

## Setting directions

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### Key actions

- Understand natural resource management and climate implications on your feedbase.
- Review nutritional/water requirements of stock.
- Review and discuss implications of stock requirements with the nutritional information gained for major pasture plants (native shrubs, grasses and forbs).
- Use body condition scoring to determine the energy status of your stock.
- Estimate feed available and how long it is likely to last (carrying capacity).
- Calculate stocking rate (feed demand).
- Base grazing management (includes both stocking rate and carrying capacity) on feed availability in terms of both quality and quantity; type and class of stock; how many and for how long.

### Principles of Sustainable Grazing Management

It is recommended that arid zone producers focus on monitoring pasture rather than just livestock when deciding on when to adjust stocking rates. If you wait until your livestock begin to deteriorate there may be a greater investment in time and energy to get the stock back into condition. Further, the time lag in stock displaying a loss of condition and a decline in vegetation condition means that the paddock should have been spelled much earlier.

An understanding of the pasture plants' life cycle (germination, growth, flowering and seed set) will enable you to target grazing to either suppress or promote growth of a species, or to plan stock movements. Knowing the plants' nutritional qualities and when plants will produce green feed is also useful.

Spelling pastures (this may involve the whole paddock as the grazing management unit or only part of the paddock), prior to and during flowering and seed set will encourage a plant to produce seeds and so become more prolific. Conversely, heavy grazing at these times can suppress plant growth, reproduction and regeneration.

### How does this module assist you?

This module builds on your existing knowledge of sustainable grazing management by providing you with knowledge and information on:

- nutritional requirements/needs of different types and classes of stock and how to monitor stock condition (eg body condition scoring)
- integrating this knowledge into your paddock and property stocking and management strategies (eg carrying capacity and stocking rates).

### Linkages to other modules

This module describes and quantifies the property's physical resources, climate, current pastures and soil nutrition status for use in **Module 1: Setting directions**.

Pasture growth and quality are directly linked to **Module 3: Managing your natural resources** and indirectly through pasture utilisation to **Module 5: Weaner throughput** and **Module 7: Meeting market specifications**.

### Procedures for achieving best pasture growth and quality

- Procedure 1 - Understand long term weather, climate data and pasture growth
- Procedure 2 - Understand livestock nutritional requirements
- Procedure 3 - Understand nutritional properties of major arid zone pasture plants
- Procedure 4 - Determine carrying capacity and stocking rate

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In the arid zone, rainfall and soil moisture are the major factors limiting both plant growth and pastoral production.

Rainfall in the arid zone is highly variable and for the most part lacks distinct seasonality, although there is a tendency towards winter dominance in the south and summer dominance in the north.

Another characteristic is the marked variation in both monthly and yearly rainfall. This variation reduces the usefulness of averages in describing the rainfall at any particular location. Typically, for annual or monthly rainfall, the average is considerably higher than the median value, as it can be inflated by a few very wet years.

This is a difficult environment for decision making as there is no clear signal marking the beginning or the end of the feed production period. Seasonal risk assessments based on the Southern Oscillation Index (SOI) system provide useful information over much of the region in the late winter-spring period but at other times there is only historical climate data to use to determine 'trigger points' for decision making on pasture growth (Hacker et al., 2005).

Use of the SOI and historical data is systematically being replaced by the Predictive Ocean Atmosphere Model for Australia (POAMA) which is a seasonal forecast system based on a combined ocean/atmosphere model and ocean/atmosphere/land observation system. Unlike existing statistical forecasting, this system is not limited by historical relationships and so it can forecast a new set of climatic conditions. For example, because they simulate the real world they have the potential to predict how the impacts of one El Niño might be different to those of another.

### **Infiltration and run-off**

In a well-functioning landscape, rain either infiltrates the soil surface or runs off to lower-lying parts of the landscape. In larger rainfall events some of this run-off may leave the local landscape through major drainage systems. However, much of it is absorbed in other parts of the landscape, creating a mosaic of 'run-off-run-on' areas that are important in determining the amount of soil moisture available for plants and the overall productive capacity of the land.

Concentrating water (and nutrients) in restricted parts of the landscape can result in higher plant production in localised areas rather than an even spread. The scale of this mosaic in different land types varies widely. In some areas it is very evident in the formation of groves of dense vegetation separated by relatively bare areas. The redistribution of rainfall through run-off-run-on patchworks is an important part of the functioning of rangeland systems and underpins their production (Hacker et al., 2005).

While run-off is also important for enabling dams to fill, it is important that this does not result in water erosion and that as much water as possible infiltrates the soil, in turn contributing to plant growth.

### **Temperature**

Temperature is an important feature, as it determines both the effectiveness of rainfall and the growth response of plants. In dry environments evaporation is one of the main means of water loss.

Temperature influences evaporation and so is an important factor in determining how much rainfall is available for plant growth (effective rainfall). It also determines the amount of water required by plants to maintain their growth and how long growth can be sustained by a given amount of water contained in the soil profile. The growth rate of plants is influenced by temperature (relates also to soil temperature), so that slower growth may be observed in winter than in spring or summer regardless of the amount of soil moisture available.

### **The immediate effect of rain on grazing animals**

Livestock need particular attention following drought-breaking rain, as the sudden change in diet arising from the new pasture growth may cause nutritional imbalances. Stress due to wet conditions and a period of low nutrient intake needs to be managed carefully if the transition is to be successful.

Prolonged wet conditions will often cause stock to limit their intake or 'go off their feed'. If rain is coupled with windy conditions, stock will also need sheltered areas, particularly if stock are in poor condition. Low temperatures compound the problem; the nutritional stress experienced by stock in cold, wet, windy conditions is likely to increase substantially. An increased intake of high quality nutritious feed is likely to be required in order to prevent stock losses but also keep in mind that sudden dietary changes can severely disrupt the functioning of the rumen.

Particular attention should also be given to the rapid germination of potentially toxic plants following rainfall events, such as spurge and pimelea. Often these are some of the first plants to emerge following rain and may be consumed by cattle if there is little else on offer.

### **Soil surface management**

Soil erosion by wind and water is one form of land degradation affecting pastoral productivity. Erosion of topsoil reduces nutrient availability to

the plants growing in that soil and often exposes subsoils that are impervious to water and inhospitable to plant growth. Sealed surfaces on sloping areas can result in excessive run off and reduce the capacity of the landscape to produce pasture. Restoration of eroded areas is often difficult and may require mechanical intervention and changes to grazing management to ensure retention of ground cover.

Animal production is closely linked to the availability of feed and continuity of the feed supply can only be maximised by the presence and relative abundance of perennial forage species. These include grasses, forbs and shrubs, particularly chenopod shrubs (saltbush, bluebush and others).

Facilitating soil surface restoration using palatable perennial species requires the adoption of grazing management that adjusts the level and timing of grazing in relation to the needs of the vegetation and the opportunities or threats imposed by climatic conditions.

### **Total grazing pressure**

Non-domestic herbivores, including rabbits, feral goats, camels, donkeys, horses and kangaroos, can account for a substantial portion of the total forage demand. When combined, the pasture consumed by non-domestic herbivores can represent a significant level of competition to livestock. Under good seasonal conditions the demand by all species can be satisfied but when conditions deteriorate, the level of competition increases and producers may realise a negative economic impact. Also, the increased competition means greater potential for land degradation. The control of **total grazing pressure** therefore is a fundamental management requirement aimed at addressing arid zone land degradation issues, as well as declining livestock productivity.

