HOW TO MAKE MONEY OUT OF GRASS

A farmer’s guide to grazing management of native pastures in the Northern Agriculture Districts of SA
Acknowledgements

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The group consists of more than 300 farmers throughout the Northern Agricultural Districts of South Australia as well as government representatives and other interested people in the community.

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Introduction

Grazing management is the area of livestock and pasture management where there is the biggest potential gain for the smallest investment.

Careful attention to detail in this area can reap big rewards in terms of pasture productivity, weed control and animal performance.

Most producers consider the livestock business, not the grass business, as their primary occupation, so their main focus is on the animal and not on how the pasture grows and responds to grazing.

However if production is to be maximised, an understanding of this relationship is essential.

In the Northern Agricultural Districts of South Australia, most livestock will be spending part of their lives grazing native pasture.

The basis of a native pasture is perennial native grass, of which there are several common species (see pages 47–57 for more information). The spaces in between the grass tussocks would have originally been filled by native broad leaved plants, mosses and lichens.

Traditionally these native pastures are on the non-arable areas of the farm and are continuously grazed at the same time each year (usually from the autumn break in May until harvest in December) to fit in with the cropping program.

Over time, this has reduced the population of native perennial grasses and produced pastures dominated by introduced annual grasses such as wild oats and barley grass.

From a pasture management point of view, these annual plants are not desirable.

They compete strongly for nutrients and moisture while producing little leaf material, are low in palatability and actively grow for only a few months of the year.

Native grasses are perennial and will persist for many years if grazed correctly.

Native grasses are resistant to drought, frost tolerant and many are highly palatable and vigorous growers.

The condition of your native pasture resource is of vital importance to the long-term profitability of the grazing enterprise on your property.

The information contained in this book is based on six years of research carried out in this region and will help you to:

- Learn about native pasture management
- Understand the principles of planned grazing management
- Give you simple steps to develop your own grazing plan
- Improve your farm profitability
- Protect and sustain your land
- Provide you with practical pasture monitoring tools

"Livestock — it’s an appreciating asset!"
The Aim

This book focuses on the plant production side of your livestock enterprise.

It brings together the knowledge you already have, tells you about the management practices that have been developed through research and hopefully makes you more aware of what is happening in your pastures.

Sustainable grazing management of grasslands can increase the biodiversity of native pastures and the profitability of livestock enterprises in the long-term, resulting in a win-win situation for farmers and the environment.

It is not an easy task to manage native pastures because there is no fixed recipe. The land manager needs to have an understanding of:

- The complex interactions between plants, soils, rainfall and grazing animals
- How to monitor for changes in pasture condition
- The plants that grow in these native pastures

The aim of any grazing management system should be to match the feed production cycle of the pasture as closely as possible to the needs of the livestock.

Livestock production is about converting sunlight energy into forage and forage into harvestable livestock products in a sustainable manner. The livestock are the four-legged combine that the farm manager can use to harvest their crop.

Essentially all life in native pastures relies on the plant’s ability to convert sunlight into an edible form.

This is through the process of photosynthesis, through which they are able to capture the sun’s energy and convert it to plant material.

This is called primary production and is the basis of virtually all life on earth.

All other organisms get their energy through consuming the products of photosynthesis.

The first level of consumers are animals and insects which eat the grass.

The second level of consumers eat the animals that eat the grass. This includes people, carnivorous animals such as dogs, many birds and some insects.

The flow of sunlight to food for life is represented as an energy pyramid, as shown in Figure 1 on page 3 (overleaf).

In a sustainable system there is a balance between plant production, the number of consumers which live off that plant production, and the return of nutrients back to the soil to maintain the system.

The key for the grazing manager is to find that balance.
FIGURE 1: The basic energy pyramid. Sunlight energy must firstly be converted by the plants at the base of the pyramid (Level 1) before it can be used by other life forms.
Grasses and Grazing

Grasses are nature's selection of plants that can tolerate grazing.

Grasses can be perennial, living for many seasons, or annual, which means they grow from a seed, flower and die, all in one growing season.

Broad-leaved plants, often called herbs or forbs, can also be annual or perennial.

Both grasses and broad-leaved plants can be either summer-active or winter-active.

Summer-active plants respond to late spring and summer rainfall and can provide green pick throughout the summer. Winter-active grasses are dormant in summer and respond to rain in autumn and winter.

Keeping a diverse range of species in a pasture provides a reliable source of feed.

For example, annual plants respond to rainfall and grow quickly before dying off, but slower growing perennial grasses provide a greater bulk of feed that will carry stock through dry periods and they can use water that falls at any time of the year, not just through winter.

Broad-leaved plants are less tolerant of grazing but are a good source of minerals and are an important part of a diverse pasture.

Sheep grazing a native pasture may eat more than 30% of broad-leaved plants in their diet.

How old is that grass?

Perennial plants grow from a long lived base of roots and growing tips which can last for many years.

The plant may have dead material standing above the ground with the growing tips at the base of the plant just waiting for moisture so that they can grow.

Removing the dead material through grazing allows sunlight to reach the base of the plant and enables rapid response of the new young growth tips to moisture.

Established perennials produce new leaf material more quickly after rain than annuals which have to grow from a seed.

Which plants will grow best?

In southern Australia, growth occurs when there is sufficient soil moisture, which is usually in the winter and spring months.

Plants compete for light, space and nutrients. Above ground, shading can reduce the number and size of plants that will grow.

As the above ground parts of the plant grow, the roots of the plant also grow and compete for moisture and nutrients from the soil.
Broad-leaved plants have a single long tap-root and can reach down deep into the soil whereas grasses have a shallow, fibrous root system and are able to efficiently extract soil moisture near the surface.

See Section 7 on pages 47–57 for a description and photographs of the common native grasses found in pastures in the Northern Agricultural Districts to help in identification.

The Mid North Grasslands Working Group (MNGWG) has also produced a plant identification guide to the native grassland plants of the Northern Agricultural Districts of South Australia. See Section 8 on page 58 for more information.

When do plants flower?

The nutritional quality of grass declines very quickly after it flowers.

In southern Australia, most plants grow through the winter and flower and set seed in spring and early summer.

There are also summer growing plants that flower in late summer and autumn.

Annual plants die soon after setting seed while perennial plants go into a state of dormancy after seed set.

It is important that plants be allowed to set seed at least every couple of years for the regeneration of new plants.

What happens when a grass is grazed?

If a perennial grass plant is grazed – and to keep it healthy, grasses need to be grazed – it needs time to recover before it is grazed again. See Figure 2 on page 7 which shows a perennial plant’s response to grazing.

Wallaby Grass (Austrodanthonia spp.) is one of the most valuable native grass species in the Northern Agricultural Districts of SA, due to its productivity and persistence under grazing.

Corrugated Sida (Sida corrugata) is a small perennial herb (broad-leaved plant) which is often found in grazed pastures. It has a five-petalled yellow flower.

The fan flower (Scaevola albida) is a small native perennial creeping herb which produces five petalled flowers in a fan shape during spring.
When the top of the plant is eaten by an animal, the stores of starch in the roots provide the energy for new shoots to be produced.

Roots are very important to the plant. Not only do they capture moisture and nutrients from the soil, they also store excess energy produced by the leaves safely below the ground as starch.

If it is grazed again before the roots have had time to recover, the whole plant is weakened because it does not have a renewed store of energy in its roots from which to fuel new stem and leaf growth.

If this happens continually, as it does to the more palatable plants in a set stocked pasture, the perennial plants gradually get smaller and smaller, and so weak that eventually they die.

**This is why recovery periods are the most important part of successful grazing management.**

The recovery periods vary throughout the year, depending on temperature, rainfall and sunlight availability and pastures need to be continually monitored to ensure the recovery periods are adequate.

The leaf acts as a solar panel to capture sunlight and allow the plant to photosynthesize and grow, and more solar panels you have working in the paddock the better the pasture will perform.

As a rough guide you should not take more than half the total dry matter out of the pasture at each grazing event.

In the Northern Agricultural Districts, a recovery period is likely to be between 30 days in spring up to 180 days in summer.

The shorter the recovery period the more essential it is to monitor the growth rate during this period. Experience will be the best guide to the right recovery period.

The more paddocks you have, the more flexibility you have in matching your recovery period to plant growth.

**What is grazing quality?**

Plants vary in their feed value throughout the year. When a plant is young it has high levels of protein and water but little energy in the form of dry matter.

As a plant matures, the protein level drops and the amount of dry matter increases. When pastures have dried off, protein levels are low and animals struggle to obtain their basic nutritional requirements.

Animals need a balance of energy and protein in their feed and will do best on a mature, but still actively-growing pasture.

Good quality forage is broken down quickly by the bacteria in the rumen of the grazing animal and are digested and pass efficiently through the animal. The animal can then keep eating and producing.

Poor quality feed (high in dry matter and low in energy) takes a long time to break down in the rumen because it is woody, and nutrients are deficient.

The feed stays in the rumen for longer and the animal's productivity is affected.

Animals need to be supplemented appropriately to balance any pasture deficiencies.
1. Mature plant with mature root system before being grazed by livestock.

2. Immediately after the leaf material is removed by the grazing animal, the roots start to die.

3. Root material is used by the plant to provide energy for leaf regrowth.

4. As the plant grows more leaf material and is able to produce energy through photosynthesis, roots also start to regrow. If the plant is grazed again at this stage, there is not enough root material to support leaf regrowth.

5. As the plant increases in size, so does the root area increase in size.

6. Mature plant ready to be grazed again. Note the fully developed root system which will provide the energy for the plant to regrow again after grazing.

FIGURE 2: Perennial plant response to grazing.
Grazing Management

Setting management objectives

Before any pastures can be managed, the first step is to set a management objective for both your whole farm and each individual paddock. For example:

- What production do you want to achieve from your native pasture?
- What time of the year do you want to use it? eg. is it to be winter grazed or grazed throughout the year?
- Is the paddock to be used as a lambing paddock or for producing finished stock for market?
- Is bare ground a problem?
- Are grass seeds an issue for your stock during spring?
- Do you have a particular weed issue eg. Salvation Jane or Geranium?
- Is stock water availability an issue?
- Do you need to split mobs of ewes to achieve breeding objectives?
- Will you need to destock if conditions are dry?

Matching stock class to your pastures is an important consideration when setting your management objectives.

Native pastures are ideal for lambing ewes and dry stock but are not generally suitable for weaners or finishing lambs, when an improved pasture, such as vetch or clover, would be ideal.

Thinking through these issues when setting your management objectives, will lead to better outcomes for your pastures, livestock and your bank balance.
Determining a grazing strategy

Farmers in the Mid North have been using several different grazing management strategies.

This includes set stocking, rotational grazing or planned grazing.

Which strategy you use may depend on the number of paddocks available, seasonal conditions, your management objectives and your time commitments.

Set stocking or continuous grazing:

Animals are not moved between paddocks but are kept in the same paddock for extensive periods of time, for example 3–12 months, as shown in Figure 3 below.

The number of stock may be adjusted to match the feed available or the same number of animals may be used to stock the paddock continuously each year regardless of seasonal conditions. Plants are continuously exposed to grazing.

FIGURE 3: In a set stocked grazing system, animals are kept in the same paddock for long periods of time.
Rotational grazing:

Rotational grazing usually comprises 3–7 paddocks per mob which are grazed on a fixed rotation according to the calendar (eg. stock are moved every 10 days, irrespective of pasture and seasonal conditions) or on stock condition (eg. if the stock are losing weight, move them) as shown in Figure 4 below.

FIGURE 4: In a rotational grazing system, animals are grazed on a fixed rotation, usually according to the calendar or based on stock condition.
Planned Grazing:

Grazing according to plant growth using as many stock as possible (e.g., 370 sheep per hectare) for a short time period such as 1–3 days as shown in Figure 5 below.

