Grazing management principles – how to get the most out of your pastures through grazing management

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Introduction

Getting the most of out of pastures with grazing management involves decisions which influence the effective utilisation of the available feed within and between seasons across the whole farm. The aim is to maximise the long-term profitability from livestock production while managing feed surplus and deficits within and between years; maintaining or improving environmental conditions including ground cover, biodiversity, pasture composition, water use and persistence of perennials; and contributing towards the lifestyle objectives of individuals.

Graziers have moved beyond understanding the basic principles of grazing management, and now need to develop skills and knowledge for organising their grazing to deal with the complex and dynamic nature of their farm systems. Recent market research (Sargeant and Saul, *unpublished*) identified that while the majority of graziers have a positive attitude towards rotational grazing, only 50 per cent have implemented a rotation (where stock are moved between two or more paddocks). As farming systems become more complex, such as multiple enterprises, pasture types and land-classes, implementing rotational grazing becomes challenging. Difficulties with feed and water shortages, spring utilisation, mob size and structure, and feed quality for growing stock throughout unpredictable seasons were also highlighted as challenges for implementation.

Grazing management – more than rotational grazing

In addition to day-to-day decisions relating to the timing, frequency and intensity of grazing (such as in a rotational grazing system), getting the most out of pastures also involves decisions about what stock to allocate to which paddocks; the timing of livestock purchases and sales; tactical use of supplementary feed, nitrogen or other inputs; fodder conservation; fertiliser inputs; and the seasonal manipulation of pasture composition through grazing, soil fertility, chemical or physical control methods.

The options that can be considered in grazing management are set within the constraints of the given farming system, made up of elements that can't be influenced by investment decisions - landscape, soils, climate, cash-flow, lifestyle, management style; and those that can be - the combination of pasture species and crops across the farm, livestock enterprises, lambing and calving times, fencing and water infrastructure. Therefore, to get the most out of pastures with grazing management, it is also necessary to identify opportunities for changing the farming system.

Every farm is unique. It is almost never possible to lift the exact grazing management strategies from an experimental site for implementation on farm, and there is no one system that is universally appropriate (Kemp *et al.* 1996, Virgona *unpublished*). Graziers must therefore combine principles developed from research and modelling with their own experience, the experience of others and available management tools for development of grazing plans which achieve their goals.

This paper presents some of the outcomes from recent research and case studies conducted as part of the EverGraze project to provide a snapshot of some of the more complex considerations for managing grazing systems. Steps for getting started in a grazing system are then discussed in the context of applying basic principles.

Dividing up the farm and allocation of livestock to get the best out of pastures

The classification and (sub) division of pastures, soils, capability, management needs and subsequent allocation of livestock class according to production requirements is fundamental to designing a grazing system. This can be achieved by fencing to land class and purpose. Recent farming systems work on seven EverGraze research sites (Figure 1), supported by farmer case studies, demonstrate the importance of this outcome. Experiments at each research site were designed on the principle that *"the right combination of perennial plants put in the right part of the landscape for the right purpose and with the right management will improve profitability, natural resource management and risk management simultaneously."*

Figure 1. EverGraze research site locations.

Results from this work demonstrated how management practices can provide graziers with more control, enabling them to;

- manipulate feed supply and demand,
- appropriately allocate livestock to different pastures to meet their needs throughout the season,
- capture and utilise feed quality on less arable parts of the landscape when it is available, and
- set goals and implement strategies for seasonal management of pasture composition, persistence and ground cover in targeted areas.

There are a wide range of messages emerging from the experimental and modelling outcomes from EverGraze research. Following are some of the findings from four of the sites which highlight principles specific to the design of grazing systems.

Increased control over the management of native pastures for increased utilisation and production by fencing to production zone at Orange

At Panuara, near Orange in NSW, Badgery *et al.* 2012 compared set stocking to a four-paddock simple rotation and a twenty-paddock intensive rotation on native pastures grazed by Merino ewes joined to terminal sires. All treatments were managed to maintain 80 per cent ground cover and minimum livestock condition targets.

In the rotation treatments, the native pasture landscape was fenced into three production zones – high, medium and low (Figure 2).