### **What to measure and when**

Use historical rainfall records to assess the pattern and variability of rainfall:

- collect and analyse historical records (**Tool 2.01** provides a range of sources and methods to complete this analysis)
- measure the long term trend in condition for native perennial pastures, including all palatable species (**see Module 3**)
- look for any evidence of soil erosion or sediment deposition; this should be observed routinely after rain

## Procedure 2

Here we discuss the nutrient requirements of cattle and **how nutrients are made available to your livestock**. The productivity of a cattle enterprise in an arid environment is largely determined by the quality and quantity of feed available to the cattle. Without the convenience and ability of being able to improve pastures and tailor feed it is important to be aware of the nutritive values of pastures on your property and the requirements of your cattle at any given life stage. There are also a range of factors that will influence the feed intake of your cattle that need to be understood.

Knowledge of what is required by your livestock at any stage can help you plan livestock movements and determine carrying capacity and stocking rate (these terms will be discussed in detail later in this module). This serves to ensure the highest level of production while maintaining the condition of your pastures and paddocks. Pastures with greater diversity of plant species not only represents a healthy biological system but also provides better nutrition for your cattle, giving them a range of fodder choices with different nutritional compositions and therefore more balanced diet.

There are a number of factors that will influence the nutritional requirements of your cattle including class, life/breeding stage, environment and stock preference. Also, the presence of minerals and nutrients in feed does not always mean that they will be **available** to your stock. For example, a high level of one mineral can prevent the absorption of another.

### Livestock water requirements

The quantity and quality of water made available to your livestock is also an important factor for production. Water intake will depend on a range of factors such as the breed, class and life stage of livestock, feed quality, the distance between feed and water and environmental factors (season, temperature, exposure to sun). Table 1 describes the daily volume of water required by different classes of cattle.

The quality of water depends on the dissolved salt content (or salinity level, which is sum of all mineral salts in the water including sodium chloride, calcium and magnesium sulphates and bicarbonates), sediment levels and freshness. High pH and mineral content can also affect water consumption and in some cases, reduce appetite or cause animals to perish.

Salt tolerances for cattle, described as maximum mg/L of soluble salts, are as follows:

- 10 000 mg/L - overall maximum
- 4 000 mg/L - maximum to ensure healthy growth
- 5 000 mg/L - maximum to maintain current condition

Note: 1 000 mg/L = 1,785 EC. 1 mg/L = 1ppm

Cattle require less water when green pasture is available but require more during the summer months or during drought when more roughage is consumed and additional water is required to break it down in the rumen. Access to shade, especially during the summer months, can reduce water demand greatly as it minimises the need for animals to use evaporative cooling to control their body temperatures. Livestock may also avoid warm water so troughs and pumps should be maintained in good working order during summer to help ensure fresh water is available.

Where water is saline, livestock tend to drink greater quantities to enable their bodies to regulate the salt balance in their bodies. Water quality is especially important when the pasture consists of species with a high salt content such as saltbushes and other forbs and shrubs common to the arid zone. The quantity of water consumed by cattle will be higher when they are grazing on these shrubs, as more water is required to flush the extra salt out of their system. Where saline water and high salt content pastures occur, livestock may not be able to flush enough salt through their system and therefore feed intake may be reduced and production will be affected.

Some plants contain toxic levels of salt and when these are grazed, any weight gain by animals may be due to the increase in water consumption rather than growth. Metabolising the excess mineral salts also requires a great deal of energy and so production will further suffer.

Stock water consumption can increase by 80% in situations where stock are drinking saline water in summer.

Table 1: Average daily water requirements for different classes of cattle.

Stock Class	Litres per day (average requirements)
Dry cattle - 400 kg	40-50
Lactating cow - grassland	40-100

Lactating cow - saltbush	70-140
Young stock	25-50

### Forage for production

Livestock in arid environments source the majority of their nutrition from grasses (both annual and perennial species) and annual herbs and forbs. These are the principle drivers of animal production, including maintenance, growth, fertility and milk production. Rain or flood events that contribute to more seasonal patterns of pasture growth will lead to improved animal production. As these (highly digestible and palatable) feeds are grazed or dry off, perennial shrubs are often grazed more and therefore provide valuable nutrients including protein when grasses and forbs are less abundant. Perennial shrubs however, are mostly only sufficient to maintain condition of cattle, rather than contribute to significant growth. This is because perennial shrubs tend to have a lower level of digestibility than grasses and forbs and contain a greater amount of material that is not readily available to meet the nutritional requirements of cattle.

### Plant selection by stock

Cattle may be selective about what they graze and do not necessarily eat anything or everything, especially if they have a choice. The selection of grazing plants will depend on the palatability of a particular plant. The palatability of a plant can provide a guide about how desirable a pasture species may be to cattle. Leafiness and the protein content of leaves are key determiners of a plant's palatability, and these vary between pasture species.

Variation in palatability can also occur between individual plants of the same species: you may have noticed that some shrubs will be more heavily grazed but the plant growing next to it has not even been nibbled. This may be due to slight differences in the palatability or digestibility between the two plants.

While not all the reasons for plant selection by cattle are known, it is known that the life stage of plants affects palatability. As a plant matures it becomes less digestible. Leaves are more digestible than stems and twigs, which are more digestible than branches. There are many palatable shrubs that will not be grazed if they are flowering or seeding, or if only old growth is present. Therefore regular grazing of perennial grasses and shrubs is likely to encourage production of new leaf and soft stems/twigs.

Plant selection by livestock (and native grazers) is a key contributor to the reduction of desirable species and the increase in density of undesirable species (especially shrubs), even in well-managed landscapes.

Remember that even if a species is highly nutritious in terms of its digestibility, it will have little feed value if it is not palatable or preferred by livestock.

### Bite selection by cattle

Bite selection by cattle is influenced by the way they physically eat. When cattle eat vegetation, their tongue sweeps out in an arc, wraps around the plant parts, then pulls them between the teeth on the lower jaw and a pad on the upper jaw. The animal then swings its head so its teeth can sever the material.

Conversely sheep and goats do not extend their tongues, but rather "bare" their teeth and use them to cut the plant material. This means sheep and goats take smaller bites than cattle, can be more selective and can sever plants closer to the ground.

As a result, cattle tend to preferentially select soft leafy material rather than tough leaves, twigs, stems and branches, as sheep and goats do. However if a leafy grass sward is not available, cattle will resort to eating these tougher plant plants.

### The rumen

Ruminant livestock such as cattle have a complex digestive system comprising four compartments: the rumen, the reticulum, the omasum and the abomasum (true stomach). Our attention will be focused on the rumen and the abomasum.

The rumen is extremely important to the nutrition of the animal, typically producing 60-80% of the ruminant's energy in the form of volatile fatty acids (VFAs).

The rumen may be thought of as a fermentation vat, where rumen bugs (microbes) break down fibre (the plant cell walls etc.) into VFAs, which are then absorbed into the bloodstream across the rumen wall. A further advantage of the rumen is that as the microbes multiply they utilise non-protein nitrogen (eg urea), converting it to a form that can then be utilised by the animal when the microbes themselves are digested (microbial protein).