This grazing management strategy can also be called cell grazing or high density, short duration grazing.

Farmers involved with the MNGWG and Land, Water & Wool grazing trials have found that by using planned grazing systems they have increased their pasture productivity, stocking rates, water use efficiency and significantly reduced bare ground in their pastures.

Planned grazing has also shown the greatest increase in abundance of perennial grasses and increased the size and health of these native plants.

See Section 3 for a full report on the project results.

FIGURE 5: In a planned grazing system, animals are grazed according to plant growth rates, using as many stock as possible for a short time period.

“This must be winter....the grass is taking 55 days to grow!”
Principles of planned grazing management

**Principle 1: Ensure that plants get an adequate recovery period**

Perennial grass plants are vital to the stability of a native pasture and considering their productivity is the most important factor in your grazing planning.

After a grass is grazed it needs time to regrow its leaves using energy stored in its roots.

The amount of leaf removed in a grazing period and the daily growth rate of the plant are the keys to determining the rest period.

*In the climatic conditions experienced in the Northern Agricultural Districts plants can take 90–180 days to recover during winter and 30–40 days to recover during spring.*

During summer when there is usually very little pasture growth, recovery periods are less important as the plant is not actively growing.

Depending on the number of paddocks available it may not be possible to achieve the optimum rest period but the rule is any rest is better than no rest.

**Principle 2: Match stocking rates to carrying capacity**

Always match stocking rates to the carrying capacity of your property. This needs to be applied every time animals are moved into a new paddock.

Carrying capacity is related to total feed production. For more information on carrying capacity and how to determine stocking rates see pages 14–16.

This is part of planned grazing and as pasture growth varies both from year to year and throughout the year, it needs to be closely monitored. Never assume that the pasture production this year will be the same as last year or even last month.

**Principle 3: Utilise a short graze period**

For maximum pasture and animal performance, animals should graze a paddock for no more than 3–4 days.

But this will depend on the number of paddocks available and most farm managers find they have to graze for longer periods because of a limited number of paddocks available.

Longer graze periods will result in decreased animal production.

**Principle 4: Ensure maximum stock density for the minimum time**

Stock density is the stock number on a given area at a point in time.

For example, if there are 100 animals in a 100 hectare paddock today, the stock density is 1 animal to 1 hectare. If we move the 100 animals to a 50 hectare paddock, the stock density would then be 2 animals to 1 hectare.

High stock density encourages more even utilisation of pasture plants. It reduces selective grazing which favours less palatable plants including many annual weeds such as Saffron Thistles and Salvation Jane.

High stock density also creates animal impact. Animal impact is the normal trampling effect of livestock on pasture plants and the soil surface which helps water infiltration and the cycling of organic matter.
When time in a paddock gets shorter and stock densities get higher, dung and urine are more evenly distributed and animals are continually moving onto fresh ground which has significant benefits for animal performance. Grazing at low stock density (2.5 Dry Sheep Equivalents/ha) for long periods of time can cause serious land and productivity problems.

**Principle 5: Ensure livestock has an adequate water supply**

Water quality and quantity is critical for livestock performance. Ensuring there is an adequate supply of water, preferably from clean tanks and troughs, rather than dams, is essential.

A minimum flow rate into the trough of 1 Litre/second per 2000 DSEs is required. Trough size is not as important but you need to ensure there is always water in the trough no matter how many sheep or cattle are drinking.

**Principle 6: Plan, monitor and manage the whole grazing system**

Traditionally farmers have used the condition of animals to indicate the success of their management practices. But animal performance is a poor indicator of pasture condition, especially in the short-term.

Major changes in pasture condition occur gradually so identifying changes at an early stage enables you to adjust your management accordingly.

It is important to keep records as people’s memories are short-lived and selective. The first monitoring sets the benchmark from which the pasture may improve or decline in condition.

Following monitoring results will indicate a trend for either decline or improvement in condition and this trend is an important tool in decision making for your grazing management.
Stocking rates

- Stocking rate is defined as the number of animals on an area (usually one hectare) for a period of time (usually one year).
- Usually measured in Dry Sheep Equivalents (DSE).
- For example, a stocking rate of 10DSE/ha means there were 10 sheep on one hectare for 365 days.
- A dry sheep is a 50kg wether and it is generally accepted an animal of this size will eat approximately one kilogram of feed per day.
- Therefore a flock of 500 wethers will eat approximately 500kgs of feed per day.

Sustainable stocking rates

- A sustainable stocking rate is generally no more than 50% of the grass grown should be consumed by the animals.

Why only 50% pasture utilisation?

- At least 50% of standing feed needs to be left as a reserve to maintain the pasture. This reserve:
  a. Provides cover against soil erosion
  b. Adds leaves and roots to the litter layer for nutrient recycling
  c. Helps prevent invasion by undesirable species
  d. Retains seed for new plants
  e. Provides a base for new season pasture growth
  f. Helps provide an emergency feed reserve if the autumn break is late.
- In Figure 7 below notice how it takes 10 days for the pasture to grow from 500kg/ha to 1600kg/ha, but only another 10 days to grow from 1600kg/ha to 3500kg/ha.
- In the first 10 days, the pasture grows at an average of 49.8kg/ha/day. In the second 10 days the pasture growth rate is increased to 110.2kg/ha/day and in the third 10 days the pasture growth rate is increased to 190kg/ha/day.
- This happens because there is a lot more leaf material to produce energy for the plant to grow.
- So, the more pasture that is left behind after grazing, the more quickly the plant recovers and the better the pasture regrowth rate and production.

FIGURE 7: The relationship between pasture utilisation and pasture growth after grazing.
Carrying capacity

- Carrying capacity is how much a property can produce dependably for an infinite time
- Each property will have a different carrying capacity depending on your soil type, rainfall, timeliness of rain and pasture type
- You will usually have a good idea of the ability of your property to grow grass
- Carrying capacity will change seasonally and from year to year, so pasture growth rates and productivity need to be reviewed regularly throughout each year
- Stocking rates should be matched to carrying capacity
- Carrying capacity is related to total feed production. Standing feed at the end of the dry season shows how well stocking rate was matched to pasture growth during the season

How do I determine stocking rates?

- You need to know how much available feed is in your paddocks

Available feed:

- Quantity of pasture in the paddock
- Measured as kg dry matter/ha (kg DM/ha)
- Controls feed intake of animals and pasture regrowth rate

How much do I need?

a. Too little: less than 1000kg DM/ha
- Feed intake and pasture growth rate will be greatly restricted and desirable species may not persist

b. Ideal: 1000—3000kg DM/ha
- Feed intake, diet selection and pasture growth rates optimised

c. Too much: more than 3000kg DM/ha
- No advantage for feed intake, pasture quality and growth rates decline, shading may reduce the number of plants
How do I work it out?

Green pasture:

• Available green feed is calculated from pasture height

• For measurements of green pasture, take height from the top of the bulk of grass to the ground, do not extend leaves and do not measure to the top of seed heads

• As a guide, in the Northern Agricultural Districts of SA, 1cm of pasture equals 200kg DM/ha

• For example, 6cm of pasture will equate to 6 x 200 = 1200kg DM/ha

Dry pasture:

• For measurements of dry/dead pasture, estimate handfuls (an average man’s single handful) of pasture in an area the size of one square foot (0.33m x 0.33m)

• See Table 1 for an approximate guide to the calculation of available feed (kg DM/ha) from the handfuls of dry/dead pasture in an area of one square foot

How do I compare different types of stock?

• An animal’s feed intake varies with body weight and in different stages of life and reproduction

• For example, a ewe carrying twins has a higher feed requirement than dry ewe or a ewe with a single lamb

• Cattle and horses are roughly equivalent as are sheep and goats

• Use the DSE ratings in Section 9 on pages 59–60 to calculate the number of dry sheep equivalents for each age and class of animal

Stocking Rate Calculation Example:

To determine the number of 50kg wethers which can be carried in a 20ha paddock which has 2000kg/ha of available feed:

Step 1: Multiply 2000kg x 20ha = 40,000kg of available feed

Step 2: A planned utilisation rate of 50% gives 20,000kg of pasture which can be grazed

Step 3: DSE rating of stock, one 50kg wether = one DSE

Step 4: Divide 20,000kgs ÷ 1.0 = 20,000 days of feed for one DSE (one 50kg wether).

Step 6: Farmers usually don’t have a flock of one DSE. In this example assume a flock of 250 DSEs (250 50 kg wethers) therefore divide 20,000 ÷ 250 = 80 days of feed for the flock of 250 wethers

<table>
<thead>
<tr>
<th>Available feed (kg DM/ha)</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average man’s single handful of pasture</td>
<td>1000</td>
<td>2000</td>
<td>3000</td>
</tr>
</tbody>
</table>

TABLE 1: An approximate guide to the calculation of available feed from handfuls of dry/dead pasture.
Rest and Graze Periods

• The key to successful grazing is simple — rest is best!

• Remember the principles of good grazing management

Look behind - what recovery period do I need?

• When pastures are growing rapidly, the recovery period required will be much shorter than during periods when plant growth is slow

• For example, recovery periods of 30–40 days may be adequate in spring, while during summer anywhere from 90–180 days may be required for desirable pasture plants to recover from grazing

• As a guide, allow a rest period of 60 days in winter, 30 days in spring and 90 days in summer and autumn

• Plant growth rates need to be monitored to determine how quickly grazed plants are regrowing

• Compare the plants in the paddock you have just left with the plants you are going into to help check your recovery period is correct

• Remember to leave at least 1000kg DM/ha behind and the more green leaf that is left on the plant the quicker the recovery will be

• Never assume that you are right, always check both the paddock you have left and the paddock into which you are moving the stock

Look ahead — has this paddock had enough rest?

• The paddock is ready to be grazed when there are no visible signs of the last grazing event

• For example, the grass looks fresh and there are plenty of leaves

• If the rest period is too short, you may have to lengthen it by keeping the stock where they are for longer if there is sufficient feed to do so

• If you are short of feed you may be overstocked and may need to reduce stock numbers

• Moving livestock before the pasture is ready can launch you into a vicious cycle of chasing the grass and once in that cycle stock will find less and less grass waiting for them each time they move

Where the livestock are — is the graze period right?

• The graze period is a function of the required recovery period and the number of paddocks available

• Once the recovery period is decided — for a single mob grazing the average graze period for each paddock will be:

\[
\frac{\text{Number of days recovery}}{(\text{Number of paddocks} - 1)}
\]
• If paddocks are of an uneven size, pasture quantity adjustments may need to be made accordingly. See page 19 to calculate graze periods when paddocks vary in size.

• The longer grazing animals are allowed to remain in a paddock, the greater will be the amount of feed wasted, the lower will be the feed quality and the longer the recovery time.

• Extending grazing periods for too long not only reduces the amount of feed actually harvested but can also impact negatively on animal performance and pasture health.

What should I monitor?

• Check the plants first to make sure they are not being overgrazed i.e. too much leaf material removed.

• Check your pasture utilisation rates. Make sure you are not taking more than 50% of the available feed.

• Monitor to make sure that there is sufficient feed ahead of you and that paddocks are recovering behind you as you had anticipated.

• Keep a record. Use the feed budgeting sheets provided in the Appendix to record what is actually happening so that you can better manage your grazing.

• Check the animals. Animal performance will fall off if the grazing period is longer than 5 days — for top livestock performance, move every 3 days.

How many paddocks do I need?

• The more paddocks available to a mob, the greater the flexibility of management of pastures.

• If only a small number of paddocks are available or before expensive infrastructure changes are carried out, such as new fencing or water systems, significant benefits can be achieved by combining mobs into a single flock and allowing the maximum area of pasture to be resting at any time.

