

Much of the region remains in a relatively natural condition and its biodiversity of both plants and animals appears to be largely intact. Some 18% of the woodland has been cleared to improve pasture production, with more impact on biodiversity in the south of the region.

Lying on the eastern margins of the Great Artesian Basin, parts of the Desert Uplands are important recharge areas for the aquifers of that basin.

Coal deposits occur at depth and several large coal mines are planned for the Galilee basin along the western side of the Belyando River.



Map of the Desert Uplands showing towns (adapted from Queensland Government Wetlandinfo and Google Earth)

6.2. Main land types

Full details of all land types in the Desert Uplands can be found at *https://futurebeef.com.au/knowledge-centre/desert-uplands/*

Box country – poplar box or Reid River box woodland

Box country often has a shrubby understory of ironwood, dead finish, ellangowan, desert oak, beefwood, false sandalwood, currant bush and bauhinia.

Preferred grasses include desert bluegrass, forest bluegrass, black speargrass, kangaroo grass, golden beard grass and buffel grass. Stemmy wiregrasses are common.

The recommended pasture utilisation is 30%.

Topsoils of sandy loam are susceptible to sheet erosion and scalding while the sodic clayey subsoils are dispersive and susceptible to gully erosion.

Hard ironbark country

Hard ironbark country is an open to low woodland of silver-leaved, narrow-leaved, and whites ironbarks, with occasional mallee box, bloodwood, desert oak, false sandalwood, currant bush, ghost gum, wattles, quinine and tea tree as a sparse understory.

Preferred grasses include kangaroo grass and soft spinifex, but less desirable wiregrasses are abundant. Recommended pasture utilisation is 20%.

The hard-setting sandy loam topsoil lying over a sodic sandy clay subsoil, frequently with a hardpan of ironstone at 0.5 m, is vulnerable to sheet erosion.

Ironbark country

This is an open woodland of silver-leaved ironbark with scattered wattle, currant bush, poplar box, ironwood, false sandalwood, prickly pine, quinine, dead finish and cypress pine.

Preferred grasses include desert bluegrass, Queensland bluegrass, kangaroo grass, soft spinifex, golden beard grass and black speargrass. Less desirable grasses include wiregrasses, red natal grass and wanderrie grass.

Recommended pasture utilisation is 30%.

Soils are a deep sandy loam over a sandy clay loam with texture-contrast profile.

Yellow Jacket country

This is an open woodland of yellow jacket on plains and hill slopes of very deep red sandy loam. It is often associated with other bloodwood (e.g. Clarkson's, western), applejack, ghost gum and with a dense understorey of wattles, quinine and soap tree.

Heartleaf poison bush is common and can cause high stock fatalities if grazed at the wrong time.

Grass cover is mainly soft spinifex, black speargrass, kangaroo grass, golden beard grass and forest bluegrass with less desirable wiregrasses. Utilisation is 20%.

Spinifex-dominant pastures together with accumulated leaf litter under the bloodwoods are highly susceptible to wild fires started by pre-wet lightning strikes.

The deep sandy soils are extremely deficient in phosphorus and have very low salt content.

The deep free-draining soils provide important recharge for aquifers of the Great Artesian Basin.

Scrubs on deep clays

Gidgee and brigalow on low woodlands may be associated with boree, leopardwood, yapanyah, blackbutt, false sandalwood, poplar box, coolabah and currant bush.

The deep clay soils are fertile and the vegetation has often been cleared for planting productive pastures of buffel grass. Preferred native grasses include bull Mitchell grass and bluegrasses; non-preferred grasses include five minute grass and wiregrasses.

Recommended pasture utilisation is 30%.

Scrubs on shallow clays

This blackwood open woodland on plains and slopes has scattered coolibah, river red gum, blackbutt, false sandalwood, bauhinia, belah, ironbark, leopardwood, Reid River box, currant bush and mimosa. The moderately fertile soils are shallow, uniform grey and brown cracking clays with hard-setting topsoil over a sodic subsoil.

Perennial (3P) grasses include Mitchell grasses (barley, bull, hoop, curly), desert bluegrass, Queensland bluegrass, forest bluegrass and silky browntop, with Flinders and button grass as annuals. Buffel grass can be found in the central and southern areas.

Channels and swamps associated with major streams

Coolabah, river red gum and box woodlands grow on mostly sandy soils of moderate fertility. There is an understory of whites ironbark, currant bush, wattle and mimosa.

Preferred grasses include green couch, bull Mitchell grass, forest bluegrass, desert blue grass, golden beard grass and kangaroo grass.

Ideally these areas should be fenced off to retain water quality and used only for dry season grazing.

Weeds, such as copperburr, are a problem , as are wild pigs.

These watercourse and swamp areas provide important habitat for migratory waterbirds, breeding frogs and as water source for many species.

Jump-ups

Jump-ups include scarps, hills and ridges of generally shallow and stony soil on bedrock or with a hardpan of ironstone or silcrete, with some sodic subsoils that are highly susceptible to erosion.