As the name suggests, the 'true stomach' is most similar in function to the stomach of humans and other monogastric animals, as it is where food matter is broken down by acidic digestion rather than fermentation.

Rumen fermentation processes create a large amount of gas which is expelled through the mouth by eructation (burping). Ridding the digestive system of these gases is vital to the health of livestock as severe cases of rumen bloating can be fatal.

Ruminants eat rapidly, swallowing much of their feedstuffs without chewing them sufficiently. The oesophagus functions bi-directionally in

ruminants, allowing the animals to regurgitate food for further chewing if necessary; this is known as “chewing the cud”. In the process of chewing the cud, more saliva is mixed with the food improving its digestion. The cud is then re-swallowed and passed into the reticulum for further digestion.

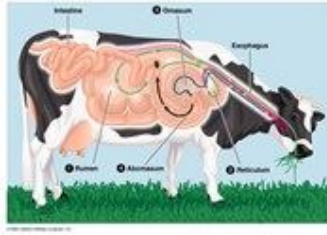


Figure 1: Ruminants have a complex digestive system

## Common nutrition terms

Following are some of the most common terms used when discussing livestock nutrition.

### Dry matter (DM): Fodder – water = Dry Matter

Dry matter is simply what is left of a plant when the water is removed. As the water content of plants is highly variable, DM is used as a standard term for animal feed and is expressed as a percentage of the total amount consumed. Dry matter contains the energy, protein, vitamins and minerals required by livestock for maintenance and production.

### Dry matter intake (DMI): Dry matter – faeces = Dry matter digestibility

Dry matter intake is the amount of dry matter ingested by an animal per day, expressed as a percentage of live weight. DMI is influenced by a many of factors including the diversity of feed available, selective grazing of preferred species and the presence and concentration of secondary compounds in plants. In an extensive shrub lands such as in the arid zone, DMI has greater importance as the level of sodium and secondary compounds can be high and this may limit the DMI of your cattle.

### Dry matter digestibility (DMD): Dry matter – faeces = Dry matter digestibility

Dry matter digestibility is the percentage of DMI that can be digested. This does not include matter that is not digested by the animal and passes as faeces. For example, if an animal consumes 5 kilograms of dry matter and passes 1 kg of dry matter, then the DMD is 4 kg (or 80%). This is the material that is used by the animal for survival and production processes.

### Dry organic matter digestibility (DOMD)

Dry organic matter digestibility is the proportion of the organic matter in the digestible dry matter that can be digested by an animal. This is calculated by incinerating the dry matter and measuring the remaining ash, which is indigestible.

### Metabolisable energy (ME)

Animals gain energy from plant material they consume. Not all energy will be used for production by animals, as it is lost to production through waste products including faeces, urine, gases.

The remaining energy, or metabolisable energy (ME), is made available to the animal for production or is lost as heat. ME is calculated from the DMD and is expressed as megajoules per kilogram of dry matter (MJ/kg DM). You may also see the term net energy. Net energy is energy that is only used for production i.e. ME minus the energy lost as heat.

ME will differ between plant species but also between different parts of the one plant. Energy requirements of sheep and cattle vary depending on a number of factors including age, sex, seasons, stage of growth and level of activity.

### Crude protein (CP)

Crude protein is a measure of the nitrogen content of feed and includes protein (true protein) and non-protein nitrogen (NPN). All protein is absorbed from the small intestine, however as previously described, there is an additional source of protein available to ruminants in the form of microbial protein synthesised in the rumen.

The protein consumed by the animal is (broadly) categorized into two groups:

- rumen degradable protein (RDP)
- rumen undegradable protein (RUP)

The RDP includes true protein and NPN and is available to rumen microbes. Eventually RDP passes into the abomasum as microbial protein. If there is not adequate RDP in the diet the ability of the rumen (and rumen microbes) to function will suffer. Therefore the energy available to the animal may be compromised and animal performance would be expected to suffer.

The UDP, as the name suggests, cannot be utilised by the rumen microbes and is therefore passed by the animal in the same form that it was

consumed by the animal. It is sometimes referred to as bypass protein.

Crude protein is considered an inaccurate measure of protein in intensive grazing systems where feed can be custom-made. This is due to the fact that crude protein can include a measure of protein which is 'bound' and is not available to livestock (or the rumen microbes). For extensive grazing systems such as those in shrub lands, crude protein is usually an adequate measure, given that the feed on offer in these systems is quite diverse. However if you have any concerns regarding the dietary protein available to your animals, you should discuss them with an animal nutritionist.

### Neutral detergent fibre (NDF)

Neutral detergent fibre is the structural components of the plant, such as the cell walls. It provides the bulk of the feed volume consumed and is slowly digested. NDF affects daily dry matter intake by cattle: the higher the level of NDF in the diet, the lower the intake. This is essentially because the feed contains too much fibre, which slows down digestion and limits intake. It is important to note that as a plant matures NDF increases.

Table 2: Nutrient requirements of cattle at different life stages (Adapted from NRC, 2000 and 200)

Life stage	DMI (% LW)	ME (MJ/kg DM)	CP (%)	NDF (%)
Cow: maintenance	1.8	8	8	30-60
Bull: maintenance	1.9	8	8	30-60
Cow: mating	2.0	10	10	30-60
Cow: late pregnancy	2.0	9	10	30-48
Cow: lactating	2.5	10.5	15	30-48
Calf: 4 months	3.5	10.8	16	30-34
Calf: 8 months	3.0	10.5	14	30-40
Bull calf: > 12 months	2.8	10.8	12	30-42

### Acid detergent fibre (ADF)

This is the least digestible part of the plant. Plants with low ADF are often higher in energy.

### Minerals

Macro minerals are the primary and essential minerals for sound animal health and production and are required in larger quantities than micro minerals.

Micro minerals (or trace elements) are also essential for animal health but are required in relatively small quantities. They include chromium, cobalt, copper, iodine, iron, manganese, molybdenum, nickel, selenium and zinc.

Table 3: Mineral requirements of cattle

Major minerals	(g/kg/DM)	Micro (trace) minerals	(mg/kg DM)
Phosphorus (P)	1.0-3.8	Copper (Cu)	4-14
Sulphur (S)	2.0	Cobalt (Co)	0.07-0.15
Calcium (Ca)	2.0-11.0	Selenium (Se)	0.04
Sodium (Na)	0.8-1.2	Zinc (Zn)	9-20
Magnesium (Mg)	1.3-2.2	Iodine (I)	0.5
Potassium (K)	5.0	Iron (Fe)	40
Chlorine (Cl)	0.7-2.4	Manganese (Mn)	20-25

Source: CSIRO Publishing 2007

### Plant secondary compounds

Plant secondary compounds (also referred to as anti-nutritive factors) are found in woody plants and shrubs and can significantly affect dry matter intake. Compounds include chemicals such as oxalates and nitrates, both of which are found in saltbushes. Concentration of these compounds may change during the lifecycle of a plant.