What is my yearly production calendar?

• Make a plan of the stock production year to identify key periods of increased nutritional demand by livestock.

• Identify timing of activities such as joining, lambing and weaning and plan in accordance with pasture growth cycles.

• Planning the grazing will help to ensure animal requirements are met and ewes are in adequate condition to maximise conception, lambing and weaning rates.

• Set aside paddocks in advance for special purposes throughout the year as this will ensure feed quality and quantity is available to meet stock requirements during critical periods.

• It is not generally advisable to force ewes to move during lambing.
• Select lambing paddocks in advance reserve for this period to ensure adequate feed for lambing
• As soon as possible after the completion of lambing the mobs may be combined and the rotation started again
• Animals generally adapt quickly and easily to moving onto fresh paddocks
• While there is sufficient feed available there will be minimal risk of mismothering during moves

How to calculate graze periods when paddocks are of varying size

Example: 10 paddocks varying in size from 100ha–400ha with the average paddock size of 250ha = Total grazing area of 2500ha
(For this example assume a 60 day recovery period)

1. Size factor = \[ \frac{\text{Paddock size}}{\text{Average paddock size}} \]

Example 1:
\[
\frac{400}{250} = 1.6 \text{ Size Factor}
\]

2. Graze period = \[ \frac{\text{Recovery period} \times \text{size factor}}{\text{No of paddocks recovering}} \]

Example 1:
\[
\frac{60 \times 1.6}{9} = 10.66 \text{ Day Graze Period}
\]
This equals a 10 day graze period for this 400ha paddock

1. Size factor = \[ \frac{\text{Paddock size}}{\text{Average paddock size}} \]

Example 2:
\[
\frac{100}{250} = 0.4 \text{ Size Factor}
\]

2. Graze period = \[ \frac{\text{Recovery period} \times \text{size factor}}{\text{No of paddocks recovering}} \]

Example 2:
\[
\frac{60 \times 0.4}{9} = 2.66 \text{ Day Graze Period}
\]
This equals a 2 day graze period for this 100ha paddock
Feed Budgeting

Feed budgeting

- Can be used to determine how many stock can be run on an area for a given period of time
- Do this in all your paddocks at least three times per year:
  a. At the start of the growing season
  b. At the start of the spring flush
  c. At the end of the growing season when going into summer
- As a guide, allow a rest period of 60 days in winter, 30 days in spring and 90 days in summer and autumn
- This may mean you have two graze periods in the non-growing season. It is better to have two shorter graze periods in the non-growing season than one long one
- The information needed to carry out a feed budget for each paddock is:
  1. Rest period
  2. Date
  3. Paddock name
  4. Paddock size
  5. Estimate of available feed (kg DM/ha)
  6. Amount of feed to be utilised (kg DM/ha). Remember the 50% pasture utilisation rule
  7. Total amount of feed to be used (kg DM/ha)
  8. Sheep number and type
  9. DSE rating
  10. Total DSE of mob
  11. Days of grazing
- An example recording sheet is provided on page 22 and spare recording sheets are provided in Section 10

How do I carry out a feed budget for my farm?

Step 1: Select a rest period depending on the time of year and your own experience. See the suggested rest periods opposite.

Step 2: Write the date and list all your paddock names.

Step 3: List all your paddock sizes in Column A.

Step 4: Estimate the available feed for all your paddocks. Use the available feed guidelines on page 16 to help you. Write your result in Column B.

- Select a location in the paddock which you believe represents the average available feed in the paddock
- If you are not sure your estimate is correct, complete an assessment in several different locations in the paddock and take an average from all the estimates

Step 5: Divide the result in Column B (estimate of available feed) by 2 to get 50% feed utilised. Write the result in Column C.

Step 6: Multiply Column C (amount of feed to be utilised) by Column A (paddock size) to calculate the total amount of feed to be used in each paddock. Write the result in Column D.
Step 7: Write the sheep number and type in Column E.

Step 8: Write the DSE rating for the sheep type in Column F. Use the DSE ratings provided in the Appendix.

Step 9: Multiply Column F (DSE rating) by Column E (size of mob) to give you the result in Column G (DSE of mob).

Step 10: Divide Column D (amount of feed in paddock to be utilised) by Column G (DSE of mob) to give you the days of grazing available in each paddock. The result goes in Column H.

- Follow the working feed budget example on the following page. Spare feed budget recording sheets are provided in the Appendix for you to use
- After finishing your feed budget it is important to consider the required rest period you have selected and whether the graze periods for each paddock will give you enough rest between grazing events

“Livestock are grass harvesters — self propelled and sunlight driven!”
<table>
<thead>
<tr>
<th>Grazing mod</th>
<th>Days of</th>
<th>G. Total Def</th>
<th>E. Sheep</th>
<th>F. DSE</th>
<th>E. DSE</th>
<th>D. Total amount of Feed to be used</th>
<th>C. Amount of Feed to be used (50% of B)</th>
<th>B. Estimate of available Feed (kg DM/ha)</th>
<th>A. Paddock</th>
<th>Name</th>
<th>Size</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.35</td>
<td>1400</td>
<td>1400</td>
<td>1.4</td>
<td>1.4</td>
<td>7500</td>
<td>7500</td>
<td>500</td>
<td>1000</td>
<td>1/09/06</td>
<td>Windsles 15</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.14</td>
<td>1400</td>
<td>1400</td>
<td>1.12</td>
<td>1.20</td>
<td>1200</td>
<td>1200</td>
<td>30</td>
<td>30</td>
<td>30/09/4</td>
<td>Leesong4 30</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8.0</td>
<td>1400</td>
<td>0.00</td>
<td>0.18</td>
<td>1.25</td>
<td>750</td>
<td>750</td>
<td>15</td>
<td>15</td>
<td>15/09/3</td>
<td>Leesong3 15</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7.14</td>
<td>1400</td>
<td>0.00</td>
<td>1.00</td>
<td>0.00</td>
<td>1500</td>
<td>1500</td>
<td>10</td>
<td>10</td>
<td>10/09/2</td>
<td>Leesong2 10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10.7</td>
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<td>1.50</td>
<td>0.75</td>
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<td>2</td>
<td>20</td>
<td>20/09/1</td>
<td>Leesong1 20</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7.35</td>
<td>1400</td>
<td>1400</td>
<td>1.4</td>
<td>1.4</td>
<td>7500</td>
<td>7500</td>
<td>15</td>
<td>15</td>
<td>15/09/6</td>
<td>Windsles 15</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Example**

Rest Period (days): 30 days

Feed Budget Planning Sheet
Paddock Monitoring

Paddock monitoring

- After each grazing event it is important to monitor each paddock to ensure your feed budget and calculated rest and graze periods were correct.
- The information needed to carry out the simple paddock and graze monitoring is:
  1. Paddock name
  2. Paddock size
  3. Date livestock went in
  4. Date livestock came out
  5. Grazing days
  6. Estimate of feed left (kg DM/ha)
  7. Sheep number and type
  8. DSE rating
  9. Total DSE of mob
  10. Feed utilised (kgs)
  11. Rest period
  12. DSE days/ha
  13. DSE days/ha/year
- An example recording sheet is provided on page 25 and spare recording sheets are provided in Section 10 for you to use.
- This means you will have one recording sheet per paddock which you can use to record all the grazing events per paddock per year. This information will enable you to calculate the annual carrying capacity of each paddock.

How do I carry out the paddock monitoring?

Step 1: Write the paddock name in the space provided at the top of the page.

Step 2: Write the paddock size.

Step 3: Write the date in that the livestock entered the paddock.

Step 4: Write the date in that the livestock came out of the paddock.

Step 5: Write the number of grazing days that the sheep were in the paddock. Write your result in Column A.

Step 6: Estimate the feed left in the paddock. Use the available feed guidelines on page 16 to help you. Write your result in Column B.
  - Select a location in the paddock which you believe represents the average available feed in the paddock
  - If you are not sure your estimate is correct, complete an assessment in several different locations in the paddock and take an average from all the estimates

Step 7: Write the sheep number and type in Column C.

Step 8: Write the DSE rating for the sheep type in Column D. Use the DSE ratings provided in the Appendix.

Step 9: Multiply Column D (DSE rating) by Column C (size of mob) to give you the result in Column E (total DSE of mob).

Step 10: Multiply Column E (total DSE of mob) by Column A (grazing days) to give you the total feed utilised (kgs).
The result goes in Column F.

**Step 11:** As you enter each grazing event through the year for the individual paddocks, you will be able to calculate the rest period between each graze by looking at the previous date that the sheep were removed from the paddock. Write the result in Column G.

- It is important to then refer back to your original feed budget and selected rest period to ensure each paddock is receiving adequate rest between grazing events

**Step 12:** Divide Column E (total DSE of mob) by the paddock size and then multiply the figure by Column A (grazing days) to give you the DSE days/ha for that paddock during the grazing event. The result goes in Column H.

**Step 13:** At the end of the grazing year add up all the results in Column H (DSE days/ha) and divide the result by 365 days. This answer will give you the carrying production of the paddock as utilised by the animals that have grazed it (DSE days/ha/year). This figure can go at the bottom of the page in Column I.

- You can then compare the performance of different paddocks and look at ways of improving poorly performing paddocks
- If you know your gross margin you can put this figure (DSE days/ha year) into dollar terms and use it for budgeting and development
- After filling in the information for each grazing event on your paddock recording sheet, it is important to refer back to the figure in Column C (50% feed utilisation rate kg DM/ha) to ensure you have not exceeded the planned 50% utilisation rate
- Follow the working paddock monitoring example on the following page. Spare paddock recording sheets are provided in Section 10 for you to use

“What should you plant in your pasture? A fence post!”
# Paddock Monitoring Sheet

**Paddock name:** Lesongs

<table>
<thead>
<tr>
<th>Paddock size</th>
<th>Date in</th>
<th>Date out</th>
<th>A. Grazing days</th>
<th>B. Estimate of feed left (kg DM/ha)</th>
<th>C. Sheep number and type</th>
<th>D. DSE Rating</th>
<th>E. Total DSE of mob</th>
<th>F. Feed utilised (kgs)</th>
<th>G. Rest Period</th>
<th>H. DSE days/ha</th>
<th>I. DSE days/ha/year</th>
</tr>
</thead>
<tbody>
<tr>
<td>25</td>
<td>1/06/06</td>
<td>6/6/06</td>
<td>5</td>
<td>1000</td>
<td>500 Ewes</td>
<td>1.4</td>
<td>700</td>
<td>3500</td>
<td>30 days</td>
<td>140</td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>7/08/06</td>
<td>14/08/06</td>
<td>7</td>
<td>2000</td>
<td>500 Ewes</td>
<td>1.4</td>
<td>700</td>
<td>4900</td>
<td>62</td>
<td>196</td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>12/09/06</td>
<td>22/09/06</td>
<td>8</td>
<td>2000</td>
<td>500 Ewes</td>
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<td>700</td>
<td>5600</td>
<td>34</td>
<td>224</td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>2/11/06</td>
<td>7/11/06</td>
<td>5</td>
<td>1000</td>
<td>500 Ewes</td>
<td>1.0</td>
<td>500</td>
<td>2500</td>
<td>31</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>21/01/07</td>
<td>25/01/07</td>
<td>4</td>
<td>1000</td>
<td>500 Ewes</td>
<td>1.0</td>
<td>500</td>
<td>2000</td>
<td>80</td>
<td>740</td>
<td>2.02</td>
</tr>
</tbody>
</table>
As your experience in feed budgeting and pasture assessment improves, there are some additional indicators which can be monitored to help you to fine-tune your grazing management including:

a. Pasture growth rate
b. Water-use efficiency
c. Diversity of desirable perennial grass species
d. Perennial grass component of available feed
e. Legume component of available feed
f. Ground cover

### Pasture growth rate

- Production of available feed over time
- Measured as kg dry matter/ha/day (kg DM ha/day)
- Used in the feed budgeting process to set appropriate stocking rates
- As a guide, a range of pasture growth rates for the Northern Agricultural Districts of SA are shown in Table 2
- These estimates have been calculated from pasture monitoring measurements taken in the MNGWG grazing trial by Agricultural Information and Monitoring Services

<table>
<thead>
<tr>
<th>Season</th>
<th>Poor</th>
<th>Average</th>
<th>Good</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spring</td>
<td>15</td>
<td>30</td>
<td>45</td>
</tr>
<tr>
<td>Summer</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Autumn</td>
<td>0</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>Winter</td>
<td>5</td>
<td>10</td>
<td>15</td>
</tr>
</tbody>
</table>

**TABLE 2:** An estimate of the range of seasonal pasture growth rates (kg DM/ha/day) measured in the Northern Agricultural Districts of SA.