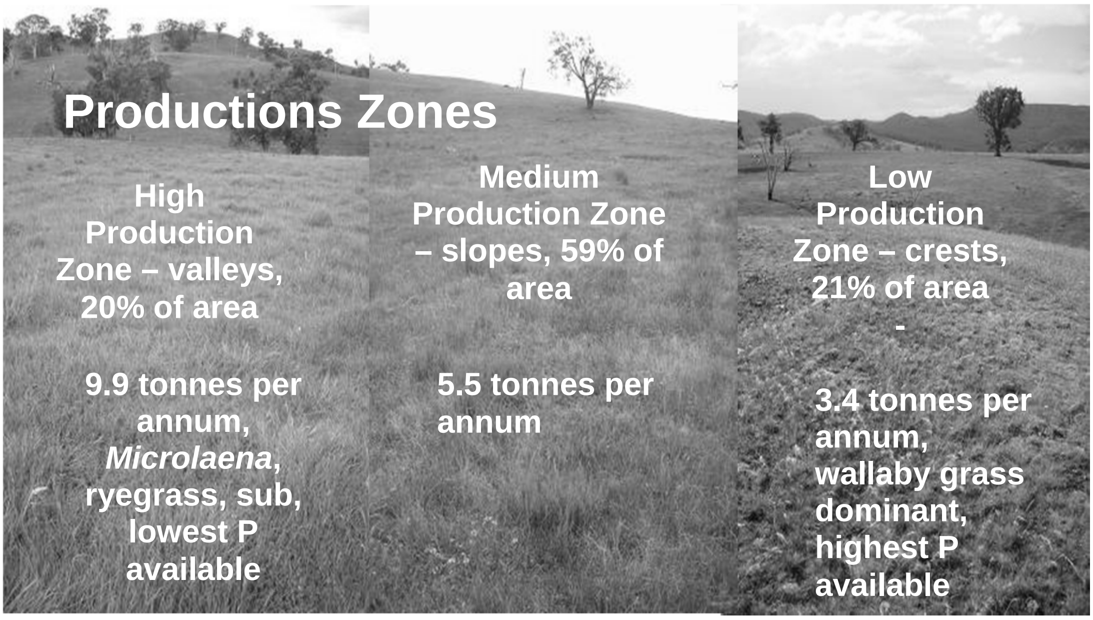

Figure 2. Production zones at Orange EverGraze site (Panuara).

Fencing to the production zones gave more control over the grazing in the rotationally grazed treatments, leading to improved utilisation and higher stocking rates. In good years, the ability to keep stock out of the more vulnerable low production zone at the end of the season allowed stock to be grazed later into the season on the high production zone than what was possible where they had access to all areas at the same time. In poor years, increased utilisation and regulation of grazing pressure enabled a feed wedge to develop and higher stocking rates to be maintained (Table 1).

The production per head was greater in the set stocked treatment where stock were allowed to selectively graze. This resulted in no difference in profitability in the two poor years despite the higher stocking rates in the rotation treatments. Profitability of the rotational grazing systems were however higher in the 20-paddock system ($581/ha) compared with the four paddock ($485/ha) and one paddock ($371/ha) systems in a good season (2010) when lambs could be retained and grown out on the high production zone after weaning. The stocking rate difference in the good year was also higher.

Table 1. Stocking rates (DSE/ha) at Panuara EverGraze site.

Production year	one paddock	four paddocks	20 paddocks
2008	9.0	9.4	9.5
2009	5.1	5.5	6.6
2010	5.2	6.4	7.7

Capturing feed quality, manipulating feed supply and demand, and managing composition of native pastures in an integrated system at Holbrook

In an ‘integrated system’ at the Holbrook EverGraze research site, ewes and lambs grazed phalaris in a four-paddock simple rotation and strategically grazed fertilised native pastures at key times of the year. Ewes were grazed on the native pasture from mid-October (after lamb marking), and again in late summer/early autumn to capture feed quality before the autumn break. They grazed the phalaris for the rest of the time. This system was compared to a ‘separate’ system where wethers were set stocked on the native pastures and ewes and lambs were rotated around the four-paddock rotation on phalaris. The treatments are presented in Figure 3.

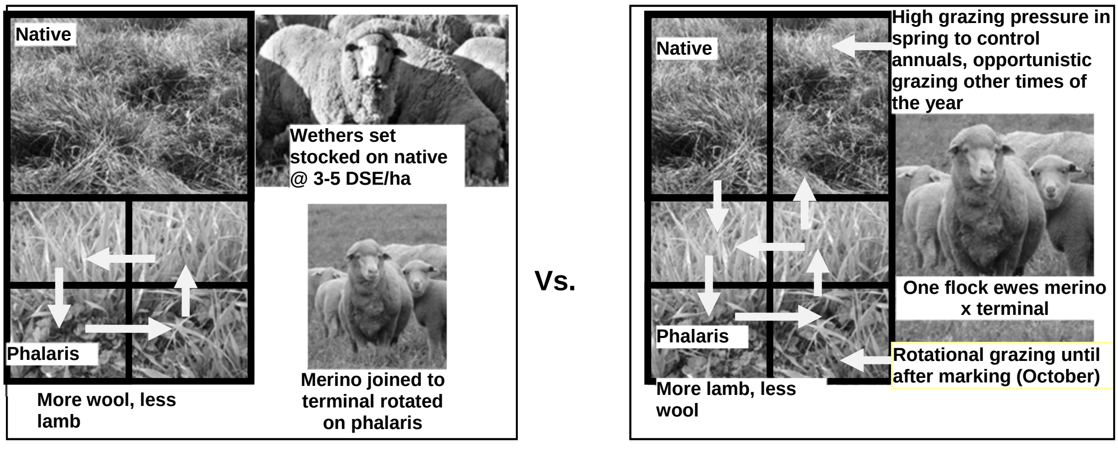

Figure 3. Holbrook EverGraze site grazing systems.