Plants containing more than 2% soluble oxalate (of DM) have the potential to cause acute oxalate poisoning in ruminants, however poisoning is normally associated with much higher concentrations (eg >10%). The effect on stock depends on 'pre-conditioning', ie whether livestock have had previous exposure to plants containing oxalate and whether the animals are hungry or not when given access to the plant.

As a general rule, any plant containing greater than the equivalent of 1.5% potassium nitrate (of DM) can be considered a potential cause of nitrate poisoning, however the concentrations associated with clinical disease are frequently more than 5%.

## Livestock nutrition

Typically livestock will source their nutrition from a wide range of plants. When planning or monitoring the available nutrition it is important to remember that livestock grazing in arid zones require a diverse choice of feed. Having a diversity of plants means they have a greater chance of meeting their nutritional requirements.

## Consumption limitations

Livestock do not have the ability to simply 'keep eating'. The amount of feed consumed can be influenced by a number of processes. The following are the key drivers:

- intake increases, and feed passes through the digestive system more quickly, when feed is more digestible, providing room for more feed
- the rumen's multiple stages, the production of saliva and the need to break feed into smaller particle sizes, requires time and energy to work effectively
- as NDF (fibre) increases animals will consume less
- anti-nutritive factors found in rangeland shrubs may negatively affect feed intake
- high salt (sodium and potassium) levels may reduce appetite, especially if animals have access to only saline water
- appetite may be reduced in areas where only plants with low or no palatability occur
- the processes involved in digestion (including the activity of rumen microbes) will be reduced if cattle are grazing plants with low metabolisable energy

## Mineral interactions

The mineral content of feed and the changing demands for these minerals by livestock at different life stages are important drivers of production. However, there may also be particularly interactions between different minerals when they are consumed by cattle. It is therefore important to not only consider the mineral content of feed but what other minerals are present in the diet. The following describe some of the negative interactions that can occur:

- where aluminium is high, absorption of other minerals is reduced
- high sulphur levels may make copper unavailable
- high potassium, calcium and protein together may limit magnesium absorption
- high molybdenum, sulphur and iron may limit copper absorption.



## Setting directions

The following information (Tables 4 and 5) on the nutritive value of selected arid zone plants, including perennial shrubs, grasses and forbs, has been collated from a range of sources. However, any analysis of plant nutritive value should be interpreted with caution as the ratings are highly dependent on:

- when and where the plants were sampled
- the nature of seasonal conditions prior to and at the time of sampling
- whether soil particles were present in the samples.

Note: All sampling should focus on leaves and small twigs/branches, as this represents the 'usual' feeding behaviour of cattle.

Table 4: Range of ME (MJ/kg); crude protein (%) and relative mineral content\* of preferentially grazed plant species in the arid lands of South Australia (Productive Nutrition Pty Ltd 2009).

Scientific name	Common name	ME (MJ/kg DM)	CP (%)	Mineral levels - high	Mineral levels - low
<i>Acacia victoriae</i>	Prickly acacia	4.6-10.4	10.2-22.7	Ca, Mg, Mo, Fe, Co, Se	P, Na, Cu
<i>Aristida contorta</i>	Kerosine grass	6.7-8.5	5.2-12.2	Fe, Mn, Co, Se, K, Mg	Cu, Na, Se
<i>Astrebala pectinata</i>	Barley Mitchell grass	4.5-11.3	3.3-23.1	Fe, Co, S, Mg, K	Cu, Se
<i>Atriplex vesicaria</i>	Bladder saltbush	6.5-11.2	6.8-21.6	Ca, Mg, Na, S, Mn, Fe, Co, Se	P, Cu, Zn
<i>Chenopodium nitriaceum</i>	Nitre goosefoot	5.2-11.9	20.1-29.4	Ca, K, Mg, S, Fe, Mn, Se	
<i>Cullen australasicum</i>	Tall verbine	6.1-14.4	8.1-22.8	Ca, K, Mg, Mo, Zn, Mn, Fe, Co Se	Na
<i>Cullen cinereum</i>	Short verbine	8.7-12.7	14.1-24.1	Ca, K, Mg, Zn, Mo, Fe, Se	
<i>Dactyloctenium radulans</i>	Button grass	6.0-10	4.2-22.1	K, Mg, Na, S, Mo, Zn, Mn, Fe, Co	P
<i>Eragrostis australasica</i>	Swamp canegrass	3.4-9.2	3.1-15.2	K, Na, S, Fe	Ca, P, Mg, Zn
<i>Erodium crinitum</i>	Geranium, Storksbill	9.4-10.3	7.9-20.9	Ca, Na, Fe, Co	P, Zn, Se
<i>Iseilema membranaceum</i>	Small Flinders grass	6.8-9.1	3.0-9.2	Fe, Co	Ca, P, Mg, Zn, Mn
<i>Maireana aphylla</i>	Cottonbush	5.7-10.8	6.8-29.5	Ca, K, Mg, Na, Fe, Mn, Co, Se	P, Mo, Zn

<i>Maireana astrotricha</i>	Low bluebush	7.6-10.1	10.4-23	K, Mg, Na, Mn, Fe, P, Cu	P
<i>Salsola kali</i>	Buckbush, Roly-poly	7.9-12.4	8.3-19.2	Mg, Na, Mn, Fe	P, Cu, Se
<i>Scleroleana dicantha</i>	Grey copperburr	4.6-11.2	12.3-30.1	Ca, K, Mg, Na, Mn, Fe, Co,	P, Cu, Se
<i>Trigonella suavissima</i>	Native clover	8.6-12.6	15-29.6	Ca, K, Mg, S, Mn, Fe, Co, Se, Mo	Cu
<i>Zygochloa paradoxa</i>	Sandhill canegrass	3.5-6.9	1.8-10.3	K, Fe, Co, Se	Mg, Na, S, Cu, Zn

Table 5: Range of ME (MJ/kg DM); crude protein (%) and relative mineral content\* of preferentially grazed native shrub species in the arid lands of New South Wales

Scientific name	Common name	ME (MJ/kg DM)	CP (%)	Mineral levels - high	Mineral levels - low
<i>Atriplex leptocarpa</i>	Slender-fruited saltbush	7.4-9.6	24.1-36.2	Ca, Mg, K, Fe, Na, Mn	P
<i>Atriplex lindleyi</i>	Eastern flat-top saltbush	7.5-9.6	14.6-27.7	Mg, K, Na, Mn, Se	
<i>Atriplex nummularia</i>	Old Man saltbush	8.6-9.2	24.8-29.4	Mg, K, Na, Mn, Zn	P
<i>Atriplex pseudocampanulata</i>	Mealy saltbush	8.6-8.9	27.1-29.4	Mg, K, Na, Mn, Zn	P
<i>Atriplex semibaccata</i>	Creeping saltbush	10.5-10.8	14.3-24.8	Mg, K, Na, Zn	P
<i>Atriplex vesicaria</i>	Bladder saltbush	8.4-8.9	34.2-45.0	K, Na, Zn	P
<i>Chenopodium nitrariaceum</i>	Nitre goosefoot	8.8-10.0	24.1-30.1	Ca, Mg, K, Na, Zn	
<i>Einadia nutans</i>	Climbing saltbush	9.2-9.7	17.4-26.6	Mg, K, Na	
<i>Enchylaena tomentosa</i>	Ruby saltbush	5.3-9.4	27.7-28.8	K, Na	P
<i>Maireana aphylla</i>	Cottonbush	5.9-6.0	39.7-60.4		P
<i>Maireana brevifolia</i>	Yanga bush	7.5-7.6	21.2-27.3	Na	P
<i>Maireana ciliata</i>	Hairy fissure-weed	8.6	50.6	Na	P
<i>Maireana decalvans</i>	Black cottonbush	8.3	20.3	K, Na	P
<i>Maireana enchylaenoides</i>	Wingless fissure-weed	7.7	56.1	K, Na, Co	P
<i>Maireana pyramidata</i>	Black bluebush	7.2-8.0	19.4-33.3	K, Na	P