**As a guide to the seasonal conditions:**

a. Poor season: A late start to the season and less than 50% of your average annual rainfall
b. Average season: Your average annual rainfall
c. Good season: An early break to the season and more than your average annual rainfall

### Pasture Growth Rate Calculation Example:

- To determine whether there is sufficient feed to carry 250 wethers in the 20ha paddock in an average season

**Step 1:** Estimate available feed at the start of period June 1 (1000kg DM/ha).

**Step 2:** Estimate available feed at end of period of 92 days (August 31) in an average winter using Table 2 which would give a pasture growth rate of 10kg DM/ha/day (1920kg DM/ha).
Step 3: Multiply 1920kg x 20ha = 38,400 kg of available feed at the end of the season.

Step 4: A planned utilisation rate of 50% gives 19,200kg of pasture which can be grazed.

Step 5: Using a DSE rating of 1.0 divide 19,200kg ÷ 1.0 = 19,200 days of feed for one DSE.

Step 6: Assuming the flock of 250 DSEs (250 50kg wethers) divide 19,200 ÷ 250 = 77 days of feed for the flock of 250 wethers.

- In this example (even during an average season) there is not enough feed available to hold a mob of 250 wethers in this 20ha paddock for 92 days
- The flock would need to be reduced or the sheep would need to be removed from the paddock in mid August

Water use efficiency:

- Available feed grown per millimetre (mm) of rainfall
- Measured as kg dry matter/ha/mm rainfall (kg DM/ha/mm)
- Indicates how effectively pastures convert rainfall to grass
- Ideally, calculate water use efficiency rates over the period from the autumn break until the end of October

As a guide to optimum water-use efficiency rates:

a. Poor: less than 5kg DM/ha/mm
b. Marginal: 6–9kg DM/ha/mm
c. Good: 10–13kg DM/ha/mm
d. Ideal: greater than 13kg DM/ha/mm

- See page 28 for an example of how to calculate water use efficiency rates
- If you want to determine your actual pasture growth rates for a specific period you need to use a pasture cage (an enclosure or cage which will protect the pasture from grazing but still allow sunlight and rainfall through) for the same period as the graze period
- Estimate the available feed at the start of the graze period. Then after the graze period has finished, cut the pasture inside the cage, dry and weigh the material to obtain the actual pasture growth rates in that paddock for the specified period

Can you identify the plants in your pastures?

- Knowing the key perennial plants in your pasture and how these plants respond to grazing is critical to improving your knowledge of the native pasture system
- A good way of knowing the plants is to collect specimens, press them and get them identified and keep in a folder for future reference
- See Section 7 pages 47–57 for a list of the most common native grass species in the Northern Agricultural Districts of SA
- Plant identification can become the most interesting part of
pasture monitoring because many land managers discover that there is a diversity of plants in their native pastures

• These plants behave in different ways, depending on climatic conditions, grazing patterns and whether the plants are summer active or winter-active

How to calculate water use efficiency rates

**Step 1:** Calculate pasture growth rate over the specified season. Use the seasonal pasture growth rate table on page 26 as a guide. For this example pasture growth rates in the growing season from April 1 to October 31 are being used and it is an average season.

April: 2 kg DM/ha/day × 30 days = 60 kg DM/ha growth rate in April
May: 2 kg DM/ha/day × 31 days = 62 kg DM/ha growth rate in May
June: 10 kg DM/ha/day × 30 days = 300 kg DM/ha growth rate in June
July: 10 kg DM/ha/day × 31 days = 310 kg DM/ha growth rate in July
August: 10 kg DM/ha/day × 31 days = 310 kg DM/ha growth rate in August
September: 30 kg DM/ha/day × 30 days = 900 kg DM/ha growth rate in September
October: 30 kg DM/ha/day × 31 days = 930 kg DM/ha growth rate in October

Therefore the pasture growth rate from April 1 to October 31 = 2872 kg DM/ha/year (A: 2872 kg DM/ha/214 days)

**Step 2:** Record rainfall over the period used to calculate pasture growth. When doing this calculation please use your own on-property rainfall records. In this example 375 mm of rain was recorded during this period from April 1 to October 31. (B: 375 mm)

The calculation is:

\[ \frac{A}{B} = \text{____ kg DM/ha/mm} \]

Therefore:

\[ 2872 \div 375 = 7.65 \text{ kg DM/ha/mm} \text{ which is considered marginal} \]
Diversity of desirable perennial grass species:

- Stability is provided by the presence of perennial species with different growth cycles which maximise the conversion of sunlight and rainfall into grass.
- A measure of stability is the number of different perennial grass species in your pasture.

As a guide to perennial grass diversity:

a. Too little: less than 3 perennial grass species
b. Marginal: 4-6 perennial grass species
c. Ideal: greater than 7 perennial grass species

Perennial grass component of available feed:

- Percentage of available feed provided by perennial grass species.
- Measured as percent of available feed (%).
- Provides year-round stability to pasture and animal production.
- A tip for identification: Perennial grass species are difficult to pull out of the ground while annual grasses can be pulled out easily.

As a guide to the perennial grass component:

a. Too little: less than 10% perennial grass component of available feed
b. Marginal: 10-30% perennial grass component of available feed
c. Ideal: 30-40% perennial grass component of available feed

Legume component of available feed:

- Clovers (sown and naturalised), medics and native legumes.
- Measured as percent of available feed (%).
- Enhances the quality of the herbage (i.e. digestibility, crude protein and mineral content).
- In association with certain bacteria, legumes have the capacity to transform nitrogen from the atmosphere into plant material which will eventually improve soil nitrogen.

As a guide to the legume component:

a. Too little: less than 10% legume component
b. Ideal: 10-20% legume component
c. Too much: greater than 20% legume component

- If allowed to exceed 20% there is a real risk of creating bare ground when the next dry spell occurs and legumes shrivel and disappear.
Ground cover:

- Most farmers are familiar with the measure of ground cover and it is just as important in grazing systems as it is cropping systems.
- Ground cover is the area of the soil surface covered by plant material, litter or dung (i.e. not bare).
- Measured as percent of area (%).
- Reduces rainfall run-off and increases water infiltration.
- Allows you to maximise the conversion of rainfall to herbage mass.

During the growing season:

- Too little: less than 90% ground cover.
- Marginal: 90-95% ground cover.
- Ideal: 100% ground cover.

At the point of the autumn break:

- Too little: less than 80% ground cover.
- Marginal: 80-90% ground cover.
- Ideal: greater than 95% ground cover.
Planned grazing of livestock based on plant growth rates coupled with smaller paddocks and pasture budgeting will significantly improve native grass health and increase pasture growth and stocking rates, according to the final results of a grazing project in the Mid North of SA.

Run by the Mid North Grasslands Working Group (MNGWG), the six-year project evaluated the effects of a range of grazing management strategies on native pasture biodiversity, health and productivity as well as sheep and wool productivity.

Final results from the grazing project indicate that the combined effects of planned (or intensive rotational) grazing according to plant growth rates, smaller paddocks and pasture budgeting can have a range of benefits. This includes increased stocking rates, healthier perennial plants and reduced bare ground. See pages 35–37 for final soil results from the grazing trial.

Project Aim

The aim of the MNGWG project was to demonstrate that best practice grazing management could allow native pastures to be grazed for production and profitability and result in improved conservation of native grasslands.

The MNGWG wanted to test the idea that with good grazing management it was possible to run more livestock while improving the condition of the land.

Funding for the project was provided by the Natural Heritage Trust, the Native Vegetation and Biodiversity Sub-program of the Land, Water & Wool Program – a partnership between Australian Wool Innovation and Land & Water Australia – and the Northern & Yorke Agricultural Districts Integrated Natural Resource Management Committee.

The main experimental site was at the property, Anama, near Clare, while seven demonstration farms located from Robertstown up to Carrieton were also involved in the project.

A range of measurements were taken throughout the project on both the experimental and demonstration sites by Dr Lewis Kahn and Judi Earl from Agricultural Information and Monitoring Services, Armidale, NSW.

This included stocking rates, grazing period, sheep live weight, lamb marking rates, pasture growth rate, ground cover, water-use efficiency, pasture utilisation, herbage mass, the contribution of native and annual pasture species to pasture herbage and species diversity.

Grazing Trials at Anama

An experimental site was established at Ryves and Tom Hawker’s property Anama,
to determine the effects of various grazing strategies on animal and native grass productivity and landscape health.

Six different grazing treatment paddocks were established in 2000 which included summer rest from grazing with continuous grazing at all other times (the district grazing practice) and planned grazing based on plant growth rates which can be applied throughout the year.

Planned grazing is also termed cell grazing or high density, short duration grazing. It can be defined as grazing according to plant growth using a high stock density (for example, 370 sheep/ha) for a short time (1–3 days). This ensures even utilisation of feed across the paddock and prevents animals repeatedly eating the same plants, which leads to poor plant growth and even plant death.

Seasonal grazing treatments were also trialed which included autumn and summer rest from grazing and spring and summer rest from grazing.

These treatments were designed to see if the number of new perennial plants could be influenced by grazing and resting at different times of the year when plants are seeding or germinating.

Stocking rates for the seasonal grazing and district practice treatments were 2.5 Dry Sheep Equivalents/ha (1DSE/acre) which was considered to reflect the long-term carrying capacity of the Northern Agricultural Districts.

The stocking rates in the planned grazing treatment were determined by the amount of pasture herbage and plant growth and were generally higher than 2.5DSE/ha.

Typical graze periods in the planned grazing treatment were between 2–4 days while the rest periods varied from between 60–180 days.

**Results at Anama**

**Stocking rates**

One of the most significant project results was the 75% increase in stocking rate achieved in the planned grazing treatment.

The average stocking rate in the planned grazing treatment was 4.2DSE/ha compared with 2.3DSE/ha for the district grazing practice and seasonal grazing treatments (see Figure 1).

This increased stocking rate (1.9DSE) could boost sheep enterprise gross margins by $40–$45/ha.

---

**Bare ground**

The planned grazing treatment also improved ground cover and was the only management practice which maintained bare ground at less than 5% in the paddock throughout the year.

In contrast, bare ground increased nearly 10-fold under the district grazing practice, starting at 3.4% and reaching more than...
40% in the 3-year period from 2002–2004. This level of bare ground means more rainfall run-off in the paddock rather than rainfall infiltrating into the soil, more soil is lost in storms or wind and more spaces are available for weeds to establish.

**Grassland health**

The planned grazing treatment showed the greatest increase in the abundance of perennial grasses.

Over the 5-year period (2000–2005), the area of ground covered by perennial plant bases increased by 72% with planned grazing, but did not change with district grazing practice.

Visually the individual perennial grass plants in the planned grazing treatment were also significantly larger, healthier and more productive.