Jump-ups generally carry a low open woodland of lancewood, bendee, mulga and Normanton box but may have some scattered eucalypt species.

Soft spinifex and golden beard grass grow, but less desirable wiregrasses are abundant.

Recommended pasture utilisation is very light at 15%.

Downs country

Downs country consists predominantly of Mitchell grasslands, but has some whitewood, blackwood, whites ironbark, ghost gum, bloodwood, gidgee and boree.

Preferred grasses include curly, barley and bull Mitchell grasses, Queensland bluegrass and native millet.

Less desirable grasses include feathertop and white speargrass (wiregrass).

Downs country is susceptible to parthenium infestation.

The soils are deep grey or brown cracking clay with a self-mulching surface.

The recommended pasture utilisation is 30%. Overgrazing that consistently removes all ground cover and causes compaction of the soil structure will have an impact on wildlife that lives in the cracks and tussocks.

Frontage country

Frontage country of deep silty to clay loam over clay has woodlands of river red gum, narrow-leaved ironbark, Moreton Bay ash and some bloodwoods, coolabah and box.

Preferred grasses include black speargrass, desert bluegrass and kangaroo grass, while undesirable grasses include wiregrasses. The recommended pasture utilisation is 25%.

Ideally these areas should be fenced off for watercourse protection and grazed only during the dry season.

Dunes

Dunes and lunettes are found on lake fringes and plains. The deep sands or sandy topsoils over saline grey clays carry a low open woodland of sally wattle, ironwood and beefwood, often with very sparse ground layer.

Preferred grasses include marine couch and buffel grass, but wiregrasses are invasive. A pasture utilisation of 15% should maintain sufficient ground cover to stabilise the dunes.

Lake beds

These flat pans are open shrublands of samphires, grasslands, sedgelands and ephemeral herblands.

Soils are shallow sandy loam over saline clay or hardpan with high sodicity.

The soils are deep uniform cracking clay with a self-mulching surface, but with some sodicity at depth.

Preferred herbage includes saltbush but copperburr is present.

Lakebeds should be grazed only during the dry season and lightly, with a 10% pasture utilisation.

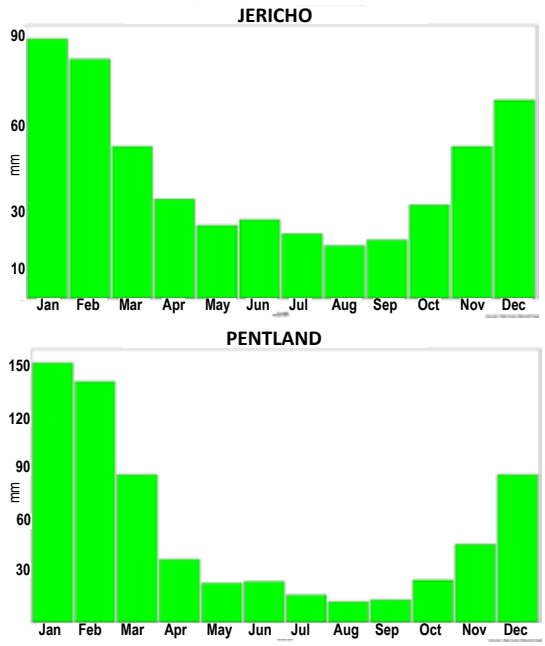
6.3. Climate

The climate of the Desert Uplands varies from semi-arid in the southern portion to intermediate arid tropical in the north.

Rainfall

The rainfall patterns for Jericho in the south-east and Pentland in the north-west (Figure 6.1) illustrate that the northern regions have wetter wet seasons but more severe dry seasons.

Figure 6.1. Graphs of average monthly rainfall showing the different patterns between the south-east and the north-west.



More detailed monthly rainfall data for the two towns is given in Table 6.1.

Climate or weather?

Climate is what you should be getting and weather is what you get. Use seasonal climate forecasts for strategic decisions and weather forecasts for tactical decisions.

Seasonal climate forecasts are probabilistic showing the chance of getting so much rain over the coming season.

Global climate model (GCM) forecasts such as those from the Bureau of Meteorology based on the states of the oceans and atmosphere are constantly improving in accuracy, duration and resolution.

How much influence does ENSO have?

The great variation in rainfall over the years (Table 6.1) indicates that the climate of the area is strongly under the influence of ENSO (El Niño-Southern Oscillation).

There has been a nearly 60% difference in average summer rainfall for Jericho, depending on the strength of the SOI (Southern Oscillation Index), over the past 100 years (see Table 1.1 on page 2).

El Niños generally break in autumn as the heat equator heads toward the Northern Hemisphere. This break is often followed by heavy rainfall leading, to the sequence of famine to flood to fire.

Floods can also be caused by excessive run-off of water over an extended period during a La Niña year. La Niña also influences the number of tropical cyclones in the ocean adjacent to northern Australia and the associated catastrophic inland downpours.

