Rain waiter or decision maker?

Managing Mitchell grass during drought

Queensland Government
Department of **Primary Industries and Fisheries**

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May 2007

This booklet was produced by the Department of Primary Industries and Fisheries (DPI&F), Queensland through Meat and Livestock Australia (MLA) and the Land Water and Wool (LWW) 'Mitchell grass death in Queensland: extent, economic impact and potential for recovery' project NBP.343.

LandWater & Wool
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Queensland Government
Department of Primary Industries and Fisheries

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The Department of Primary Industries and Fisheries (DPI&F) seeks to maximise the economic potential of Queensland's primary industries on a sustainable basis.

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Economic data were generously provided by Peter Whip of PRW Agribusiness (33 Duck Street, Longreach Q 4730) based on real-world situations.

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Foreword

Enigma: n. Riddle: puzzling person or thing.

Rain and the resultant pasture are to many of us the basis of our western Queensland extensive grazing industry. The rain we can do nothing about; the pasture, which for many of us is native grasses (basically Mitchell), is another matter.

Yet the current run of dry seasons since 2000 has highlighted how little we know about Mitchell grass and how varied its responses are to rain, grazing, fire, lightning, or the lack of any of these.

David Phelps and his team have drafted together science, pastoral experiences, observations and folk lore to have as a reference and to stimulate debate about this enigmatic plant.

This publication is not the be all and end all of the Mitchell grass saga; it is an attempt to retain current knowledge and to encourage discussion on how to best manage Mitchell grass. Too many of our veterans are going over the great divide without leaving the legacy of their knowledge for those who follow. As an example, the current average age of ringers, managers and head stockmen would be under 25 – and the time spent gaining knowledge or discussing pasture management is drastically reduced due to the demands being placed upon them.

Congratulations and heartfelt thanks must go to David Phelps, the DPI&F team and the people of western Queensland who have contributed to this effort.

Mitchell grass has suffered from dieback before but this time the area and time scale are much greater. If you read this and have something to contribute please do so for the sake of our great region, industry and way of life.

Peter Douglas, Juno Downs Jundah

The impact of drought on Mitchell grass pastures

Drought is part of the production cycle in western Queensland, not some unexpected occurrence. There have been 12 extended droughts (of at least 24 months duration) at Longreach since the 1880s, with the Federation drought (1898-1904) and the current millennium drought (2001-2003) said to be the worst on record (Table 1).

Drought	Period	Duration (months)	Total rainfall (mm)	% of time in severe drought [1]
1	Mar 1898 to Jan 1904	71	1,395	46
2	Mar 1913 to Jun 1916	40	840	35
3	Mar 1918 to Apr 1920	26	607	0
4	Feb 1925 to Aug 1931	79	1,705	23
5	Jan 1934 to Feb 1936	26	585	33
6	Apr 1937 to Sep 1939	30	532	14
7	Jul 1944 to Jul 1947	37	793	14
8	May 1965 to Jan 1968	33	648	10
9	Mar 1968 to Dec 1970	34	748	64
10	Feb 1987 to Feb 1989	25	614	0
11	Mar 1991 to Nov 1993	33	590	40
12	Jan 2001 to Dec 2003	36	706	31

Table 1. Periods of extended drought for Longreach between January 1893 and May 2006.

Rainfall records alone fail to reveal the whole story from 2004 onwards. Patchy rain in the Longreach district suggests that the millennium drought ended in December 2003, but the rains which did fall in early 2004 failed to produce any response from Mitchell grass pastures at all. Most Mitchell grass tussocks throughout the west produced a low-vigour response at best. Few Mitchell grass tussocks 'came away well' even with total rains in excess of 250 mm (10 inches). This failure of Mitchell grass to respond sparked much debate over the future of Mitchell grass pastures, within both industry and scientific circles. As a result of this debate, Meat and Livestock Australia (MLA), Land Water and Wool (LWW) and the Department of Primary Industries and Fisheries (DPI&F) joined forces to find out more about the impact of drought. More importantly, research has started to identify improved drought management for Mitchell grass country.

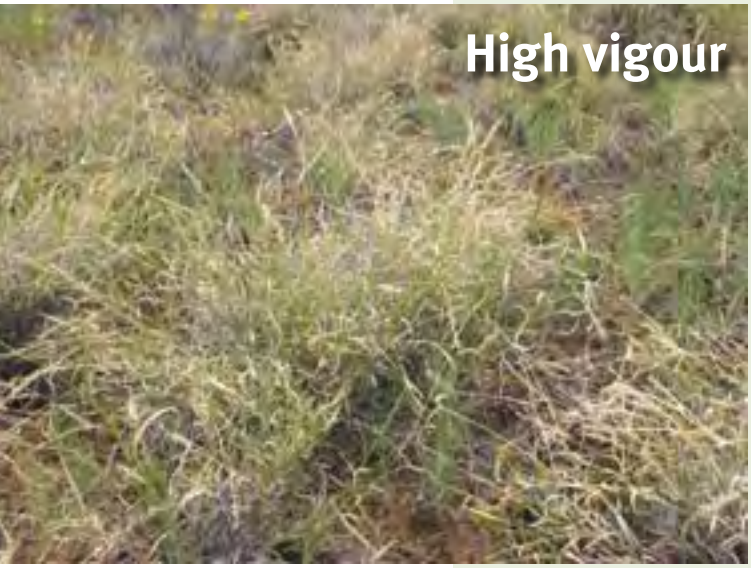
[1] SEVERE drought refers to the driest 5% of years for each 24-month period.

A plant that has responded with low vigour may display some of the following:

- greening of existing stems
- very little new leaf produced
- small sections within the tussock responding (as illustrated by the picture)
- some new tillers being produced at base of plant
- very few if any seed heads produced
- not much useable forage is produced.

Grazing which removes the fresh growth from isolated, stressed tussocks reduces:

- root growth
- the ability to respond effectively to rain
- seed production
- future pasture yields.



A plant that has responded with high vigour may display some of the following:

- entire tussock has responded with new growth
- existing stems have greened and produced leaf
- large numbers of seed heads have been produced
- has grown a good bulk of useable forage
- many new tillers being produced from the base of the plant.

Grazing high vigour tussocks to less than 10 cm height by the end of the dry season:

- fragments and stresses the tussock, leaving it more vulnerable to drought
- may reduce root growth and the ability to respond effectively to rain
- may increase seed production when coupled with a wet season spell.

‘We’ll all be rooned said Hanrahan …’

- John O’Brien [2]

Well, maybe not. Poor pasture response, and wide-scale death of Mitchell grass tussocks, has occurred historically in line with periods of extended drought since grazing of sheep and cattle commenced between the 1860s to 1880s.

Reports expressing concern over the loss of Mitchell grass can be easily found in historical literature. There are sketchy historical records describing poor pastures and extreme stock losses during the Federation drought. The Queensland Government botanist, Selwyn Everist, reported concerns in a number of articles throughout the drought years of the 1930s. Generally, the response of Mitchell grass was recorded as patchy. In the Winton district in 1934, response to early rains was not very good, and it was thought that ‘after eleven year’s drought the Mitchell grasses would not come back at all’. However, experiments conducted on the then Australian Estates Company property, *Eldersleigh*, in the Winton district over the 1935-36 summer revealed a dominance of Mitchell grass in pasture harvests following good January rains in 1936. This suggests that the Mitchell grass in the Winton district recovered quite rapidly.