**Farm demonstration sites**

Owners of the demonstration farms received financial and technical assistance to subdivide an existing paddock or paddocks producing a minimum of two and a maximum of 30 paddocks among the properties. The resulting paddock size varied from 1.5–359ha (the larger paddocks were in the north of the region).

On these areas, smaller mobs of sheep were combined and grazing plans and feed budgets were developed to minimize grazing and maximize rest periods to allow the perennial plants to recover.

Typically, grazing periods (excluding lambing) varied from 2–30 days and rest periods from 30–350 days. Periods of rest from grazing were shortest during the peak pasture growth season in spring and longest over summer.

The aim was to determine the combined effects of paddock subdivision, mob aggregation and planning the grazing process on native grassland health and productivity and animal production.

**Final results**

**Stocking rates**

Stocking rates across the farms increased by 10%, averaging 3.2DSE/ha on the paddocks grazed in a planned rotation while the control paddocks which were set stocked averaged 2.9DSE/ha (see Figure 2). This increased stocking rate (0.3DSE) could boost enterprise gross margins by $6–$7/ha.

This increase in stocking rate underestimates the real benefit because the control paddocks were stocked at a higher rate than the rest of the farm and do not accurately reflect whole farm stocking rates.

If the 3.2DSE/ha is compared with the district grazing practice of 2.5DSE/ha, this would increase the livestock enterprise gross margin by $14–$15/ha.
Ground cover

On all the farms, ground cover increased and this has been most notable on north-facing slopes, where previously sheep could selectively graze and create stock camps.

Typically most of the demonstration sites had an average of 30–50% bare ground on the north-facing slopes but planned grazing has reduced this figure to 0–20%.

The reduction in bare ground also means less rainfall run-off, erosion and fewer weeds resulting in more feed in the paddocks. Ground cover increased over the other parts of the paddock on six of the seven properties.

Meanwhile, on south-facing slopes, traditionally a lack of grazing by sheep has caused problems with Saffron Thistles (*Carthamus lanatus*) and moss.

Although the amount of moss can fluctuate depending on seasonal conditions, moss has reduced considerably and Saffron Thistles have declined from 10% down to 1% of the pasture herbage through better grazing of these south-facing slopes.

These results show smaller paddocks and larger mob sizes achieve better control of livestock grazing whereby north-facing slopes are grazed less and south facing slopes grazed more. This results in better pasture growth on both slopes.

Plant composition changes

The amount of annual weeds, such as Geranium (*Erodium brachycarpum*) and Salvation Jane (*Echium plantagineum*) varied significantly from year-to-year, depending on seasonal conditions.

But project results suggest that increased ground cover at the break of the season can reduce annual weeds.

To manage for improved ground cover, the farmers carried out feed budgets at the start of and during summer to determine how many stock could be carried.

The aim was to ensure there was at least 1,200 kilograms of dry matter per hectare and 85% ground cover at the Autumn break.

Changes in the perennial plant population have been slow but, during the six-year period, visually, the perennial plants have become larger, healthier and are producing more feed.

There has also been some recruitment of new perennial plants.

Pasture productivity

Pasture growth rate during the growing season averaged 15kg DM/ha across the demonstration farms which equated to total pasture growth of 2,800kg DM/ha over the growing season.

Water use efficiency (measured in terms of the amount of pasture produced in kilograms of dry matter per hectare per millimetre of rainfall recorded) averaged 9.6kg DM/ha/mm across the demonstration farms.

Utilisation of the pasture by livestock averaged nearly 35% which meant that during the growing season, sheep consumed 35% of the pasture growth.

This level of utilisation is acceptable with levels greater than 50% resulting in lower future pasture growth and more bare ground at the break.
Soil Results

Planned grazing of livestock based on plant growth rates has achieved a 17-fold increase in water infiltration rates and helped to build a better soil, according to research from the Mid North Grasslands Working Group (MNGWG) grazing project.

Final results from the project indicate that the combined effects of planned grazing (or intensive rotational grazing) according to plant growth rates can have a range of benefits for soil condition and health.

This includes improved water infiltration rates, increased soil porosity and better soil friability and softness.

See pages 31–34 for more information on the project and the final native pasture and livestock results from the grazing trial.

As part of the grazing trials carried out at the property Anama, near Clare, a range of soil measurements were taken by Cliff Hignett from Soil Water Solutions, Adelaide. The tests were carried out across two of the trial paddocks; the district grazing practice treatment and the planned grazing treatment paddock.

This included water infiltration rates, soil strength and density and water storage.

The measurements were taken in 2001, near the start of the grazing trial and in 2003 and 2005.

What makes a "good" soil?

For a grazier or farmer, a good soil needs to support plant growth.

A good soil is one which is soft enough to allow plant roots to penetrate easily, but not so soft that it erodes in rainstorm or allows soil to blow away or be easily compressed by animals or vehicles.

A good soil for plants will allow rain to enter quickly but then hold the water where plants can access it, but do so in a way that minimises water lost to evaporation.

No single, uniform material can have all these properties. So a good soil for agriculture must comprise not one, but two materials.

One material which holds on to water, and one which allows water to pass through quickly. One which allows plant roots to penetrate easily and another that resists compaction and erosion.

This can be done by forming the soil into aggregates - small, tough dense "lumps" of soil material, ideally about one millimetre in size, separated by pores (channels and cavities).

The aggregates provide water storage and strength and the pores provide channels for water flow and easy root penetration.

The aggregates have internal bonds which are strong and cannot be destroyed by wetting or traffic by animals and the aggregates are too large to erode easily by water or wind.

The bonds between aggregates are weaker allowing plant roots to push them apart to grow.

This transformation can be achieved artificially at considerable expense by adding bonding materials (glues like PVA), or at low cost over several years, by encouraging the growth of soil organisms who manufacture the glues for free. This can be done just by feeding them organic matter.

Worms and other soil organisms, many of microscopic size, break up the soil and coat the resulting aggregates with jelly (same material as in a snail trail). This improves
the strength of the aggregates so that they no longer collapse if wet. If the aggregates do not collapse, any new root channels or animal burrows remain intact through several seasons, and the number of channels slowly increases in number.

The experimental site at Anama had good examples of both "good" and "bad" soils, with obvious differences in plant growth.

The district grazing practice sites were a mass of sand, silt and clay particles packed tightly — near their maximum possible density. Even if they were cultivated, these soils would quickly compact back to their dense state because the aggregates formed by cultivation are not bonded in any way and collapse when wetted.

Planned grazing has changed this dense soil material into small dense aggregates of soil separated by spaces.

It is these spaces (pores) which gave the planned grazed sites significantly different soil properties compared with the district practice treatment.

**Results at Anama**

**Soil strength**

Soil strength was measured as the force needed to twist a steel plate embedded in the soil with a torque wrench — a direct measure of the tractor drawbar force needed to cultivate the soil.

The district grazing practice averaged 16 kg-cm which was significantly (20%) stronger than the planned grazing paddock which required only an average 13kg-cm needed to disrupt the soil.

The actual difference was even greater as the planned grazing treatment had more vegetation and the soil was drier than the district grazing treatment at the time of testing.

For comparison, the most compacted soil on the site was on the roadway leading up the hillside which measured 24kg-cm.

**Soil density**

If a soil is very dense then it will have few pores. For example, the most compacted soil, which was on the roadway at the Anama site, was near maximum for this soil with a density of 1.38 grams per cubic centimetre (g/cc). In this state, 48% of the soil volume is pores.

At the end of the trial period, the planned grazing treatment had an average soil density of 1.21g/cc (55% pores) compared with 1.29g/cc (51%) for the district grazing practice. This represents a small difference in porosity but a significant improvement in the space available for roots to grow.

Soil porosity does not distinguish between cavities (which don’t connect) and pores which are connected channels and can transfer water.

**Water infiltration rates**

A better measure of pores which are connected into channels is the water infiltration rate.

At the start of the trial, the planned grazing treatment measured an infiltration rate of 0.22 millimetres per minute (mm/min) while the district grazing practice measured 0.1mm/min.

In 2003, the infiltration rate in the planned grazing treatment had increased to 12.2mm/min while the district grazing practice had a slight improvement, measuring 0.55mm/min.
By 2005, with planned grazing, the water infiltration rate had significantly improved, measuring 19.1mm/min while the district grazing practice had an infiltration rate of 3.73mm/min (see Figure 1). These results mean that the planned grazing treatment absorbed water more than four times faster than the district practice treatment.

Although 4mm/min (240mm/hour) suggests that both soils would absorb all but a hurricane level rainfall, this is misleading.

Rain usually comes in short bursts of high intensity which may only last a few seconds, but if a soil has poor infiltration rates, runoff will start during a short rain burst and the rest of the “storm” will be lost.

Therefore, soil infiltration rates need to be high if all rainfall is to be captured. Infiltration rate is also a good measure of the number of vertical pores – which can also be used by young plants to get their roots quickly into deeper soil layers after germination. The more pores in the soil, the more quickly the young plant will find a suitable channel.

**Water storage**

Water storage in the soil is measured as the amount of water held in the soil after it has had sufficient time to wet up and to drain. With this measure, the effects of porosity are working against the plant.

Water storage in the planned grazing treatment was 31% compared with 33% in the district grazing treatment and 35% on the roadway.

While the more compacted soils actually stored more water, this has limited value if the soil is too hard for roots to grow into it.

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**FIGURE 1:** Water infiltration rates at Anama in the Planned Grazing and District Grazing Practice treatments, measured in 2001, 2003 and 2005 by Soil Water Solutions.
Despite continuing dry conditions, switching to planned grazing has resulted in healthier country and native grass pastures, according to Carrieton graziers John and June Parnell.

Since making a change during 2002, John, who was involved in the Land, Water & Wool (LWW) grazing project, has observed a range of improvements including an increase in ground cover, the number of perennial grasses and reduced soil capping.

The Parnell family own an 8094 hectare grazing property, running a self replacing Merino flock of 2500 ewes plus hoggets.

The annual rainfall is 300 millimetres but during the past several years, the average rainfall has been significantly less.

A degrading landscape

John and June bought Glenroy Estate from June’s family in the mid 1980s.

Even then, John could recall his father-in-law commenting on the reduced productivity of the property and that the land did not recover as quickly.

Over the years, the Parnell family looked at a range of different management options, but they were still not satisfied the farm was being run in the best possible way and believed that set stocking system was contributing to the problem.

Low pasture growth rates and increased bare ground were having a detrimental effect on sheep productivity with reduced wool growth, low lambing percentages and a general look of ill-thrift in the sheep.

Paddock subdivision

Using the five paddocks they had, the ewes were mobbed up and rotated through each paddock.

The results encouraged the Parnells to look at further paddock subdivision.

They received some funding through the Natural Heritage Trust incentives scheme, run by the Mid North Grasslands Working Group (MNGWG) and have continued fencing even after the scheme finished.
The extensive paddock subdivision has increased paddock numbers to 41, varying in size from 100ha up to 250ha. Further paddock subdivision is currently being carried out.

Significant funds were also spent on establishing a reliable watering system. One central watering trough supplies a minimum of four paddocks. A tank has been installed at each water point which gravity feeds water to the trough.

The bore water is about 3000 parts per million, which John said is not ideal for stock, so he also uses dam water where possible. There are 35 dams on Glenroy and one dam will service two paddocks.

Since 1996, about 800ha of Oldman Saltbush has also been planted. John strip grazes these areas which gives him a further 112 paddocks.

Planned grazing benefits

The ewe flock is now run in two mobs with an optimum graze period of less than five days per year with the remaining time as a rest period.

In the open paddocks, the graze period is about two weeks per year, with an optimum graze time planned for the future of five to seven days.