<i>Muehlenbeckia florulenta</i>	Lignum	5.8-6.2	34.0-34.2	K, Zn	
<i>Nitraria billardieri</i>	Dillon bush	9.7-10.7	24.5-25.3	Ca, K, Na, Zn	
<i>Rhagodia spinescens</i>	Thorny Saltbush	9.1-9.3	25.4-26.1	K, Na, Zn	
<i>Sclerolaena brachyptera</i>	Short-winged copperburr	6.9-7.5	22.5-33.0	Na	P
<i>Sclerolaena diacantha</i>	Grey copperburr	8.3-8.4	20.7-37.6	K, Na, Zn	P
<i>Sclerostegia tenuis</i>	Slender glasswort	7.3-9.6	20.0-22.2	Mg, Na	P

\*Refer to Table 3 in Procedure 2 for abbreviations of minerals

### How to conduct your own plant nutrition analysis

1. Determine which plant species to be sampled and tested. Consider the entire range of plants that your cattle utilise in an area by observing them grazing.
2. Determine best time of year to sample (eg at the start and/or at the end of the growing season, in dry and/or wet periods or on a regular schedule such as every 3 months regardless of seasonal conditions).
3. Choose sample locations on property and within paddocks that represent how cattle graze. For example, it is pointless collecting samples from an area that is not grazed, unless you want to understand why the cattle are not grazing there.
4. To collect samples:
  - use clean cutters or your hands to strip the leaves (shrubs) or leaves and soft stems (grasses and forbs) from the plant, taking into account what parts of the plant the cattle graze
  - avoid contaminating with roots and soil
  - put the samples into a zip lock bag and label with the scientific and common name (if you are able find out what this is)
  - record the sample details, including the stage of plant growth, on the Plant Sample Sheet (see Tool 2.02)
  - take a clear photo of the plant including close-ups of its flowers/fruits and/or leaves to compare with reference material if you can't identify the scientific or common name.
5. Send the plant samples to a laboratory for testing (either NSW DPI, Wagga Wagga Feed Quality Laboratory or SGS Feed Testing Laboratory in Toowoomba, Queensland), indicating which tests you want conducted on each sample.

Samples can be analysed using a wet chemistry method for feed value including the following:

- dry matter content (moisture)
- metabolisable energy
- crude protein
- neutral detergent fibre
- dry matter and dry organic matter digestibility
- mineral content including; calcium, phosphorus, potassium, magnesium, sodium, sulphur, boron, copper, molybdenum, zinc, manganese, cobalt and selenium

## Procedure 4

Firstly some universal understanding of terminology is required. This includes:

- dry sheep equivalents
- body condition scores
- carrying capacity
- stocking rate

### Dry sheep equivalents (DSE)

As the energy needs (and therefore the feed requirements) of livestock differ not only between stock type but also between life stages, grazing management can be made simpler by using a common measure for all types of livestock.

Dry sheep equivalents (DSEs) are the most common unit used when comparing the feed and energy requirements for different classes of stock, including cattle. It is also a valuable measure when matching stocking rates to available pasture.

The conversion weights applied to different livestock will vary depending on the model you use (and the ratings the model uses), so it is important to decide on the model that you believe best applies to your livestock and always use that model, rather than switching between different ratings.

The NSW Department of Primary Industries defines 1 DSE as a 50kg Merino wether, dry ewe or non-pregnant ewe that is maintaining its condition. See Table 6 for the ratings of different stock classes.

### Why are DSEs important?

DSEs are an important tool when matching your stocking rate to the available feed in a paddock. It is also useful if you run other types of livestock on your property, such as sheep or goats, as you can then compare different types of animals using the same measures.

#### 100 cattle are not always 100 cattle

For example, the feed in your top paddock may support 100 dry cows at maintenance for 90 days but will only support 100 pregnant cows for 50 days as they require additional nutrition for calf development and lactation.

The calculations are averages of energy needs and do not take into account other limiting factors such as paddock topography, pasture types and protein or mineral requirements of livestock. This is where your knowledge needs to be built in to your grazing plan and management.

Table 6: Dry Sheep Equivalent (DSE) ratings for different classes of cattle

Class of cattle (British breeds)	DSE at specified live weights	
	200kg	250kg
<b>Weaned calf</b>		
■ gaining 0.25kg/day	■ 5.5	■ 6.5
■ gaining 0.75kg/day	■ 8.0	■ 9.0
<b>Yearling</b>	<b>400kg</b>	<b>500kg</b>
■ gaining 0.25kg/day	■ 7	■ 8
■ gaining 0.75kg/day	■ 10	■ 11
<b>Mature cattle</b>	<b>400kg</b>	<b>500kg</b>
■ dry cow or steer (maintenance)	■ 7	■ 8
■ cry cow or steer gaining 0.25kg/day	■ 8	■ 8
■ bullock (maintenance)	■ 8	■ 9
■ bullock gaining 0.25kg/day	■ 12	■ 14
■ pregnant cow (last 3 months)	■ 9	■ 11
■ wet cow with 0-3 month calf	■ 14	■ 18
■ wet cow with 4-6 month calf	■ 18	■ 22
■ wet cow with 7-10 month calf	■ 22	■ 25

Note: These ratings apply to British breeds of beef cattle, if you have *Bos indicus* cattle alternative models/ratings should be sought.

## What is Body Condition Scoring (BCS)?

Body condition scoring (BCS) is a method for estimating the condition or nutritional well-being of livestock.

A national system of objectively describing cattle in low body condition has been introduced, with a focus on managing for animal health and welfare. The new rating system includes a BCS of 0 for very low condition animals.

The new system replaces the traditional descriptions such as poor, backward and weak that have not been well defined and are subjective, and their use is now discouraged.

Many producers find it easier to base their management decisions around livestock rather than around pastures. However changes in the condition of cattle can be relatively slow to respond to changes in feed quality and quantity. Therefore it is important to use BCS in conjunction with estimates of pasture condition.

Conducting BCS on a regular basis will tell you how your livestock are performing on the available feed, so it can be a powerful tool to use in conjunction with estimating pasture condition.

Read *A national guide to describing and managing cattle in low body condition*

### When to assess BCS

Ideally, you should assess BCS of your livestock on a monthly basis, as this will give you a reasonable lag time since changes in pasture condition occurred. You should also assess BCS at the same as you assess pasture condition.

A good time to do these assessments is when you are doing water/mill runs, as you are likely to see cattle at watering points. In other words, the assessments don't need to be considered as another job, but simply part of an existing one. Get in the habit of making BCS and pasture assessments as you drive past cattle and through paddocks.