In the Boulia district, the response during the 1930s ‘was rather patchy. In those areas which received rains in November and December, the Mitchell grass responded well, but in those areas which missed the early rains and received only the February rains, the response was poor’. For the Longreach district, historical reports were then conflicting. For the Longreach-Jundah district, it was written that ‘Mitchell grasses…responded remarkably well, having regard to the seasonal conditions. Old tussocks believed to be dead showed a wonderful recovery.’ However, the district Inspector of Stock reported that ‘the Mitchell grass responded very poorly even in places where conditions were favourable, and where it was reasonable to expect good results. Only a percentage of the old roots responded to the good rains’.

Local knowledge from central-western Queensland also reports severe effects on Mitchell grass tussocks in the 1960s drought, and for some areas, the 1980s. However, it is difficult to find detailed records of the pasture condition for the remaining seven drought events, highlighting the necessity of capturing detailed observations and conducting field experimentation during the current event.

Mitchell grass pastures have recovered from severe droughts previously. However, the millennium drought appears to have been different. Even where good summer rains (>250 mm) fell in western Queensland in January-February 2004, there was a lack of response from Mitchell grass tussocks. This was in spite of generally early de-stocking and the retention of grass stubble. The only areas where a response was reported were those fortunate enough to receive 20-50 mm of rain prior to Christmas, suggesting that early rain is critical in promoting Mitchell grass response during drought.

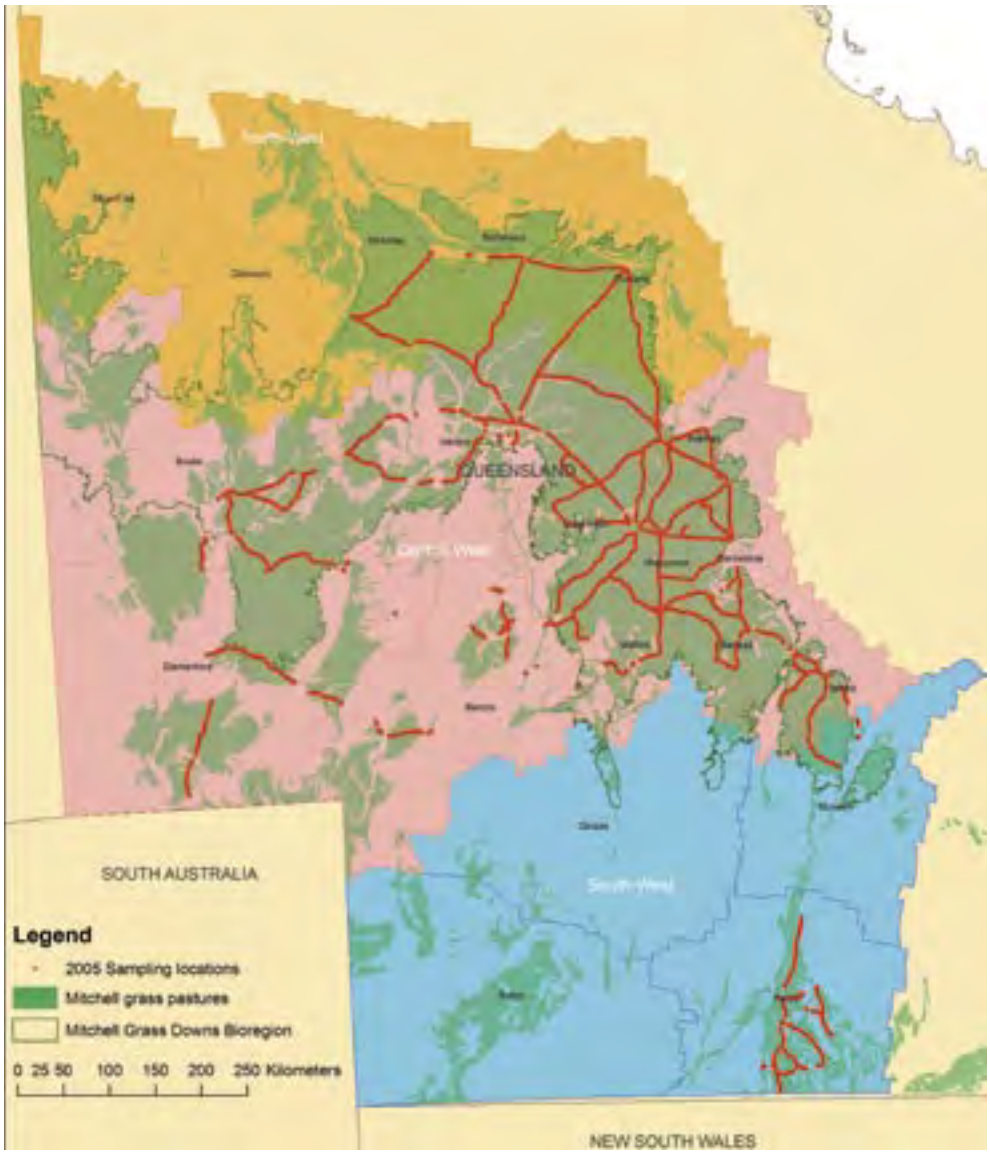
[2] The full poem by John O’Brien can be found at the end of this publication

... And there may well be cause for concern

Despite the rainfall records suggesting the millennium drought to be finished, most of the Mitchell grass country was still drought-affected by the end of summer in 2007. Some pockets of country received drought-breaking summer rains between 2004 and 2007, but widespread summer rains generally failed to eventuate.

The short-term productivity and long-term health of Mitchell grass pastures in 2005

Surveys of the productivity of Mitchell grass pastures in Queensland were undertaken by DPI&F staff in mid to late 2005 to provide a better picture of the impact of the drought than rainfall records alone could. Productivity was assessed at over 4000 locations by estimating pasture yield and Mitchell grass tussock vigour throughout the Mitchell grasslands (See Map 1). This information has been used to support Exceptional Circumstances applications and reviews by providing a useful snapshot of the impact of the drought and the potential conditions needed for recovery.



Map 1. The sampling routes (red line) undertaken during 2005 and 2006 within the Mitchell grass pastures (green shading) of the Mitchell grass bioregion (green outline) of the north-west, central-west and south-west statistical divisions.

Short-term production losses

In Mitchell grass pastures short-term production losses can be estimated by assessing pasture yield and the vigour of the Mitchell grass tussocks that are responding. Mitchell grass vigour can be estimated on a scale of none to very high and is based on the amount of growth shown by individual tussocks. There may be few tussocks actually responding to rain, but if these have grown well and gone to seed, then the vigour will be high. The lack of response in other tussocks does not necessarily mean the rest of the Mitchell grass is dead, but it does mean they are not contributing to the pasture.