Increased mob sizes are used to ensure a short graze at high density occurs with plenty of opportunity for sheep manure to fertilise the paddocks as the mobs pass through.

The Oldman Saltbush is used to balance the time livestock spend in the open paddocks to ensure short graze periods and prevent overgrazing.

Despite the dry years, there has been a noticeable recovery in the native grasses and bushes with an increase in numbers, growth and diversity while bare ground has reduced.

John now believes he has a more sustainable grazing system with the critical management factor being a long rest period after a short graze period at increased mob sizes.

During this time, the Parnell family made a decision not to increase stocking rates and allow the land to recover.

The stocking rate during the past two years has been about 0.3 sheep/ha.

John has also made some production changes, shifting the shearing time from August/September to April, and lambing from April to June/July. This means the ewes are lambing off-shears and there should be some green feed available.

The saltbush areas are also a valuable tool in the grazing system and provide another option during the drier times.
Sheep running in these areas require supplementation due to a lack of energy supplied by the saltbush. Barley is fed out at a rate of 1.4 kilograms/head/week.

**Pasture monitoring**

A grazing chart is used to plan the paddock moves up to a year ahead and John believes this is a valuable tool.

He now feels confident that despite seasonal conditions, there is sufficient feed to support the current stock numbers for the next year.

The pastures are still visually monitored and the sheep will be shifted earlier than planned, if necessary.

But John always ensures a rest period for each paddock of at least 11 months.

John also lists the support and advice he has received from the MNGWG and the Agricultural Information & Monitoring Services (AIMS) researchers through workshops and regular visits as vital for their success.

According to John, he considers the future of sustainable pastoral grazing is dependent on encouraging native pastures by using short graze periods followed by long periods of rest which allow the native grasses to recover.
Adopting a planned grazing approach has regenerated native grass pastures and significantly boosted stocking rates for Brinkworth woolgrower Chris Heinjus.

According to Chris, who was involved in the Land, Water & Wool grazing trial in the Mid North, the change in grazing management has resulted in a range of long-term benefits for both land condition and farm profitability.

Chris owns a 1420 hectare farm, running a self-replacing Merino flock of 2400 ewes. The 400ha of arable country will be sown to opportunity crops, depending on the seasonal conditions. The annual average rainfall is 400 millimetres.

Fencing and water

Chris became involved in the project due to concerns about the impact set stocking was having on his hill country.

Significant areas of bare ground were appearing and he believed the overall productivity and health of the land was being reduced.

During 2000, Chris received some funding through the Natural Heritage Trust incentives scheme, administered by the Mid North Grasslands Working Group (MNGWG) and initially subdivided three paddocks into 12 paddocks.

Since then, the 1200ha of hill country has been fenced into 25 paddocks varying in size from 6ha up to 166ha. Chris would eventually like to increase the number of paddocks and reduce the paddock size to about 15–20ha.

Fences comprise four strands of plain wire, although there are plans to incorporate some internal paddock electric fences in the future.

Half of the paddocks are watered via natural flowing watercourses, while a windmill has been installed to pump water to the outer-lying paddocks. More than seven kilometres of piping has also been installed.

Where possible, the fencing has been carried out according to aspect with north and south-facing slopes separated, which Chris said has been a huge benefit.
Previously, the southern slopes were under grazed and covered by a huge thatch of wild oats. Once the wild oats were removed by grazing, the perennial grasses have gradually reappeared.

Meanwhile, the northern slopes were suffering from overgrazing and long periods of rest have assisted in the recovery of these areas.

**Grazing management**

Chris runs two large mobs of 1200 ewes and employs a planned grazing system based on plant growth rates and rainfall.

Rest periods range from 30 days during periods of peak pasture growth up to 120 days in late summer. Typical graze periods range from 1–2 days up to a maximum of 10 days in the larger paddocks.

The pastures in each paddock are visually monitored before and after the sheep graze the paddock.

According to Chris, he aims to utilise no more than half the available feed in a grazing event. His observations show that leaving at least 5cm of pasture height behind after grazing appears to provide sufficient leaf material for the grass to recover and regrow.

**Planned grazing benefits**

Since making the change to planned grazing, Chris has observed a significant improvement in the condition of the land including a reduction in bare ground while capped areas are breaking up and sheep tracks are grassed over.

Perennial grass and annual grass populations have also increased.

Stocking rates have increased from an average of 1–1.5 Dry Sheep Equivalents/ha up to 3–4DSE/ha with the smaller paddocks achieving a higher stocking rate due to more even pasture utilisation.

**Animal production benefits**

Under guidance from the project researchers, Agricultural Information & Monitoring Services (AIMS), Chris has made several significant changes to his farm’s yearly production calendar.

Spring shearing and autumn lambing have now been shifted to a June shearing and an August lambing to better match peak pasture growth with the ewe’s peak nutritional requirements.

As a result, the average lambing percentage has increased from 78% up to 100%.

All the ewes are pregnancy scanned with twin bearing ewes separated and will receive preferential treatment including larger paddocks with high levels of feed.

A significant reduction in bare ground has been one of the benefits of adopting a planned grazing approach in the hills country on Chris Heinjus’ farm near Brinkworth.
A drift move is employed at lambing and Chris has not had any problems with mismothering.

The change in shearing time has also had an impact on wool productivity.

Average staple strength has increased from 28 Newtons per kilotex up to 44N/ktex and mid-point breaks have been reduced.

Cottonseed meal or Copra is supplemented to the ewes from the end of December through to the season break. This helps to ensure a ewe body condition score of three at joining.

**Continual learning**

Chris admits it has been a steep learning curve, but involvement in Resource Consulting Services training programs such as Grazing For Profit and Executive Link have helped to increase his grazing management and overall farm business skills.

As part of the project, he has also attended several training programs and grazing workshops run by AIMS, which have also been beneficial.

An important tool that Chris now uses to plan ahead is a grazing chart. This allows him to plan the paddock moves more than three months ahead and incorporate critical times such as holidays or shearing and lambing.

The actual paddock moves are then recorded on the chart, which over the year provides detailed information on the productivity of each paddock.

But Chris emphasises that the grazing plan is flexible and subject to change depending on seasonal conditions.

Despite the initial capital infrastructure cost when changing to a planned grazing system, Chris believes he will soon recoup the costs and achieve a better return on assets by running a single sheep enterprise compared with a mixed farm.
Woolgrower Case Study 3

Farm information

Farmer: Bill Hoffmann
Location: Mt Carmel, Jamestown
Property size: 769 hectares
Enterprises: Wool, prime lambs, lucerne, crops
Annual rainfall: 480 millimetres

Since making a change to a planned grazing system using small paddocks, large mobs and long rest periods, the improvement in the land and pasture productivity has amazed Jamestown prime lamb producer Bill Hoffmann.

According to Bill, who was one of the participants in the Land, Water & Wool grazing trial in the Mid North, the alternative grazing management has increased stocking rates and improved ground cover and native grass populations.

Bill owns a 769 hectare property running 1800 Merino ewes mated to White Suffolk terminal sires to produce prime lambs and grows wheat, triticale, oats and lucerne. The average rainfall is 480 millimetres.

Adopting a new approach

Traditionally, Bill ran 800 ewes on his 162ha of hill country from May through to December, to coincide with the cropping program.

They would then be moved onto the stubbles for the summer period until the break of the season.

In 1999, he answered an advertisement in the local newspaper for free fencing. Initially Bill was only going to fence off a small area of 5ha but with encouragement from the Mid North Grasslands Working Group (MNGWG), he decided to tackle half of the hills country area, subdividing 80ha, which was originally two paddocks, into nine paddocks.

Sheep were then combined into one large mob and rotated through the nine paddocks.

The results encouraged Bill to fence the remainder in 2003 resulting in 21 permanent paddocks.

He has also subdivided some arable land that was previously used for cropping.

Early on, Bill used five plain wires but now believes three plain electrified wires are sufficient.

Temporary electric fencing is also used to make the paddocks smaller which provides better control over the grazing and more even pasture utilisation.

Jamestown farmer Bill Hoffmann has been amazed by the improvement in his land’s condition and productivity since adopting a planned grazing system in 2000.
Where possible, the fencing has separated north and south-facing slopes into different paddocks. This has reduced overgrazing on the northern slopes and increased pasture utilisation on the south facing slopes.

The paddocks are between 6–10ha in size and where possible large mobs — up to 1100 ewes — will be run in a single mob. The current ewe flock has been split into two mobs and is rotated through the paddocks.

Graze periods are 2–3 days while rest periods vary from 60–90 days depending on the time of year, with a short rest period during peak pasture growth in spring and a longer rest period in summer.

Production improvements

Initially Bill only had a 30–40 day recovery period as he did not have enough paddocks and although he admits this was not long enough, he could still see improvements in the condition of the land.

Ground cover and native grass populations have increased and the perennial plants present now are robust, productive and growing a lot more vigorously.

As a result, livestock profitability has also improved through a doubling in stocking rates.

Previously the stocking rate was 3–4 Dry Sheep Equivalents/ha, but this figure has...
increased to 6–8DSE/ha. And this is despite some tough seasons during the past few years.

For Bill, this achievement confirms that the principles of planned grazing — using small paddocks, large mobs, a short graze and a long rest period — can be successful in a range of environments.

His goal is to continue to increase the perennial pasture content, maintain ground cover at 100% and to get a balance between the annuals and perennial plants as they both have their benefits.

Ewes are still grazed from May to December but Bill believes that as the perennial grass population continues to improve, in the future it will be possible to graze some of the ewes in the hills during summer.

The ewes lamb in July and Bill has not had any problems continuing the paddock moves through lambing. After a pregnancy scan the twin bearing and single bearing ewes are generally split into smaller mobs.

He believes the sheep are well-adjusted to the rotation now and he simply opens a gate and they move quietly through with their lambs.

During the past two years he has averaged more than 100% lambing and this includes 30–40% maiden ewes.

Shearing occurs in October and the lambs are weaned at shearing and moved into lucerne paddocks on the flat country to be finished.

Bill aims to have at least 70–80% of the lambs sold by the end of December. The ewes go back into the hill country until the stubbles become available.

Regular monitoring

According to Bill, an important part of managing a planned grazing system is regular visual assessment to monitor pasture growth. This ensures the stocking rate is matched to the land’s carrying capacity and overgrazing does not occur.

Involvement with the project and attending several grazing management workshops held by MNGWG have helped to improve his pasture assessment skills.

Although Bill admits it can take a while to become proficient at estimating available feed, he said time flies as it is good fun and there is always something different to see on the ground.

Bill also believes the money he has spent on fencing is a far better, long-term investment than money spent on continual fertiliser applications.
Native Grass Identification

There are more than 300,000 hectares of native pastures in the Northern Agricultural Districts of South Australia that are grazed.

Knowing the key perennial grasses on your property and how these plants respond to grazing is critical to improving your native pasture knowledge.

The value of native pastures is the diversity of the grasses and other plants present. A native pasture could include winter and summer growing plant species, grasses and broad leaved plants and annual and perennial plants.

Native grasses are perennial and form tussocks of various sizes. Some of the tussocks are tall and robust, with coarse leaf material, while others are smaller and have finer, softer leaves. Some of the grasses grow during the winter, such as Spear Grass or Wallaby Grass. Other species are summer active such as Kangaroo Grass, Windmill Grass and Brush-wire Grass.

There are 10 common native grass species found in the Northern Agricultural Districts. A general description and photographs are provided which should help you to more easily identify each species.

Each of the native grasses can be found in the four vegetation types in the Northern Agricultural Districts which include grasslands, shrublands, woodlands and mallee.

Grasslands:

Grasslands are usually defined as tree and shrub-less communities, in which the tallest and most common plants are from the grass family. They also usually have a wide variety of herbs and forbs and scattered shrubs and small trees at a low density.