Another important time to do body condition scoring is at joining, calving and weaning, to give you important feedback on the reproductive performance of your cattle, as there is a strong correlation between BCS of cows at calving and their future reproductive performance.

### Important points when assessing BCS

- You only need to assess 25 animals to obtain a statistically correct average for a mob, making it a relatively quick task.
- Each animal assessment should only take a matter of seconds. Therefore to get an average for the mob should only take 2 minutes or so.
- When assessing a mob, make sure the 25 animals you select are all the one class, eg all weaners, dry breeders, or lactating breeders. Do not mix classes and especially do not mix lactating and dry breeders.
- Make sure your sample of 25 animals is random, so don't select the best looking animals.
- When assessing BCS, it is also preferable to feel the animal but not essential, especially with short-haired cattle. It will only be critical to feel cattle if they are very hairy as the hair can make it difficult to see the condition of the cattle.

### Body condition scoring of beef cattle

The fat cover over the loin area between the hip (hook) bone and the last rib is the major location on the animal's body used for condition scoring, especially in thin animals. It is measured by placing your hand on the loin area, fingers pointing to the opposite hip bone. With your thumb, feel that fat cover over the ends of the short ribs.

Since there is no muscle between the end of the short ribs and the skin, any padding felt by the thumb will be fat. In cows that score above 3, the short ribs can no longer be felt, even with firm pressure. Therefore, in fatter cattle, the fat cover around the tail head and over the ribs is also used to assess the animal's condition score. Half measures (eg 2.5) can also be used here.

### Carrying capacity and stocking rate

A major driver of natural resource condition trend is the level of total grazing pressure over time. Managing grazing pressure so that a negative trend in condition is avoided requires an understanding of the carrying capacity of your property and individual paddocks and how these differ to stocking rates. It is also important to know how to measure both and how to manipulate the stocking rate in order to not exceed carrying capacity.

Firstly it is important to understand the main terms. The terms **Carrying Capacity** and **Feed on Offer (FOO)** are often used interchangeably and refer to how much feed (the supply of feed) is available in a particular time frame. This procedure will refer to carrying capacity.

Carrying capacity can be estimated over long and short time frames. The long term carrying capacity is the average number of animals that a pasture can be expected to support over a long term planning horizon (10–15 years) and the short-term carrying capacity is the number of animals that a pasture can support for a set period of time; say a week, month, season or year.

It is important to stick to one time frame or the other when using carrying capacity figures, as obviously the short-term figures are far more variable than long-term estimates. In this procedure, we will refer to the short-term carrying capacity, which is usually measured as grazing area (ha) per dry sheep equivalent (DSE).

**Stocking Rate** refers to the number of animals or DSEs currently grazing an area of land (i.e. the demand for the available feed). Stocking rate is usually expressed in grazing area (ha) per dry sheep equivalent (DSE) for a nominated period of time. As stocking rate uses the same units as carrying capacity it is important to be clear which figure you are working with at the time.

A pasture or paddock's stocking rate will change with seasonal conditions and animal reproduction, mortalities, transfers in/out and the impact of non-domestic grazers.

**It is important to understand the difference between the two terms so keep in mind:**

**Supply = carrying capacity**

**Demand = stocking rate**

Another aspect that is important to remember is that both carrying capacity and stocking rate are a function of both **stock numbers** and **time**. The length of time the feed will last is a function of how many stock will graze it (carrying capacity), and how many stock can graze the available feed is a function of how long we need to make the feed last (stocking rate).

To better reflect the impact of time in the estimation of carrying capacity and stocking rate, DSE days per hectare (DDH) can be used. These units take into account both stock numbers and time.

### **Factors to consider when estimating carrying capacity**

Estimating the carrying capacity of a property is no easy task due to scale and the variability in land and vegetation types. However with practice and regular checking of your estimates, accuracy will improve quite quickly.

When estimating the amount of feed available to be eaten (carrying capacity), bear in mind the following factors:

- Do not include feed you know the stock will not eat (non-palatable plants).
- Aim to leave 40% to 50% of the available feed to ensure the plants can grow again, rather than letting animals graze all of the plant/pasture.
- Determine a realistic grazing radius from each water point to calculate the area grazed, which in turn is used to calculate carrying capacity. Look for obvious signs of grazing and cattle activity at a number of points away from water and work out the furthest point cattle range. However, it is important not to include areas that are outside a realistic grazing distance from water. The distance cattle range will also depend on the livestock's water requirements. For example, lactating cows won't graze as far out from water as dry stock and high temperatures can limit the grazing radius.
- Consider how long the pasture will last. For example, is it made up of perennial grasses rather than annual forbs that will shrivel up and blow away on the first hot day. The quality of the feed and the stage in the plant's life cycle is also important. Leaves of plants, including grasses, will deteriorate in nutritive value once they begin to flower.
- Estimate the carrying capacity of paddocks as a sum of the carrying capacities for each of the land types in each paddock. If you can estimate or know the proportion of each land type in the paddock, you can work out a total for the paddock.
- Remember that cattle tend to graze (grasses and forbs) at 95% and browse shrubs for the remaining 5%, depending on what feed is available. However, if shrubs make up the largest of the feed component available, then these figures can change dramatically.

### **How to estimate carrying capacity**

There are numerous methods you can use for determining the amount of feed available, use any method which works for you. Refer to **Tool 2.03**.

Only one method will be discussed here, which is often called the 'square' method. It can be used in different land types and is relatively easy to use. You simply estimate the area required to feed one DSE for one day, taking into account all of the above factors ie what the stock will eat, what they won't eat, how much feed resource you wish to leave behind, your production and natural resource management goals and actions from **Module 1: Setting directions**.

For this example, we'll assume that you are estimating the carrying capacity for one paddock, however this method can be extrapolated over the whole property and all paddocks if required.

The general idea is to visualise the area required to feed one DSE for one day. The easiest way to do this is to have at least two people to act as the corner posts of your square. If you are working alone, use posts to plot this square area. Look at the amount of feed in the area you have marked out and ask yourself "Is there enough feed in that area to feed one DSE for one day?" Remember you are aiming for maintenance - no gain or loss of live weight.

### **What you will have to think about**

Try this in the field with family or neighbours. Discuss what plants are in the area, what stock will eat, what they won't eat, is there enough feed or too much? Keep adjusting the size of the square until you agree that it is about the right size. If you can't agree, go with the person who wants the biggest area. The biggest square will give you the lowest and most conservative estimate of carrying capacity or Feed on Offer (FOO). Once you have established your square, pace out two sides and record these measurements.

**It is better to underestimate the feed available than overestimate it.**



Figure 1: Estimating daily feed requirements for 1 DSE.

As mentioned earlier, you may need to do more than one estimate across the paddock. How many you do will be determined by the land type variability in the paddock, the size of the paddock and the distribution of waters. You also need to consider the nutritional value of the plants for each land type within the paddock.

### Working out how many DSE days of FOO there are

Use the example of Jess's paddock with 2 different land types, described in Table 7.

Once you have made all your estimates and recorded the length of the sides in Column A (see Table 7), work through the following steps.