The short-term productivity of Mitchell grass pastures was understandably low when assessed in 2005, as patchy rains only had been received over the 2004-05 summer. Mitchell grass vigour was lowest in the south-west (Murweh and Paroo Shires with over 90% of the Mitchell grass country showing no to low response. The north-west (Shires of Flinders, Richmond and McKinlay) did not fare much better with 80% of the survey sites showing no to low vigour. The central-west (Boulia, Winton, Longreach, Aramac, Ilfracombe, Isisford, Barcoo Shires) was better, with half of the sites surveyed showing at least moderate vigour (Figure 1).

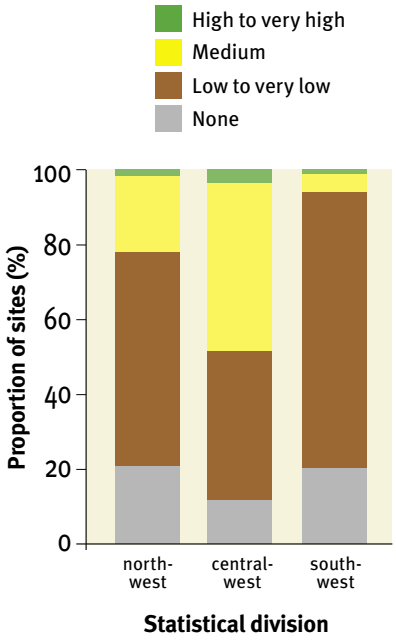


Figure 1. Mitchell grass tussock vigour (from very high to none) having responded to rain over the 2004-05 summer, as the proportion of all sites surveyed within the north-west, central-west and south-west statistical divisions.

Pasture yields ranged between 300 and 750 kg/ha, which is less than half that generally expected for Mitchell grass country (Figure 2). Pasture yield included approximately 200 kg/ha of dead inedible pasture in each Statistical division. In the south-west, dead pasture accounted for half of the total yield. The low pasture vigour and yields are reflected in reports of stock numbers being reduced by 50% or more on most properties throughout Mitchell grass country.

Long-term production losses

The potential future loss in productivity was assessed at the same time, by estimating the density of Mitchell grass tussocks still capable of responding to rain. In many areas the millennium drought has lead to the wide-spread death or weakening of Mitchell grass tussocks. For Mitchell grass pastures, this signifies substantial areas in low, or moderate, health.

Mitchell grass health can be estimated as the density of tussocks still capable of responding to summer rain, on a scale of none to very high. A tussock may show no current response but be drought dormant and hence still capable of responding to reasonable rains. In many cases, however, tussocks are obviously dead, e.g. they can be easily kicked out of the ground, and have no capacity to respond. Health is thus a measure of the longer-term potential of the pasture to respond to drought-breaking rains and to quickly return to full productive potential.

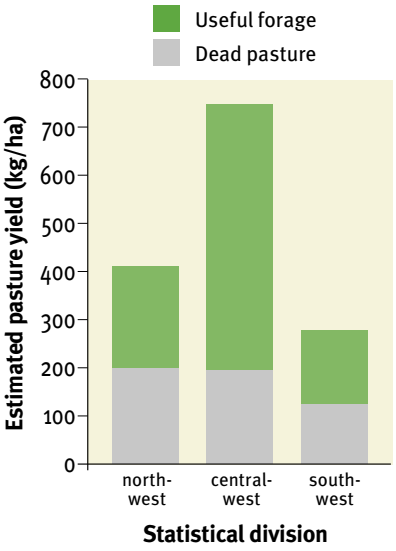


Figure 2. Pasture yield (kg/ha of dry matter) estimated within the north-west, central-west and south-west statistical divisions during winter 2005. Useful forage is available to sheep and cattle, whilst dead pasture is old and inedible material.

A pasture in low health may display some, or all, of the following:

- low to very low tussock density of approximately one live Mitchell grass tussock every 20-30 paces or less
- the bulk of the feed restricted to short-lived annual grasses or forbs following rain
- severely reduced carrying capacity in the longer term (generally less than 50% of the nominal long-term average).

A rapid return to moderate pasture health and reasonable productivity may result from well above-average rains. Improvements in health may be hastened through grazing practices which protect isolated tussocks and encourage seedling growth, such as spelling for the entire wet season (October – March).

A pasture in moderate health may display some, or all, of the following:

- moderate tussock density of approximately one live Mitchell grass tussock every 5-10 paces
- feed comprised of a mix of Mitchell grass and short-lived annual grasses or forbs
- reduced carrying capacity in the longer term (generally 60-75% of the expected long-term average).

A rapid return to high pasture health and full productivity is possible following above-average rains. Improvements in health may be hastened through grazing practices which allow tussocks to grow and replenish energy reserves, such as spelling during the early wet until Mitchell grass has gone to seed (generally 6-8 weeks after rain).

A pasture in high health will display the following:

- high to very high tussock density of approximately one live Mitchell grass tussock every 2-3 paces
- feed dominated by Mitchell grass but supplemented by other perennial grasses, short-lived annual grasses, forbs and legumes
- no reduction in potential long-term carrying capacity, although reduced in the short-term depending on rainfall and on Mitchell grass tussock vigour.

A pasture in high health will return to full productivity when average to above average rains wet the soil up sufficiently to promote high Mitchell grass vigour. The grazing practices which have promoted high pasture health in the past, such as conservative stocking or spelling fresh growth, should continue to promote high pasture health into the future.

Mitchell grass health was medium to high for most areas in the central and north-west statistical divisions, providing an optimistic outlook for reasonable pasture recovery once drought-breaking rains do fall. However, in the south-west nearly 70% of areas were showing low pasture health and hence a reduction in long-term productivity (Figure 3). The most critical areas in the central and north-west were re-assessed in 2006 (Figure 4).

Pasture health declined in just 12 months. The area re-surveyed in 2006 increased from 30 to 60% of the country being in low health. New drought management strategies, based on sound grazing principles such as wet-season spelling, as well as rain, will be critical in returning these pastures to full health and productivity.

In addition, 5-10% of sites in 2005-06 had no tussocks capable of responding to rain. These areas will require careful pasture management to encourage pasture re-establishment from seedlings.

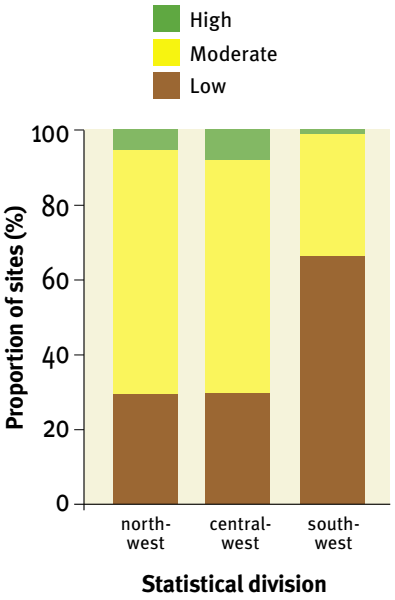


Figure 3. Mitchell grass pasture health in winter 2005 within the north-west, central-west and south-west statistical divisions. Health was assessed by estimating the density of Mitchell grass tussocks capable of responding to rain.