Most grasslands in the region are grazed by livestock although there are small remnant grasslands on private land where stock have been excluded. Grasslands that have been extensively grazed are usually referred to as native pastures as significant amounts of the native plants have been replaced by introduced species.

Shrublands:

Shrublands are plant communities that are dominated by woody perennial plants, usually less than 5m in height. Shrubs generally provide up to 30% ground cover with herbs and grasses in between. Shrublands are often interspersed with areas of timber. Shrublands occur in the drier regions of the district.

Woodlands:

Woodlands are plant communities dominated by trees with single trunks and have an understorey of shrubs, grasses and herbs. Woodlands are most common in the ranges and on the more fertile soils and are usually dominated by eucalypts in the wetter areas and sheoaks in the drier parts of the region.

Mallee:

Mallee communities are scattered throughout the Northern Agricultural Districts, usually occurring on sandy soils or shallow, rocky soils in the ranges. Dominant plants are *Eucalyptus* trees with multiple, branched, trunks, growing from an underground rootstock.

Understorey vegetation ranges from mixed shrubs to spinifex tussocks and other grass species. Plant diversity can be very high in some mallee communities.
1. *Aristida behriana*
Common name: Brush-wire Grass

**Description**

- Low-growing, summer active perennial to 15cm in height
- Bright green leaves
- Seed heads are held among the leaves and are often purple before opening out to white, fluffy, bottle brush-like structures
- The seeds have a three-pronged awn
- Flowers and seeds in spring and summer

**Occurrence**

Brush-wire Grass is common in all vegetation types and is found in most grazed native pastures in the region, particularly where there has been bare ground.

It can cause contamination in wool because of the sharp awns.

**Palatability**

- Low frost tolerance
- High drought tolerance
- Feed quality is moderate to high during summer when it is actively growing
2. *Austrodanthonia spp*
Common name: Wallaby Grass

**Description**
- There are a variety of species in the region, all of which are small, tussock-forming, winter active perennial grasses ranging from 5cm up to 20cm in height
- Green or blue-green, fine leaves, usually hairy
- Upright, fluffy seed head with pale "seeds" generally with three rings of hair
- A dark brown, bent awn
- Flowers and seeds in spring and summer

**Occurrence**
Wallaby Grass is one of the most common native grasses and is tolerant of heavy grazing. In a grazed situation, the seed heads will often lie almost flat along the ground, rather than standing upright.

It is common in grasslands, woodlands, shrublands and mallee areas.

**Palatability**
- High frost tolerance
- High drought tolerance
- Crude protein of 15–20%
- Medium digestibility
- High feed quality
3. *Austrostipa spp*
Common name: Spear Grass

**Description**

- There are a variety of Spear Grasses, all forming tussocks which range in size from 20cm up to 60cm in height
- Leaves are usually harsh to touch, sharp edges, green to blue-green in colour
- Seed heads are held above the grass and hold distinctive spear shape seeds with long awns which have a corkscrew twist
- Extremely tough plants, they are able to withstand dry conditions and thrive even in very thin soils
- Flowers and seeds in spring and summer

**Occurrence**

The Spear Grass species vary enormously in growth habit, longevity, feed value and rarity.

While the seeds can cause problems with livestock, particularly lambs, in spring, they are held in the heads for only a short period, after which they fall to the ground and drive themselves into the soil when it is damp.

Spear Grass is common in all native vegetation types and usually the most common native grass in grazed areas.

**Palatability**

- High frost tolerance
- High drought tolerance
- Crude protein up to 17%
- Medium digestibility
- Low to medium feed quality
4. *Bothriochloa macra*
Common name: Red Leg Grass

**Description**
- A wiry, summer active perennial grass which forms a flat tussock to 10cm in height
- Leaves are bright green with reddish tips
- The tall seed is held on red stems
- Seed heads divides in four sections and has pale, hairy seed joining onto each other
- Flowers and seeds in summer

**Occurrence**
Red Leg Grass is widespread but rare in the region and is now usually only seen along roadsides.

**Palatability**
- Low frost tolerance
- High drought tolerance
- Crude protein up to 15%
- Medium digestibility
- Medium feed quality
5. *Chloris truncata*
Common name: Windmill Grass

**Description**
- Small, bright green, summer active tussock grass to 20cm in height
- The seed head is held on a short stem and is like a windmill, with arms radiating from a central point on one plane
- Seeds are short, black, arrow-head shaped and held along each arm of the seed head
- Flowers in summer and autumn
- Can be confused with *Enteropogon acicularis* but its leaves do not curl

**Occurrence**
Windmill Grass is a short lived, perennial grass which is uncommon in grazed areas. It is generally found in grasslands.

**Palatability**
- Low frost tolerance
- Medium drought tolerance
- Crude protein up to 14%
- Low to medium digestibility
- Medium feed quality
6. *Dicanthium sericeum*
Common name: Queensland Blue Grass

**Description**
- Medium sized, summer growing perennial grass, forming a neat, upright tussock to 30cm in height
- Leaves are usually blue-green, but flat and have no scent
- Seed heads are tall and upright, with rings of hairs on the joints of the stems
- The head is dark and divides into four sections, with the seeds being dark, hairy and with long awns
- Flowers in summer and autumn

**Occurrence**
Queensland Blue Grass is found on heavier soils and is rarely seen in grazed pastures.

**Palatability**
- Low frost tolerance
- Medium drought tolerance
- Crude protein up to 8%
- Low to medium digestibility
- Medium feed quality

*Seed head*

*Plant*
7. *Elymus scabrus*
Common name: Common Wheat Grass

**Description**

- Winter active grass, usually forming a small, sparse tussock to about 20cm in height
- The tall, slender seed head has distinctive, outward curving, scabrous awns when drying

**Occurrence**

Common Wheat Grass is found in grazed pastures throughout the region, although it is never a dominant grass in pastures. It is also found in woodlands and grasslands.

**Palatability**

- High frost tolerance
- Medium drought tolerance
- Crude protein up to 15%
- High digestibility
- High feed quality
8. *Enneapogon nigricans*
Common name: Blackhead Grass, Bottlewashers

**Description**

- Small, perennial, bright green, summer active grass to 30cm in height
- Seed heads are dark green, drying to grey in late summer and autumn
- Octopus-shaped "seeds" with nine awns held in a dense spike
- Flowers in summer and autumn

**Occurrence**

Blackhead Grass is common along roadsides and other areas where there is bare ground. It is found in shrublands and grasslands but is not common in grazed areas. It is a short lived, perennial grass.

**Palatability**

- Low frost tolerance
- High drought tolerance
- Medium to high feed quality
9. *Enteropogon acicularis*
Common name: Curly Windmill Grass, Spider Grass, Umbrella Grass

**Description**

- Summer active perennial forming a dense tussock to about 20cm in height
- Differs from *Chloris truncata* because the leaf blades curl into a spiral towards the tips, especially when dying back in late summer
- The seed head is like an umbrella, with the spokes carrying hairy, arrow-shaped, long awned seeds along their length

**Occurrence**

Curly Windmill Grass is common in the dried areas of the region. It is palatable to livestock and readily eaten back to its base.

**Palatability**

- Low frost tolerance
- High drought tolerance
- Crude protein up to 14%
- Medium digestibility
- Medium feed quality
10. *Themeda triandra*
Common name: Kangaroo Grass

**Description**

- Large, summer active perennial forming a tussock to 50cm in height
- Leaves are relatively soft and usually bright green in early summer, turning blue-green with orange-red tips in autumn
- The seed head is distinctive and in autumn turns orange-red
- The black seeds are similar to wild oats, but with long, twisted awns
- Flowers in summer through to autumn

**Occurrence**
Kangaroo Grass is found in grasslands, shrublands and woodlands but is not generally common in grazed areas.

**Palatability**

- Low to medium frost tolerance
- High drought tolerance
- Crude protein up to 12%
- Medium digestibility
- Medium feed quality
Further Information

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Web: www.mla.com.au

Useful publications

Back from the Brink, Peter Andrews, Australian Broadcasting Corporation.

Balancing Conservation & Production, CSIRO Tropical Agriculture.

Grasses, Gums & Groundcovers, a field guide to the common native plants of the Northern Agricultural Districts of South Australia, Mid North Grasslands Working Group, Custom Press.

Grasses of South Australia, J. Jessop, G.R.M. Dashorst and F.M. James, Wakefield Press.

Grass Productivity, Andre Voisin, Island Press.


Nature Conservation on Farms, D. George and D. Brouwer, NSW Agriculture.


The Glove Box Guide to Tactical Grazing for the semi-arid woodlands, T. Campbell and R. Hacker, NSW Agriculture.

Websites

www.pasturemanagement.com
www.the-farm-business-gym.com
www.holisticmanagement.org
www.ranchmanagement.com
# DSE Ratings

<table>
<thead>
<tr>
<th>Weight of sheep (kg)</th>
<th>Growth rate (g/day)</th>
<th>DSE rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>30</td>
<td>0</td>
<td>0.7</td>
</tr>
<tr>
<td>40</td>
<td>0</td>
<td>0.8</td>
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<tr>
<td>50</td>
<td>0</td>
<td>1.0</td>
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<td>60</td>
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<td>30</td>
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<td>100</td>
<td>1.5</td>
</tr>
<tr>
<td>60</td>
<td>100</td>
<td>1.7</td>
</tr>
</tbody>
</table>

**TABLE 1: DSE rating for dry sheep**

<table>
<thead>
<tr>
<th>Weight of ewe (kg)</th>
<th>Pregnancy/lactation</th>
<th>DSE rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>40</td>
<td>dry</td>
<td>0.8</td>
</tr>
<tr>
<td>40</td>
<td>pregnant – single</td>
<td>1.0</td>
</tr>
<tr>
<td>40</td>
<td>pregnant – twin</td>
<td>1.1</td>
</tr>
<tr>
<td>40</td>
<td>lactating – single</td>
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<td>2.6</td>
</tr>
<tr>
<td>50</td>
<td>dry</td>
<td>1.0</td>
</tr>
<tr>
<td>50</td>
<td>pregnant – single</td>
<td>1.1</td>
</tr>
<tr>
<td>50</td>
<td>pregnant – twin</td>
<td>1.2</td>
</tr>
<tr>
<td>50</td>
<td>lactating – single</td>
<td>2.2</td>
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<tr>
<td>50</td>
<td>lactating – twin</td>
<td>2.8</td>
</tr>
<tr>
<td>60</td>
<td>dry</td>
<td>1.2</td>
</tr>
<tr>
<td>60</td>
<td>pregnant – single</td>
<td>1.3</td>
</tr>
<tr>
<td>60</td>
<td>pregnant – twin</td>
<td>1.4</td>
</tr>
<tr>
<td>60</td>
<td>lactating – single</td>
<td>2.4</td>
</tr>
<tr>
<td>60</td>
<td>lactating – twin</td>
<td>3.0</td>
</tr>
</tbody>
</table>