**Step 1.** Grab your calculator and work out the size of your square in  $m^2$ , by multiplying the length of the two sides together eg  $17\text{ m} \times 15\text{ m} = 255\text{ m}^2$ .

**Step 2.** Now ask yourself, how many of those squares fit into one hectare? One hectare is 100 metres by 100 metres =  $10,000\text{ m}^2$ . So to work out how many  $255\text{ m}^2$  squares fit into one hectare, simply divide 10,000 by 255.

Column C shows the number of DSE Days of feed available per hectare.

So, for land type 1, there are 39 DSE Days per ha (DDH) of feed available. That means on each hectare there is enough feed for 39 DSEs for 1 day, or 1 DSE for 39 days, or any combination of DSEs and days in between. Do the same for land type 2 (see Table 7).

Table 7: Calculating DSE days per Ha.

	A	B	C
Jess's Paddock	Length of sides (metres)	Area of square ( $m^2$ )	DSE Days per ha, ( $10,000 \div B$ )
Land type 1 eg bladder saltbush plains	17 x 15	255	39
Land type 2 eg Dillon Bush plains	10 x 9	90	111

**Step 3.** Now we need to work out how many DSE Days of feed are available over the *whole* grazing area of the paddock. To do that, we need to know how many hectares there are in each land type.

To calculate the DSE days of FOO for land type 1, take Column C in Table 7 and multiply by the number of grazed hectares **ie. the area of the land type that is available for grazing** (it is not usually the whole paddock due to factors like topography, distance from watering points etc.)

In land type 1  $39\text{ DDH} \times 500\text{ ha} = 19,500\text{ DSE Days}$ .

Repeat for land type 2.

Then add up total DSE Days in the paddock as shown in Table 8.

Table 8: Calculating DSE Days.

	DSE Days per ha	Grazed ha i.e. area available for grazing	DSE Days of FOO
Land type 1	39	500	19,500
Land type 2	111	600	66,600

<b>Total</b>		<b>1,100</b>	<b>86,100</b>
--------------	--	--------------	---------------

In this example, we have estimated that there are 86,100 DSE Days of preferred and available feed in Jess's paddock. Given this, the next step is to determine how many stock we can graze in the paddock, and for how long. Note that lower stocking rates allow more room to move with seasonal variations and encourage higher productivity per head.

### Calculating Stocking Rate

In Jess's paddock there is an estimated 86,100 DSE Days of feed available. We now need to determine if any adjustments are required to the number of stock being run in the paddock. This also relates to the goals and actions your wish to achieve (Module 1).

Some other information to inform this example:

- The feed is required from mid-January to end of May, a total of 135 days.
- There are currently 100 dry cows in the paddock.
- The cows are currently around 400 kg live weight (gaining .25kg/day to ensure successful joining).
- The cows will be joined beginning of Autumn and we are aiming for a 95% calving rate.

**Step 1:** Plan out the stocking rate for the time that the feed needs to last as shown in Table 9.

Table 9: Calculation of stocking rate in DSE Days for Jess's Paddock.

Row		January	February	March	April	May
2	Days	15	28	31	30	31
3	Cow numbers	100	100	100	100	100
4	Status	Dry	Dry	Dry	Pregnant*	Pregnant
5	DSE rating	7	7	7	9	9
6	Total DSEs in paddock	700	700	700	900	900
7	Stocking rate DSE Days	10,500	19,600	21,700	27,000	27,900
8	<b>Total DSE Days of feed demand for the 135 days</b>					<b>106,700</b>

\*Assume 100% joining

To do this, firstly write down how many days in each month (Row 2), and then determine the DSE rating to use for each month (Row 5). The DSE rating is based on bodyweight, growth rate and physiological state of the animal.

Then multiply the number of ewes by the monthly DSE rating to give you the total number of DSEs in the paddock for each month (Row 6).

The next step is to then multiply the number of DSEs in the paddock for each month by the days in the month to give you the DSE Days of feed demand for each month (Row 7).

Add up all the DSE Days for each month, and this gives you the expected stocking rate in DSE Days for the next 135 days (Row 8).

**Step 2:** Determine if there is enough feed to satisfy the demand.

The estimate of FOO was 86,100 DSE Days of feed available, and there is a demand of 106,700 DSE Days. This means that the paddock will be overstocked.

**Step 3:** So, how many cows need to come out?

The paddock is overstocked by  $106,700 - 86,100 = 20,600$  DSE Days, so the demand for feed (or stocking rate) needs to be reduced by this amount. The feed needs to last for 135 days so divide 20,600 DSE Days by 135 days, there is 152 DSEs too many in the paddock. The next question is "How many cows need to be removed from the paddock?"

To calculate this, take the number of excess DSEs, (152) and divide by the DSE rating per head. Now, the DSE rating changes over the months, so on the more conservative side, use the lowest DSE rating. This will result in slightly more cows being removed than if you



calculate the average DSE rating over the 135 days. So the number of cows to remove from the paddock will be 152 DSEs divided by 7 DSE per head = **21 head**.

#### **Other important points:**

Note that in calculating this stocking rate, non-domestic grazers such as rabbits; goats; donkeys; camels; horses and kangaroos have not been included. They can make up a significant part of your total grazing pressure.

When planning out your stocking rate, you need to take your livestock productivity goals and actions (**Module 1**) into account when assigning DSE ratings. If you use anything less, you will not provide sufficient feed for the levels of productivity to be achieved. Your productivity goals and feed budgets must be aligned - if they aren't, you may have great difficulty achieving them.

You need to determine how significant the number of stock to removed ie **how significant is 21 head?** Do you have any paddocks available to put these cows? For example, vacant paddocks that have sufficient feed available or do you need to make a decision to sell? All your stocking decisions are interrelated with your productivity and natural resource goals. So you need to look at these decisions in a holistic way.

**Livestock productivity goals should be consistent with stocking rate and vice versa.**

#### **Further information and resources**

Addison, J., *Managing Range Condition, Agriculture WA*, Kalgoorlie.

Alchin, M., Addison, J., Shrubbs, V., Cockerill, Z., Young, M., Johnson, T., and Brennan, G., 2008, *Pastoral Profits Guide – A paddock guide to achieving sustainable livestock productivity*, WA Ag.

*A national guide to describing and managing beef cattle in low body condition*

Hacker, R., Beange, L., Casburn, G., Curran, G., Gray, P. & Warner, J. (2005), *Best Management Practices for Extensive Grazing Enterprises*, NSW Department of Primary Industries, Orange.

National Research Council (1987), *Predicting Feed Intake of Food-Producing Animals*, National Academy Press, Washington, D.C.

National Research Council (2000), *Nutrient Requirements of Beef Cattle*, Animal Nutrition Series, Seventh Revised Edition, National Academies Press, Washington, D.C.

Outback Lakes Group (2009), *Best practice nutritional management of grazed pasture plants*, Productive Nutrition Pty Ltd.

PRIMEFACT 533, *Water for Livestock: Interpreting Water Quality Tests*, (2007), NSW Department of Primary Industries.

*Guidelines for the development of extensive cattle stations in northern Australia - Insights from the Pigeon Hole Project*

## Setting directions

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Rainfall is the key driver of native pasture growth and the major factor behind variation in pasture growth rates between locations. A sound knowledge of the seasonal trends and the extent of year to year variability are essential for optimising the seasonal growth and quality of pasture.