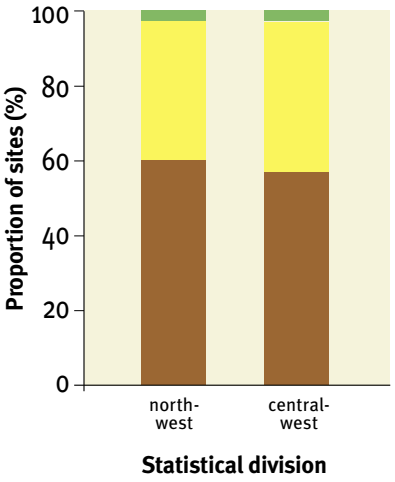


Figure 4. Mitchell grass pasture health in winter 2006 within the north-west and central-west statistical divisions. Health declined in both areas, suggesting new drought management strategies are needed to promote recovery.

The drought is really hitting the hip pocket

The economic cost of low pasture health within the central-western Shires of Longreach, Barcaldine, Ilfracombe and Isisford combined has been estimated at $15,000,000 per annum until the health of the country is restored. This cost is based solely on the reduced capacity of the country to carry livestock. This estimate does not include the direct costs to grazing enterprises with Mitchell grass pastures in low health, such as increased strategic supplementation, drought feeding and agistment.

Property figures from western Queensland demonstrate that proactive management as well as rain makes a large difference to profitability of an enterprise – especially during drought years.

Table 2. Management can make all the difference during poor and good seasons[3].

management approach	low-input manager	proactive manager	low-input manager	proactive manager
seasonal conditions	poor season	poor season	good season	good season
cattle number (AE)	700	2,400	1,000	3,300
ha/AE	19	16	8	10
gross margin/AE	$95	$110	$110	$210
return on equity	-7%	1%	2.5%	5%
summary position	negative income	breaking even	doing OK	doing very well

What is AE?

AE is an adult equivalent, a 450 kg dry beast. Standardising to an AE allows for a fair comparison across enterprises.

[3] Courtesy of Peter Whip, PRW Agribusiness Longreach.

How might future droughts affect Mitchell grass pastures?

The issue of climate change was prevalent in the media in early 2007, often in the context of drought[4]. Increased rainfall variability, and an increased frequency of drought, is one of the most likely outcomes of climate change across Mitchell grass country. In turn, this is likely to lead to increased death of Mitchell grass tussocks but potentially also increased recovery from seedlings. Any overall reduced rainfall may lead to less annual grasses, such as Flinders grass, and more forbs, such as Flinders poppy, boggabri and verbine.

Under this scenario, grazing management strategies will need to provide more frequent wet-season spelling to ensure the recovery of Mitchell grass country following more frequent droughts. If more spelling is not used, it is quite possible that Mitchell grass country in good health will become relegated to folk-lore. The potential exists for the health of Mitchell grass country to start a steady decline. Do the conditions of the millennium drought suggest this decline has already started, or will the country bounce back as good as ever?

So what do you reckon is effective drought management?

3P Grasses are:

- Perennial i.e. long lived – providing stability to our grazing systems
- Productive i.e. producing a good bulk of feed
- Palatable i.e. providing nutritious feed readily eaten by livestock.

The maximum benefit in terms of long-term productivity in Mitchell grass pastures comes from ensuring high numbers of live Mitchell grass tussocks. Mitchell grass can be promoted by applying the following principles:

- generally aim to keep 15-20 cm of tussock stubble height by the end of the dry season to promote new growth following rain
- promote seed production through infrequent (e.g. once every 10 years) heavy grazing to reduce tussock stubble height to 5-10 cm at the end of the dry season – but only when an above-average summer is anticipated
- retain isolated tussocks and tillers in low health pastures to build soil seed levels and encourage seedlings
- spell fresh new growth for 2-4 weeks at the start of the growing season to strengthen these tussocks in low health pastures
- protect seedlings from heavy grazing for 2-3 summers, especially in low health pastures.

Fortunately, Mitchell grass is tough. This resilience comes from a number of sources:

- the clay soils supporting Mitchell grass are relatively fertile, deep and naturally resistant to erosion through good soil structure and gentle relief. These soils provide good growing conditions because they are able to hold water for extended periods of time, allowing Mitchell grass roots to tap into deeper moisture reserves and keep the tussock alive
- Mitchell grass is a 3P grass (see feature on this page for details). Many individual tussocks live for 20-30 years. These tussocks can continue to produce seed and maintain soil seed reserves, allowing for germination of seedlings with drought-breaking rains. Seedlings that are allowed to grow rapidly to larger than 5 cm diameter at the base appear to have a greater chance of surviving droughts

[4] More information is available from The Queensland Climate Change Centre of Excellence at www.nrw.qld.gov.au/climatechange/

- Mitchell grass can become dormant during drought, reducing the impact of severe moisture stress
- sheep graze annual grasses and forbs before Mitchell grass, effectively providing an early wet season spell for the fresh Mitchell grass growth under moderate to low stocking rates. However, if there has not been enough rain and these sweet alternatives are not readily available, sheep will heavily graze the fresh Mitchell grass growth. Under high grazing pressure, these herbages are grazed out earlier, resulting in fresh Mitchell grass growth being grazed too soon
- infrequent high summer rainfall events germinate and establish seedlings, and re-invigorate the pasture irrespective of the current grazing pressure.

3 *Which pasture would you prefer to have in the long-term?*

Perennial Mitchell grass dominating healthy pastures providing relatively stable production

Annual grasses dominating unstable production

Unpalatable forbs dominating a relatively unproductive pasture

4 *Broken up Mitchell grass tussocks are less productive than intact ones*

When grazing keeps Mitchell grass tussocks short, especially during drought, the combined stresses of grazing and a lack of moisture breaks tussocks into smaller segments. These segments are less vigorous, are less likely to survive drought, and are less productive than large intact tussocks. Spelling during the early growing season allows these segments to grow well and re-form into larger tussocks. This can help promote the survival of Mitchell grass during drought – a time when the rate of plant death is naturally high.

Left: This broken up (segmented) tussock will reform and become stronger with wet season spelling

Rain waiter or decision maker?

Making the most of your Mitchell grass really boils down to one simple question:

Do you want to wait to be 'bailed out' by an infrequent and unpredictable well above-average rainfall event, or do you want to proactively manage to make efficient use of your rain?