**TABLE 2: DSE rating for ewes**
<table>
<thead>
<tr>
<th>Weight of steer or dry heifer (kg)</th>
<th>Growth rate (kg/day)</th>
<th>DSE rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>200</td>
<td>0</td>
<td>3.5</td>
</tr>
<tr>
<td>250</td>
<td>0</td>
<td>4.5</td>
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<tr>
<td>300</td>
<td>0</td>
<td>5.0</td>
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<tr>
<td>350</td>
<td>0</td>
<td>6.0</td>
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<tr>
<td>400</td>
<td>0</td>
<td>7.0</td>
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<tr>
<td>200</td>
<td>0.5</td>
<td>6.0</td>
</tr>
<tr>
<td>250</td>
<td>0.5</td>
<td>7.0</td>
</tr>
<tr>
<td>300</td>
<td>0.5</td>
<td>7.5</td>
</tr>
<tr>
<td>350</td>
<td>0.5</td>
<td>8.5</td>
</tr>
<tr>
<td>400</td>
<td>0.5</td>
<td>9.5</td>
</tr>
<tr>
<td>200</td>
<td>1.0</td>
<td>Not likely</td>
</tr>
<tr>
<td>250</td>
<td>1.0</td>
<td>9.5</td>
</tr>
<tr>
<td>300</td>
<td>1.0</td>
<td>10.0</td>
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<tr>
<td>350</td>
<td>1.0</td>
<td>11.0</td>
</tr>
<tr>
<td>400</td>
<td>1.0</td>
<td>12.0</td>
</tr>
</tbody>
</table>

TABLE 3: DSE rating for dry cattle

<table>
<thead>
<tr>
<th>Weight of cow (kg)</th>
<th>Pregnancy/lactation</th>
<th>DSE rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>400</td>
<td>dry</td>
<td>7.0</td>
</tr>
<tr>
<td>400</td>
<td>pregnant – early</td>
<td>8.0</td>
</tr>
<tr>
<td>400</td>
<td>pregnant – late</td>
<td>9.5</td>
</tr>
<tr>
<td>400</td>
<td>lactating – early</td>
<td>14.0</td>
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<tr>
<td>400</td>
<td>lactating – late</td>
<td>17.0</td>
</tr>
<tr>
<td>500</td>
<td>dry</td>
<td>9.0</td>
</tr>
<tr>
<td>500</td>
<td>pregnant – early</td>
<td>10.0</td>
</tr>
<tr>
<td>500</td>
<td>pregnant – late</td>
<td>11.5</td>
</tr>
<tr>
<td>500</td>
<td>lactating – early</td>
<td>16.0</td>
</tr>
<tr>
<td>500</td>
<td>lactating – late</td>
<td>19.0</td>
</tr>
</tbody>
</table>

TABLE 4: DSE rating for cows
Feed Budget Calculations

Step 1: Select a rest period depending on the time of year and your own experience. As a guide for the Northern Agricultural Districts of SA, allow a rest period of 60 days in winter, 30 days in spring and 90 days in summer and autumn.

Step 2: Write the date and list all your paddock names.

Step 3: List all your paddock sizes in Column A.

Step 4: Estimate the available feed for all your paddocks. Write your result in Column B.

Green pasture:
Take height from the top of the bulk of grass to the ground, do not extend leaves and do not measure to the top of seed heads.

As a guide, in the Northern Agricultural Districts of SA, 1 cm of pasture equals 200 kg DM/ha.

For example, 6 cm of pasture will equate to $6 \times 200 = 1200$ kg DM/ha

Dry pasture:
Estimate handfuls (an average man’s single handful) of pasture in an area the size of one square foot (0.33 m x 0.33 m). See Table 1 for an approximate guide to the calculation of available feed (kg DM/ha) from the handfuls of dry/dead pasture in an area of one square foot.

<table>
<thead>
<tr>
<th>Average man’s single handful of pasture</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Available feed (kg DM/ha)</td>
<td>1000</td>
<td>2000</td>
<td>3000</td>
</tr>
</tbody>
</table>

Table 1: An approximate guide to the calculation of available feed from handfuls of dry/dead pasture.

Remember to select a location in the paddock which you believe represents the average available feed in the paddock.

If you are not sure your estimate is correct, complete an assessment in several different locations in the paddock and take an average from all the estimates.

Step 5: Divide the result in Column B (estimate of available feed) by 2 to get 50% feed utilised. Write the result in Column C.

Step 6: Multiply Column C (amount of feed to be utilised) by Column A (paddock size) to calculate the total amount of feed to be used in each paddock. Write the result in Column D.

Step 7: Write the sheep number and type in Column E.

Step 8: Write the DSE rating for the sheep type in Column F. Use the DSE ratings provided in the Appendix.

Step 9: Multiply Column F (DSE rating) by Column E (size of mob) to give you the result in Column G (DSE of mob).

Step 10: Divide Column D (amount of feed in paddock to be utilise) by Column G (DSE of mob) to give you the days of grazing available in each paddock. The result goes in Column H.
Feed Budget Planning Sheet

Rest period (days): ........................................

<table>
<thead>
<tr>
<th>Date</th>
<th>Paddock name</th>
<th>A. Paddock size</th>
<th>B. Estimate of available feed (kg DM/ha)</th>
<th>C. Amount of feed to be utilised (50% of B.)</th>
<th>D. Total amount of feed to be utilised (kgs)</th>
<th>E. Sheep number and type</th>
<th>F. DSE rating</th>
<th>G. Total DSE of mob</th>
<th>H. Days of grazing</th>
</tr>
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<table>
<thead>
<tr>
<th>Available feed (kg DM/ha)</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1000</td>
<td>2000</td>
<td>3000</td>
</tr>
</tbody>
</table>

TABLE 1: An approximate guide to the calculation of available feed from handfuls of dry/dead pasture.

Remember to select a location in the paddock which you believe represents the average available feed in the paddock.

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Step 6: Multiply Column C (amount of feed to be utilised) by Column A (paddock size) to calculate the total amount of feed to be used in each paddock. Write the result in Column D.

Step 7: Write the sheep number and type in Column E.

Step 8: Write the DSE rating for the sheep type in Column F. Use the DSE ratings provided in the Appendix.

Step 9: Multiply Column F (DSE rating) by Column E (size of mob) to give you the result in Column G (DSE of mob).

Step 10: Divide Column D (amount of feed in paddock to be utilised) by Column G (DSE of mob) to give you the days of grazing available in each paddock. The result goes in Column H.
Feed Budget Planning Sheet

Rest period (days): ........................................

<table>
<thead>
<tr>
<th>Date</th>
<th>Paddock name</th>
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<th>F. DSE rating</th>
<th>G. Total DSE of mob</th>
<th>H. Days of grazing</th>
</tr>
</thead>
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</tr>
</tbody>
</table>
Paddock Monitoring Calculations

Step 1: Write the paddock name in the space provided at the top of the page.

Step 2: Write the paddock size.

Step 3: Write the date in that the livestock entered the paddock.

Step 4: Write the date in that the livestock came out of the paddock.

Step 5: Write the number of grazing days that the sheep were in the paddock. Write your result in Column A.

Step 6: Estimate the feed left in the paddock. Write your result in Column B.

Green pasture:
Take height from the top of the bulk of grass to the ground, do not extend leaves and do not measure to the top of seed heads.

As a guide, in the Northern Agricultural Districts of SA, 1 cm of pasture equals 200 kg DM/ha.

For example, 6 cm of pasture will equate to $6 \times 200 = 1200$ kg DM/ha

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<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>1</td>
</tr>
<tr>
<td>2</td>
</tr>
<tr>
<td>3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Available feed (kg DM/ha)</th>
<th>1000</th>
<th>2000</th>
<th>3000</th>
</tr>
</thead>
</table>

**TABLE 1:** An approximate guide to the calculation of available feed from handfuls of dry/dead pasture.

Select a location in the paddock which you believe represents the average available feed in the paddock.

If you are not sure your estimate is correct, complete an assessment in several different locations in the paddock and take an average from all the estimates.

Step 7: Write the sheep number and type in Column C.

Step 8: Write the DSE rating for the sheep type in Column D. Use the DSE ratings provided.

Step 9: Multiply Column D (DSE rating) by Column C (size of mob) to give you the result in Column E (total DSE of mob).

Step 10: Multiply Column E (total DSE of mob) by Column A (grazing days) to give you the total feed utilised (kgs). The result goes in Column F.

Step 11: As you enter each grazing event through the year for the individual paddocks, you will be able to calculate the rest period between each graze by looking at the previous date that the sheep were removed from the paddock. Write the result in Column G.

It is important to then refer back to your original feed budget and selected rest period to ensure each paddock is receiving adequate rest between grazing events.

Step 12: Divide Column E (total DSE of mob) by the paddock size and then multiply the figure by Column A (grazing days) to give you the DSE days/ha for that paddock during the grazing event. The result goes in Column H.

Step 13: At the end of the grazing year add up all the results in Column H (DSE days/ha) and divide the result by 365 days. This answer will give you the carrying production of the paddock as utilised by the animals that have grazed it (DSE days/ha/year). This figure can go at the bottom of the page in Column I.
<table>
<thead>
<tr>
<th>Paddock Monitoring Sheet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paddock name:...</td>
</tr>
<tr>
<td>Date in</td>
</tr>
<tr>
<td>Date out</td>
</tr>
<tr>
<td>Size</td>
</tr>
<tr>
<td>A. Grazing days</td>
</tr>
<tr>
<td>B. Estimate of feed left (kg DM/ha)</td>
</tr>
<tr>
<td>C. Sheep number and type</td>
</tr>
<tr>
<td>D. DSE Rating</td>
</tr>
<tr>
<td>E. Total DSE of mob</td>
</tr>
<tr>
<td>F. Feed utilised (kgs)</td>
</tr>
<tr>
<td>G. Rest Period</td>
</tr>
<tr>
<td>H. DSE days/ha</td>
</tr>
<tr>
<td>I. DSE days/ha/yr</td>
</tr>
</tbody>
</table>
Paddock Monitoring Calculations

Step 1: Write the paddock name in the space provided at the top of the page
Step 2: Write the paddock size.
Step 3: Write the date in that the livestock entered the paddock
Step 4: Write the date in that the livestock came out of the paddock
Step 5: Write the number of grazing days that the sheep were in the paddock. Write your result in Column A.
Step 6: Estimate the feed left in the paddock. Write your result in Column B.

Green pasture:
Take height from the top of the bulk of grass to the ground, do not extend leaves and do not measure to the top of seed heads.

As a guide, in the Northern Agricultural Districts of SA, 1 cm of pasture equals 200 kg DM/ha.

For example, 6 cm of pasture will equate to $6 \times 200 = 1200$ kg DM/ha

Dry pasture:
Estimate handfuls (an average man's single handful) of pasture in an area the size of one square foot ($0.33 \times 0.33$ m). See Table 1 for an approximate guide to the calculation of available feed (kg DM/ha) from the handfuls of dry/dead pasture in an area of one square foot.

<table>
<thead>
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<th>Average man's single handful of pasture</th>
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Select a location in the paddock which you believe represents the average available feed in the paddock.

If you are not sure your estimate is correct, complete an assessment in several different locations in the paddock and take an average from all the estimates

Step 7: Write the sheep number and type in Column C.
Step 8: Write the DSE rating for the sheep type in Column D. Use the DSE ratings provided.
Step 9: Multiply Column D (DSE rating) by Column C (size of mob) to give you the result in Column E (total DSE of mob).
Step 10: Multiply Column E (total DSE of mob) by Column A (grazing days) to give you the total feed utilised (kgs). The result goes in Column F.
Step 11: As you enter each grazing event through the year for the individual paddocks, you will be able to calculate the rest period between each graze by looking at the previous date that the sheep were removed from the paddock. Write the result in Column G.

It is important to then refer back to your original feed budget and selected rest period to ensure each paddock is receiving adequate rest between grazing events.

Step 12: Divide Column E (total DSE of mob) by the paddock size and then multiply the figure by Column A (grazing days) to give you the DSE days/ha for that paddock during the grazing event. The result goes in Column H.
Step 13: At the end of the grazing year add up all the results in Column H (DSE days/ha) and divide the result by 365 days. This answer will give you the carrying production of the paddock as utilised by the animals that have grazed it (DSE days/ha/year). This figure can go at the bottom of the page in Column I.

TABLE 1: An approximate guide to the calculation of available feed from handfuls of dry/dead pasture.