Temperatures

January and February are the hottest (and wettest) months, with July and August the coldest. Mild frosts may be experienced in the southern part of the region on up to seven nights during winter.

Table 6.1. Variability in monthly rainfall at Jericho and Pentland

Monthly rainfall (mm) recorded at JERICHO P.O. over last 119 years	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Median	68	61	37	14	9	18	8	8	6	24	33	50	491
Highest on record	434	389	338	386	280	168	204	152	176	297	363	355	1,298
Lowest on record	0	0	0	0	0	0	0	0	0	0	0	0	189

Monthly rainfall (mm) recorded at PENTLAND P.O. over last 131 years	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Median	122	123	60	20	9	13	4	3	1	15	33	67	613
Highest on record	781	586	390	338	144	196	128	88	120	104	227	348	1,574
Lowest on record	2	0	0	0	0	0	0	0	0	0	0	0	95

Useful sources of information

Land types of Queensland – Desert Uplands
State of Queensland (2017). Land types of Queensland. Version 2.0 (September 2017). Queensland Department of Agriculture and Fisheries, Brisbane, Qld
https://futurebeef.com.au/knowledge-centre/desert-uplands/

Northern Australian Fire Information (NAFI) for fire management, hot spots, fire scars, fire history, bushfires and wildfires in tropical savannas.
www.firenorth.org.au/

Land systems - Desert Uplands strategic land resource assessment (DUSLARA)
http://qldspatial.information.qld.gov.au/catalogue/custom/search.page?q=DUSLARA+mapping
Please note that a CD with mapping for each property in the Desert Uplands is also available from the Desert Uplands Committee office.

Grazing Land Management – EDGE workshop
https://futurebeef.com.au/workshops/sustainable-grazing/grazing-land-management-edge/

Bureau of Meteorology for weather and seasonal climate forecasts
www.bom.gov.au

The Long Paddock – view sections and maps on the seasonal climate outlook, the current and past SOI, rainfall and pasture growth, drought, and AussieGRASS.
https://www.longpaddock.qld.gov.au/

Queensland Drought Mitigation Centre – Support tools to help farm managers use the improved seasonal forecasts in their planning. It also provides advice on climate change projections at regional levels and how to adapt to the changing climate.
https://www.longpaddock.qld.gov.au/queenslanddroughtmonitor/drought_research.html

Rainman StreamFlow climate analysis tool for your PC
Free download from:
https://www.daf.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/cropping-efficiency/rainman
- or Google Rainman StreamFlow

ClimateARM is a new online version of Rainman StreamFlow.
http://www.armonline.com.au

Will it rain? The effects of El Niño and the Southern Oscillation on Australia
University of Southern Queensland, Toowoomba 2017
https://www.usq.edu.au/research/environmental-sciences/qdmc-drought

Impacts and adaptation strategies for a variable and changing climate in the North West Queensland Region
Impacts and adaptation strategies for a variable and changing climate in the Central West Queensland Region
Cobon DH, Terwijn MJ, and Williams AA (2017). International Centre for Applied Climate Sciences, University of Southern Queensland, Toowoomba, Queensland, Australia
https://www.usq.edu.au/research/environmental-sciences/qdmc-drought

Breedcow and Dynama software
https://www.daf.qld.gov.au/animal-industries/beef/breedcow-and-dynama-software

BBSAFe – Breed, Buy, Sell, Agist, Feed evaluator
https://www.usq.edu.au/research/environmental-sciences/qdmc-drought

The **Future Beef web site** contains information on a range of Meat & Livestock Australia's EDGE network training workshops for graziers.

- Grazing land management EDGE
- Grazing fundamentals EDGE
- Nutrition EDGE
- Business EDGE
- Breeding EDGE

https://futurebeef.com.au/workshops/

Stocktake: balancing supply and demand
Stocktake is a paddock-scale land condition monitoring and management package to provide grazing land managers with a practical, systematic way to:

- assess land condition and long-term carrying capacity
- calculate short-term forage budgets.

https://futurebeef.com.au/workshops/sustainable-grazing/stocktake-balancing-supply-demand

Phosphorus management of beef cattle in northern Australia
Meat & Livestock Australia 2012
https://futurebeef.com.au/document-library/phosphorus-management-beef-cattle-northern-australia/

Weaner management in northern beef herds
Meat & Livestock Australia 2012
https://futurebeef.com.au/document-library/weaner-management-northern-beef-herds/

Heifer management in northern beef herds
Meat & Livestock Australia 2012
https://futurebeef.com.au/wp-content/.../Heifer-management-in-northern-beef-herds.pdf

Dry season management of a beef business: a guide to planning, managing and supplementary feeeding.
Russ Tyler (2008), Department of Primary Industries and Fisheries, Queensland.
https://futurebeef.com.au/wp.../Dry_season_mgt_of_a_beef_business_LowRes.pdf