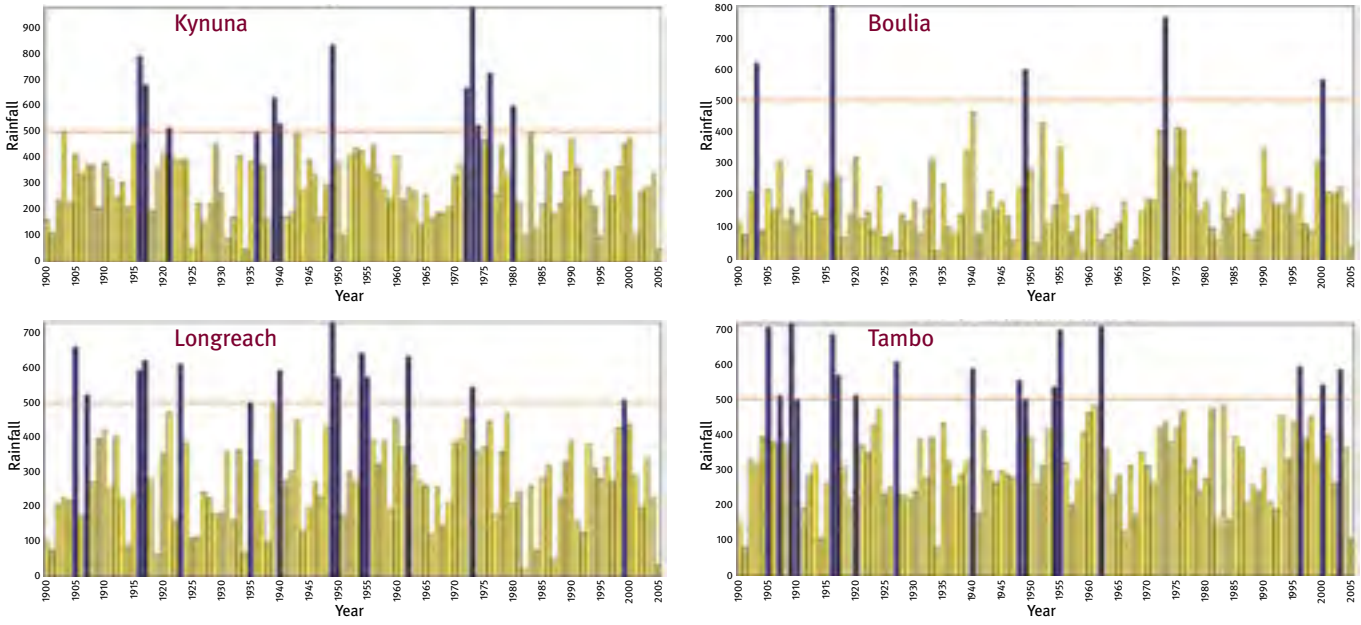
'She'll be right – I'll just wait for the rain ...'

The Federation drought and the droughts of the 1930s and the 1960s all broke with well above-average summer rains of at least 500 mm. Can we expect the millennium drought to break with such good rains? Or will the rains accumulate over the following summers, gradually restoring Mitchell grass health – assuming our grazing management allows it to recover?

Such well above-average rain germinates remaining seed, establishes seedlings and reinvigorates mature tussocks. The 1950s and 1970s are renowned for such good rainfall. Indeed, many of the Mitchell grass tussocks struggling during the millennium drought probably established during the 1971-74 period.

How often do these rains occur? Is it really a viable strategy to rely solely on well above-average rain to restore the health of the Mitchell grass country? If we define drought-breaking rains as 500 mm (20 inches) over the summer months (October to March), then this might occur as often as every 10 years, depending on location. At Kynuna, for instance, this level of rainfall has occurred in 12 summers between 1900 and 2005; in five summers at Boulia; 14 summers at Longreach; and 17 summers at Tambo (Figure 5).

Figure 5. The probability of receiving 'drought-breaking' summer rains (>500 mm over summer) at Kynuna, Boulia, Longreach or Tambo, based on historical rainfall records.



Many graziers have observed that early rains are needed to reinvigorate Mitchell grass and to establish Mitchell grass seedlings. If we say that early drought-breaking rains must provide at least 100 mm (4 inches) in a five day period before Christmas, the odds are considerably worse. Kynuna has had only six such rainfall events; Boulia had four; Longreach had nine; and Tambo had 10 in the last 105 years (Figure 6).

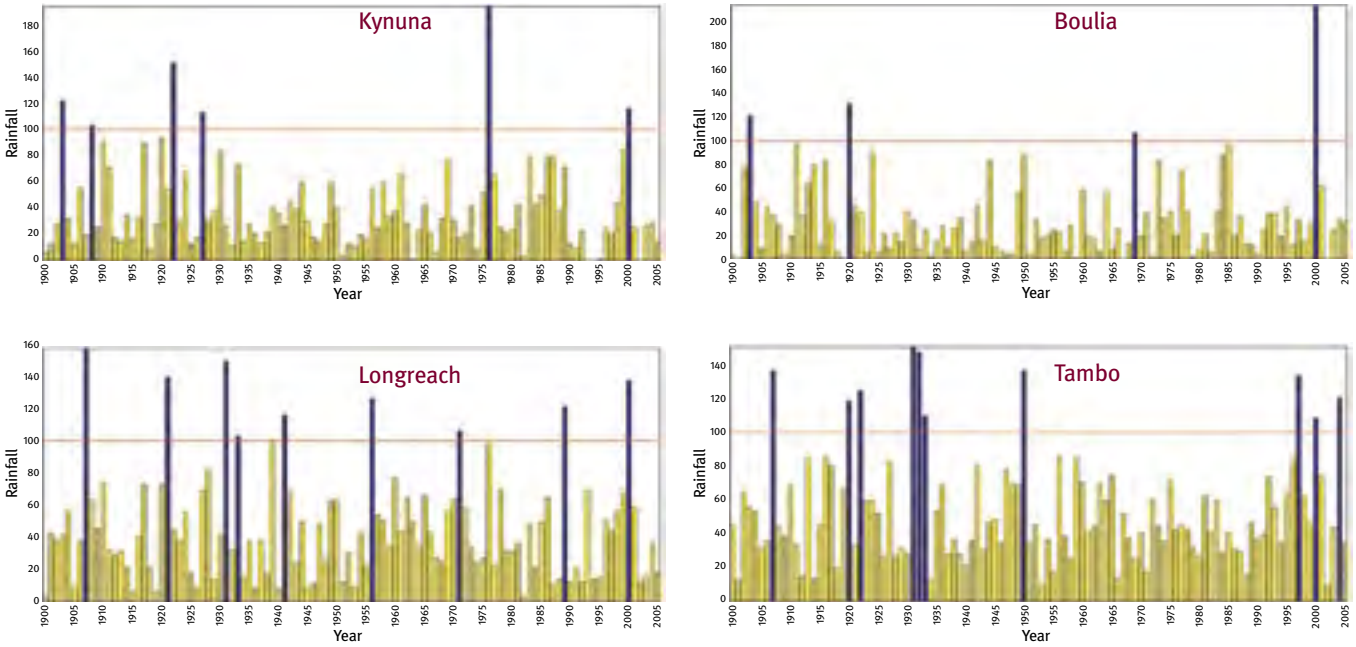


Figure 6. The probability of receiving good early summer rains (>100 mm over five consecutive days) at Kynuna, Boulia, Longreach or Tambo, based on historical rainfall records.

Drought-breaking rains, should they fall as well above-average summer rains or good early summer rain, save Mitchell grass. These rains bail us out – regardless of management strategies – because the recovery is so fast that there is not enough grazing pressure prior to re-stocking to damage rapidly growing seedlings or quickly emerging stems.

Some Mitchell grass always survives during drought, either as isolated tussocks (e.g. in depressions where rain is concentrated) or as 'low-vigour rootstock' where the rhizomes buried below ground have enough life to respond to exceptionally high soil moisture.