Producers are advised to look for either raw data, such as locally based historical rainfall records, or professionally developed data software such as Rainman™. Local sources include:

- On property records, if they go back at least 30 years
- The nearest meteorological station records from the **Bureau of Meteorology**.

Look at as many seasonal forecasts as possible to get a consensus.

Once you have a complete set of records, calculate average annual rainfall and plot on a graph.

As an alternative, producers may consider obtaining a copy of **Rainman**. This provides historical data from locations around Australia and will analyse chosen data sets to produce seasonal monthly and daily patterns in rainfall. Other features include information on seasonal forecasts based on the *El Nino* phenomenon. Rainman is available for download, or can be ordered on CD from the Queensland Department of Agriculture, Fisheries and Forestry.

### Using the information on rainfall

Look for patterns in seasonal distribution that provide guidance to the optimisation of pasture growth.

- Determine the normal start and end of your main growing season. Remembering that temperature is also an important factor.

### Sources of Information:

- Australian Weather News
- Bureau of Meteorology: Water and the land for agriculture and natural resources management
- Climate Kelpie
- Department of Primary Industries Victoria: **Climate Risk**
- Ocean Observations Panel for Climate (OOPC) **Indian Ocean Dipole** (useful data for May to November)
- **Southern Oscillation Index (SOI)** (useful data for April/May- August)
- **Predictive Ocean Atmosphere Model for Australia (POAMA)** experimental forecast
- CSIRO: **Seasonal Climate**
- Japan Agency for Marine-Earth Science & Technology (JAMSTEC) **3 month forecasts**

## Setting directions

Below is an example form to record plants present on your property and how they are being grazed.

<b>Property and owner name:</b>		<b>Samples collected by:</b>	
<b>Paddock and land type:</b>		<b>Date:</b>	
<b>Species name (scientific and common):</b>		<b>GPS coordinates:</b>	
<b>Stage of growth:</b>	<b>Proportion of feed on offer:</b>	<b>Part of plant grazed:</b>	
<ul style="list-style-type: none"> <li><input type="checkbox"/> seedling</li> <li><input type="checkbox"/> early growing</li> <li><input type="checkbox"/> flowering</li> <li><input type="checkbox"/> seed set</li> <li><input type="checkbox"/> dying off</li> <li><input type="checkbox"/> dormant</li> </ul>	<ul style="list-style-type: none"> <li><input type="checkbox"/> &lt;5% - minimal volume</li> <li><input type="checkbox"/> 5-10% - some volume</li> <li><input type="checkbox"/> 10-20% - common</li> <li><input type="checkbox"/> 20-30% - very common</li> <li><input type="checkbox"/> &gt;30% - dominant</li> </ul>	<ul style="list-style-type: none"> <li><input type="checkbox"/> new growth eaten</li> <li><input type="checkbox"/> all leaf eaten</li> <li><input type="checkbox"/> leaf and stalk</li> <li><input type="checkbox"/> leaf and branch</li> </ul>	
<b>Grazed by:</b>		<b>Grazing preference:</b>	
<ul style="list-style-type: none"> <li><input type="checkbox"/> cattle</li> <li><input type="checkbox"/> sheep</li> <li><input type="checkbox"/> other – rabbits, kangaroos etc</li> </ul>		<ul style="list-style-type: none"> <li><input type="checkbox"/> sought out</li> <li><input type="checkbox"/> readily eaten</li> <li><input type="checkbox"/> not preferred</li> <li><input type="checkbox"/> last resort</li> <li><input type="checkbox"/> paddock/area destocked</li> </ul>	
<b>Photo taken:</b> yes/no			
<b>Comments/other information</b> (eg seasonal conditions, how green plant is at time of sampling)			



## Setting directions

Use this recording sheet for estimating carrying capacity and calculating DSE days per hectare.

	A	B	C
<b>Paddock Name:</b>	<b>Length of sides of area to feed 1 DSE for 1 day (metres)</b>	<b>Area of square (m<sup>2</sup>)</b>	<b>DSE Days per ha = (10,000 ÷ B)</b>
<i>Example</i>	10 x 12	120	83
<b>Land type: describe major plant species</b>			
Estimate 1			
Estimate 2			
Estimate 3			
<b>Average</b>			
<b>Land type:</b>			
Estimate 1			
Estimate 2			
Estimate 3			
<b>Average</b>			
<b>Land type:</b>			
Estimate 1			
Estimate 2			
Estimate 3			
<b>Average</b>			

## Setting directions

	A	B	C
	<b>DSE days per ha (refer to Tool 2.03)</b>	<b>Grazed ha</b>	<b>DSE days of Feed on Offer = (A x B)</b>
<i>Example</i>	83	2,837	235,471
<b>Paddock:</b>			
Land type 1			
Land type 2			
Land type 3			
<b>Paddock:</b>			
Land type 1			
Land type 2			
Land type 3			
<b>Paddock:</b>			
Land type 1			
Land type 2			
Land type 3			
<b>Paddock:</b>			
Land type 1			
Land type 2			
Land type 3			



## Setting directions

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Below is an example of a Stocking rate planning sheet, it should be completed for each month and for all classes of stock on the property.

<b>Month</b>	<b>Class of stock</b>	<b>Class of stock</b>	<b>Class of stock</b>	<b>Total DSE days</b>
Jan	No. head: DSE rating: Days: DSE days:	No head: DSE rating: Days: DSE days:	No. head: DSE rating: Days: DSE days:	
Feb	No head: DSE rating: Days: DSE days:	No. head: DSE rating: Days: DSE days:	No. head: DSE rating: Days: DSE days:	
Mar				
Apr				
May				
Jun				
Jul				
Aug				
Sept				
Oct				
Nov				
Dec				
				<b>Total DSE days</b>



## Setting directions

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To compare feed on offer to stocking rate follow the equations below:

### **A: Over or under supply of feed**

$(\text{Total Feed on Offer in DSE days}) - (\text{Total planned stocking rate in DSE days}) = \text{Feed vs stocking rate ratio}$

If the answer to the equation is negative, demand for feed is greater than supply (overstocked).

If the answer is positive, demand for feed is less than supply (stocking rate is less than carrying capacity). You could put more stock on or leave the excess feed for the country to regenerate.

### **B: Stocking rate adjustments**

$(\text{Number of days the feed has to last}) \div (\text{Answer to equation A}) = \text{Number of DSE to adjust stocking rate by}$

### **C: Class of stock used to adjust stocking rate**

Determine the class of stock that will be used to adjust stocking rate (e.g. dry cows) and use the equation below:

$(\text{Average DSE per head for the class of stock}) \div (\text{Answer to equation B}) = \text{Number of animals to adjust stocking rate by without exceeding carrying capacity}$



## Setting directions

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To calculate the number of stock for each paddock follow the formula below:

$$\frac{\text{(DSE days of feed available} \div \text{number of days)*}}{\text{Average DSE rating of stock over the grazing period**}} = \text{Number of stock that can be put in the paddock}$$

\*This figure is the number of DSEs that can be run in the paddock.

\*\*This figure can be taken from a completed stocking rate planning sheet - see Tool 2.05.