5 *Mitchell grass can recover from drought as isolated tussocks, 'low vigour rootstock' or as new seedlings*

Isolated tussocks survive during drought, producing seed ready for the next generation of Mitchell grass

'Low-vigour rootstock'– Mitchell grass stems growing from old, buried, rhizomes but without any evidence of an old tussock on the surface

Mitchell grass seedlings establish with good summer rains – especially if not being out-competed by annual grasses and forbs

Healthy Mitchell grass, such as the ungrazed seedling on the left, have well developed root systems. Constant grazing (e.g. the seedling on the right) stops roots from developing

'No, I don't want to leave it up to chance ...'

I want to proactively manage my pasture so it will recover faster at the end of this drought."

The most effective strategy to help rapid pasture recovery following drought appears to be maintaining high pasture health, both leading up to and during the drought. Dense Mitchell grass tussocks (one every 2-3 paces or better) which have high vigour going into a drought have a better chance of surviving until the next rains. Vigorous, robust Mitchell grass tussocks store starch as an energy reserve and have well developed root systems that can tap into deep moisture to prolong life as long as possible.

What are some of the practical measures that can help to maintain healthy Mitchell grass pastures?

Develop realistic expectations of what your country can produce. It may be useful to benchmark the carrying capacity of your country using Natural Resources and Water figures as a guide or by attending a DPI&F Grazing Land Management workshop. Discussing realistic long-term production (e.g. wool cuts or beef production) and carrying capacity figures with your neighbours may also be of benefit.

High pasture health

Don't commit fully to any one management strategy. Develop a flexible approach to grazing management based on observing the results of grazing by sheep or cattle at different times of the year and in different locations. Your observations can be enhanced by implementing a monitoring system, such as the DPI&F StockTake feed budgeting and paddock monitoring package. Incorporate the best available current advice into your flexible grazing strategy.

Adhere to the following general principles when developing your flexible grazing strategy:

- graze to balance animal need with the feed on offer, and generally utilise only 30% of the feed
- don't consistently graze fresh new Mitchell grass growth all year every year. Grazing of fresh new growth needs to be coupled with wet season spelling to prevent damage to Mitchell grass tussocks
- in general, aim to graze to 15-20 cm by the end of the dry season, and don't graze below 10 cm
- occasionally spell by deferring grazing for 6 to 8 weeks after rain to allow Mitchell grass to go to seed
- consider occasional heavy grazing (e.g. once every 10 years) coupled with early wet season spelling to promote Mitchell grass seed production, except during drought as Mitchell grass tussocks are already weakened through low soil moisture levels.

Note: When we talk about a 'wet season spell' we are assuming that it is summer rain promoting Mitchell grass growth. Occasionally, there is enough winter rain coupled with warmer temperatures to allow Mitchell grass growth. In this case an effective spell can be achieved over winter. Essentially the

concept of spelling or resting is as simple as avoiding grazing fresh Mitchell grass growth to allow the plant to develop strong roots and store starch to be ready to respond effectively to rain.

What are some practical measures to stop a moderately healthy pasture from slipping into low health during drought?

Moderate pasture health

Again, a realistic expectation of the productivity of your country during drought is essential, and maintaining a flexible management strategy is even more critical.

Base your grazing strategy on the principles stated above, but bear in mind that it is crucial to protect the live Mitchell grass tussocks in your pasture. This may be best achieved through:

- spelling critical areas or paddocks for 2 to 4 weeks following rain, allowing the fresh leaf to photosynthesise and replenish energy reserves in the crown and promote root growth
- practicing whole of wet season spelling to promote growth of fragmented tussocks into stronger more robust plants and to allow Mitchell grass root growth and the storage of starch.

Very low stock numbers, in the order of a dry sheep equivalent to 4-8 ha (10-20 acres) or lighter, may achieve the same effect as wet season spelling, although some patches will always be grazed more heavily and suffer as a result. There is speculation that the presence of sheep deters grazing by kangaroos. If correct, it may help to stock very low rates of sheep to keep the overall grazing pressure low by deterring kangaroos.

My pasture is in low health, with very few live Mitchell grass tussocks – surely grazing heavily can't make it any worse?

Low pasture health

Nothing could be further from the truth. As with country in moderate health, the few isolated tussocks struggling to come back as low vigour rootstock or small numbers of stems, are critical to the future health of the pasture. Even scattered tussocks across a paddock will produce enough seed to replenish the amount of seed in the soil, promoting re-establishment of Mitchell grass from seedlings when the right rains fall.

The only way that a pasture in low health can improve is through Mitchell grass re-establishment from seed and seedlings. Some practical strategies to help re-build pastures in low health include:

- whole of wet season spelling, or at least until Mitchell grass has gone to seed, to protect isolated tussocks
- whole of wet season spelling, or conservative stocking, for 2-3 seasons following Mitchell grass germination to allow these young plants to grow, mature and become robust
- reduced sheep numbers, or de-stocking entirely, if there are signs of the sheep digging up Mitchell grass tussocks as a source of drought feed.

In the case of low health pastures, there is often valuable feed provided by Flinders grass or other annual grasses or forbs. These components of

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the pasture can be grazed without damaging the Mitchell grass, provided Mitchell grass tussocks are observed for signs of grazing. If there are signs that Mitchell grass is being pulled out of the ground, then stock numbers (especially cattle) within the paddock should be reduced. All stock should be removed once Mitchell grass tussocks are grazed to a height of 15-20 cm.

I can't afford to reduce stock numbers any further - my cash flow is already too low!

Can you afford to have pastures in low health now and into the future? It is a reality that many people cannot reduce stock numbers any lower during the millennium drought, or there will be insufficient cash flow to survive. Balancing short-term demands with long-term goals is never easy. If you can't see any way of modifying grazing management now for long-term gains, then how about planning for future droughts? Consider the options that you have chosen over the last 10 years and weigh up those that have, or have not, worked.

The key challenge in creating an effective, flexible grazing strategy is balancing your short-term demands, such as maintaining cash flow, with promoting long-term pasture health. However, the productivity of your pasture, the health of your country and the success of your business all depend upon achieving the right balance.

6 *Are sheep or cattle 'harder' on Mitchell grass country?*

Cattle numbers have been increasing throughout Mitchell grass country since the early 1990s at the expense of sheep numbers, mainly due to market forces. Part of this process of change has included a renewal of the debate over which animal can be 'harder' on Mitchell grass.

Overgrazing occurs when there are too many mouths for the amount of feed on offer. The most critical time for Mitchell grass is when it has a short fresh green pick. At this time the grass needs every last square centimetre of leaf to capture the sun's energy and replenish its own reserves – especially during drought. Over-grazing by any animals – sheep, cattle or kangaroos – will do damage unless the short green pick is first allowed to grow to replenish plant energy reserves.

Right: This image shows Mitchell grass where the leaves should have done their job and re-stocking is possible. To maximise the health of the pasture, spelling until Mitchell grass has seeded is even better.

Cattle have a broad muzzle which limits their capacity for diet selection, and are unable to graze right down to ground level. As a result, cattle diets are typically dominated by grasses although they are capable of including forbs in their diet. Cattle can eat relatively coarse stem and if pushed, will leave only 5-10 cm of Mitchell grass stubble behind.

Cattle draw feed into the mouth by wrapping their tongue around plants at the same time as biting and tugging to break off a bite-sized portion. This tugging can lead to portions of Mitchell grass being pulled out of the ground – especially when the soil is wet. Mitchell grass growing in ashy soils may be particularly susceptible.

Cattle are most likely to damage Mitchell grass through tugging portions out of the ground during the wet season, or by grazing tussocks down too low towards the end of the dry season.

Sheep have a narrow muzzle allowing for a high level of selectivity within the pasture and are able to graze right down to ground level. As a result, sheep diets are typically dominated by forbs or annual grasses which tend to grow close to the ground.

Sheep nibble, and are unable to draw feed into the mouth with the tongue. This means that sheep are not able to eat as much stubble, and generally graze the most succulent plants with the least resistance to being bitten off.

During drought, the alternative succulent feed often fails to grow – meaning that sheep are concentrating on the fresh leaf of Mitchell grass. During the height of drought, sheep will also dig up the crown (the raised base of the plant) and rhizomes (the swollen underground portion at the base of the stem) of Mitchell grass tussocks, leaving only small and fragmented plants which cannot respond well to rain.

Sheep are more likely to damage Mitchell grass through constantly grazing the short green pick during drought and by digging up the crowns and rhizomes.

Kangaroos in large numbers can be very damaging to green pick as well, not just because they are selective but also because they may be relatively mobile – especially in times of drought [5].

Following a drought it is tempting to re-stock or bring stock back from agistment as soon as possible. Regardless of the grazing animal, this is likely to weaken the pasture as fresh Mitchell grass leaf is grazed instead of replenishing vital starch stores.

[5] See the book 'Living with kangaroos' for more information

What have we learnt during the millennium drought?

We now have enough experience and knowledge to understand that there are ways to speed up the recovery of Mitchell grass tussocks. A speedy recovery of Mitchell grass means a speedier recovery for the country's carrying capacity and a faster return to full productivity.

Where there is still a reasonable density of living Mitchell grass (one tussock for every 5-10 paces, or better), light grazing early in the wet season will allow these tussocks to replenish their store of starch. A good store of starch allows the tussocks to grow more vigorously with further rains. A good rule of thumb is to spell country following the first summer rains, until the Mitchell grass has gone to seed. A single wet season spell can be sufficient to promote the rapid recovery of existing Mitchell grass tussocks.

Where most of the Mitchell grass has died and the density of tussocks is low (one tussock for every 20-30 paces or less), recovery will be through encouraging seedling establishment. Mitchell grass seedlings germinate best over summer, and establish well if there is follow-up rain. Follow-up rain promotes seedling root growth and tillering, and this allows seedlings to survive over the dry season. Grazing pressure at the time of seedling establishment appears to make little difference to their survival – which is basically dependent on rain. However, overgrazing in subsequent summers prevents these seedlings from growing properly. Light grazing, or two to three years of wet season spelling, is the best management option to promote rapid seedling recovery. Heavy grazing of the seedlings inhibits root growth and also prevents the expansion at the base which is needed for storage of starch and promotion of new stems.

In addition, we now understand that may be possible to reduce the impact of drought on Mitchell grass through alternative grazing strategies or through burning. For instance, some areas which were burnt in the early 2000s and spelled have consistently shown a better response to rain than areas which were not burnt. Other burnt areas, when also grazed by kangaroos or livestock, have not responded any better than surrounding un-burnt areas. Areas burnt prior to 2001 do not demonstrate the same benefits. While we do not yet fully know how, it is clear that burning has the potential to mitigate the impact of drought.

In some areas where grazing has been confined to the dry season while Mitchell grass is not growing, the Mitchell grass tussocks have consistently shown a better response than neighbouring areas. Alternatively, other areas grazed heavily by sheep at the start of the wet season have reduced the competition from Flinders grass and annual herbages, leaving more soil moisture available to promote rapid Mitchell grass growth.

Main paddock (left hand side) showing a poor response, or laneway (right hand side) showing a good response.

Which pasture would you have preferred following 150 mm rain in early 2004?

Case study 1 – **Wet season spelling coupled with short-duration heavy grazing in winter**

Mitchell grass tussocks in a laneway in the Ilfracombe district have been heavily grazed for 3-6 weeks every winter for the last 20 years or more, leaving very little stubble behind. The response, even during the height of the drought, has been spectacular. Mitchell grass tussocks have grown new stems from the crown, producing good feed and also setting seed. Simple tests of soil moisture levels suggest that rains have penetrated to 60-70 cm depth within the laneway, but only to 30-40 cm depth within the paddock.

Main paddock – predominantly dead Mitchell grass, Flinders grass and herbage

Laneway – healthy, vigorous Mitchell grass with herbage in between

In the main paddock, Mitchell grass tussocks failed to respond

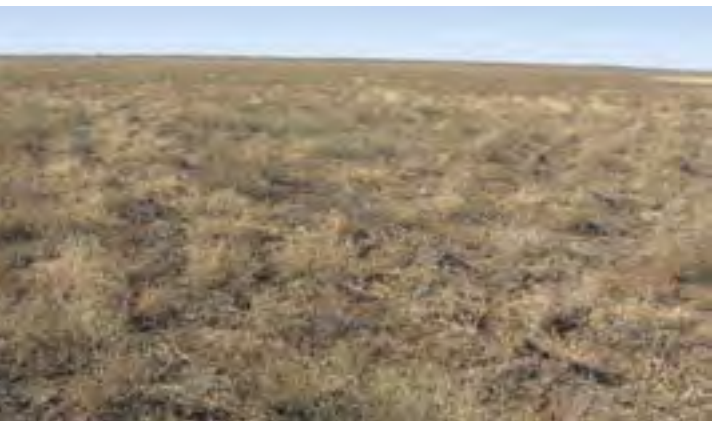
In the laneway, individual Mitchell grass tussocks have responded with new stems from the crown, even though they were grazed back to the crown in the previous winter.

Unburnt area (left hand side) shows a poor response whilst the burnt area (right hand side) shows a good response.

Which pasture would you have preferred in November 2005?

Case study 2 – **Wildfire in late April 2001 promoted the survival of Mitchell grass**

Mitchell grass in a burnt area in the Aramac district responded well following late summer rains in 2004. The pastures were spelled, or grazed only lightly for the three years following the fire. The surrounding unburnt pasture failed to respond to the same rain, as did large areas in the central-west. Could the fire have removed old dead stems, stimulating the production of new stems better able to survive drought?



Unburnt area – patchy, isolated Mitchell grass struggling to make use of rain during the drought

Burnt area - quickly responding Mitchell making the most of rain during the drought

The burnt area can be clearly seen as healthy Mitchell grass within an area of dead Mitchell grass and roly poly

An area where sheep have grazed out the competition during rain, allowing Mitchell grass to grow vigorously (left hand side), compared with an ungrazed area full of competing Flinders grass (right hand side).

Which pasture would you have preferred following good rain in early 2006?

Case study 3 – **Could reducing the competition give Mitchell grass a head start?**

Could early wet season grazing with sheep have a role in reducing competition as a short-term strategy to promote Mitchell grass growth under some circumstances? The notion goes against conventional scientific wisdom. Undoubtedly, any benefits would be realised only when coupled with precise timing of stocking and resting, such as grazing with sheep for 2-4 weeks in the very early wet season and then spelling for the remainder of the wet. All evidence demonstrates that continued high grazing pressure would certainly lead to low pasture health with feed dominated by unpalatable forbs such as roly poly or galvanised burr.

Main paddock – quickly responding Mitchell grass making the most of soil moisture without competition from Flinders grass.

Stock route – patchy, isolated Mitchell grass, struggling to compete for moisture with Flinders grass.



Continued high grazing pressure will lead to low pasture health, irrespective of the type of animal (sheep, cattle or kangaroos).

Roly poly is one consequence of constant heavy grazing, especially when coupled with late winter rain. Roly poly is often an indicator of low pasture health, but may also protect vulnerable Mitchell grass seedlings from overgrazing.

Galvanised burr is another consequence of constant heavy grazing. Galvanised burr is generally a sign of low pasture health.

Flinders poppy, an unpalatable and potentially poisonous plant, can also dominate heavily grazed areas.

There has not yet been enough research or trial and error to define practical management strategies based on burning or alternative grazing approaches. However, there is enough evidence to give hope that there will be more validated options available to reduce the impact of drought on Mitchell grass in the future.

We do not have all the answers, but we do have a blend of science and experience that shows Mitchell grass is healthy and vigorous when fresh new growth is not constantly grazed off, and when tillers are allowed to grow and set seed, and that pastures are better able to recover if the reserves of Mitchell grass seed are high.

In summary:

- early summer rain can keep Mitchell grass growing better than post-Christmas rain; however, early summer rain does not occur very frequently
- Mitchell grass can die, or die off substantially, during drought, and therefore needs replacing by new tillers or seedlings
- drought often leads to a decline in the health of country, regardless of most management practices with resulting costs as high as $15,000,000 per annum for the central western shires of Ilfracombe, Longreach, Aramac and Barcoo alone – without even accounting for the cost of agistment, feeding or restocking
- very little Mitchell grass country was at peak health in 2005 following five years of drought
- management can alleviate the impacts of drought, allowing for opportunities during drought and increasing the rate of recovery afterwards:
  - decrease grazing pressure on seedlings or tussocks for as long as possible by
    – drastically reducing stock numbers
    – spelling the country after the drought.
- observations of enhanced Mitchell grass response have been made in areas that have:
  - been burnt
  - reduced competition from annual grasses
  - been rested over summer but grazed heavily for 4-6 weeks during winter.

Further sources of information

Training packages

Grazing Land Management, Stocktake and NutritionEDGE training workshops are available through the DPI&F. Contact you local office, the DPI&F on 13 25 23 or visit http://www2.dpi.qld.gov.au/beef/18481.html for more information.

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The Leading Sheep Drought e-books series

The Queensland Climate Change Centre of Excellence at www.nrw.qld.gov.au/climatechange/

Historical information sources

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Angela Moffat (1987). "The Longreach Story". Published by The Jacaranda Press, Longreach Shire Council.

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‘Said Hanrahan’ *by John O’Brien*

“We’ll all be rooned,” said Hanrahan,
In accents most forlorn,
Outside the church, ere Mass began,
One frosty Sunday morn.

The congregation stood about,
Coat-collars to the ears,
And talked of stock, and crops, and drought,
As it had done for years.

“It’s looking crook,” said Daniel Croke;
“Bedad, it’s cruke, me lad,
For never since the banks went broke
Has seasons been so bad.”

“It’s dry, all right,” said young O’Neil,
With which astute remark
He squatted down upon his heel
And chewed a piece of bark.

And so around the chorus ran
“It’s keepin’ dry, no doubt.”
“We’ll all be rooned,” said Hanrahan,
“Before the year is out.”

“The crops are done; ye’ll have your work
To save one bag of grain;
From here way out to Back-o’-Bourke
They’re singin’ out for rain.

“They’re singin’ out for rain,” he said,
“And all the tanks are dry.”
The congregation scratched its head,
And gazed around the sky.

“There won’t be grass, in any case,
Enough to feed an ass;
There’s not a blade on Casey’s place
As I came down to Mass.”

“If rain don’t come this month,” said Dan,
And cleared his throat to speak -
“We’ll all be rooned,” said Hanrahan,
“If rain don’t come this week.”

A heavy silence seemed to steal
On all at this remark;
And each man squatted on his heel,
And chewed a piece of bark.

“We want an inch of rain, we do,”
O’Neil observed at last;
But Croke “maintained” we wanted two
To put the danger past.

“If we don’t get three inches, man,
Or four to break this drought,
We’ll all be rooned,” said Hanrahan,
“Before the year is out.”

In God’s good time down came the rain;
And all the afternoon
On iron roof and window-pane
It drummed a homely tune.

And through the night it pattered still,
And lightsome, gladsome elves
On dripping spout and window-sill
Kept talking to themselves.

It pelted, pelted all day long,
A-singing at its work,
Till every heart took up the song
Way out to Back-o’-Bourke.

And every creek a banker ran,
And dams filled overtop;
“We’ll all be rooned,” said Hanrahan,
“If this rain doesn’t stop.”

And stop it did, in God’s good time;
And spring came in to fold
A mantle o’er the hills sublime
Of green and pink and gold.

And days went by on dancing feet,
With harvest-hopes immense,
And laughing eyes beheld the wheat
Nid-nodding o’er the fence.

And, oh, the smiles on every face,
As happy lad and lass
Through grass knee-deep on Casey’s place
Went riding down to Mass.

While round the church in clothes genteel
Discoursed the men of mark,
And each man squatted on his heel,
And chewed his piece of bark.

“There’ll be bush-fires for sure, me man,
There will, without a doubt;
We’ll all be rooned,” said Hanrahan,
“Before the year is out.”

Around the Boree Log and Other Verses, 1921

Rain waiter or decision maker? Managing Mitchell grass during drought provides the latest guidelines to managing Mitchell grass pastures for productivity and sustainability during drought. Scientific research has been combined with the insights and experiences of graziers within western Queensland to produce a guide that is both factual and practical. This guide provides advice on:

- the vigour and health of Mitchell grass pastures from Cunnamulla in the south, Richmond in the north, to Boulia in the west
- the short and long-term impacts of drought and pasture vigour and health on productivity and income
- how climate change may influence future droughts and pasture vigour and health
- the different impact of sheep and cattle on drought stressed pastures
- practical measures to maintain healthy Mitchell grass pastures.

Rain waiter or decision maker? reveals that many questions remain unanswered. However case studies provide evidence that wet season spelling and burning or grazing to reduce competition may provide clues to improved drought management in the future.

This book will be useful for graziers, natural resource management groups and practitioners, scientists and people with an interest in native pastures.