The theory behind the integrated system emerged from a review conducted by Virgona (*unpublished*) into the management of native pastures. Several authors (e.g. Robinson and Lazenby 1976) demonstrated that fertiliser would increase the clover and other annual species in native pastures. The increase in quality resulting from the clover content would make it suitable for grazing by ewes and growing lambs. Secondly, by having all ewes and lambs together in one mob, there would be greater chance of utilising the native pasture in spring. This would reduce competition from the higher proportion of annual species, and hence protect the perennial native component (Kemp *et al.* 1996, Nie *et al.* 2005).

By grazing the native pasture at specific times of the year at Holbrook when feed quality was not limiting, lambs were able to maintain growth rates at similar levels to the lambs in the separate treatment grazing phalaris. The ability to utilise the native pastures for production of more lambs which were of higher value than the wool from the wethers meant that the integrated system was significantly more profitable (in 5 out of 6 price scenarios) than the separate treatment.

The seasonal variation (2 very dry years and 2 years of abundant rainfall) in the experimental period at Holbrook meant that composition and ground cover changes as a result of grazing were difficult to detect, and stocking rates difficult to manage. However, it was evident that in the dry springs and autumns, the ability to remove stock from the phalaris to graze the native pasture meant that a feed wedge was developed on the phalaris, allowing stock to be retained on the system for longer without supplementary feeding.

Real farm benefits from integrating native and introduced pasture management at 'Spring Valley'
Locke (2010) presented a compelling argument for integrating the management of native and introduced pasture species on his farm 'Spring Valley' near Holbrook. Fertilised native pastures were set stocked with wethers for twelve months of the year, resulting in low ground cover, high levels of Paterson's curse and poor production. In the new system, the wethers were removed and replaced by spring-calving cows through winter until the last month before calving. This strategy improved the fitness of the cows and relieved the pressure on phalaris during the winter feed gap. Sheep grazed the native pastures for a short period in October to reduce the annual weed biomass, and the native pastures were then rested for the summer to allow them to seed and regenerate. The result was improved ground cover and perennial native grass composition, reduced weed burden and increased overall productivity. The stocking rates achieved on native pastures in the old wether system compared to the new strategic grazing system are presented in Figure 4.

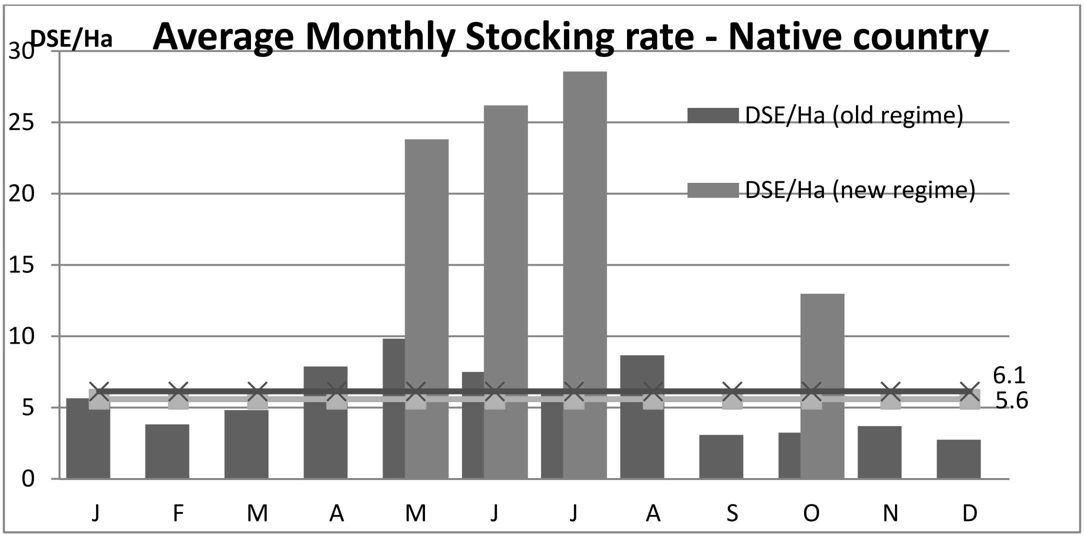

Figure 4. Stocking average monthly stocking rates in the “old” and “new” systems at Spring Valley

Species, livestock and management to allow flexibility and options

The second fundamental aspect of grazing management is managing seasonal variability and capturing the opportunities of good seasons while minimising losses in poor seasons. This is also one of the biggest challenges. Considerations for managing variability include:

- where possible, including a summer active perennials as a component of the feedbase to provide quality feed for longer in good seasons, and to respond to out of season rainfall, guarding against high supplementary feeding costs in poor seasons and reducing ground-water recharge;
- running an enterprise mix where stocking rates and finishing times can be varied according to seasonal conditions;
- setting trigger points, feed budgeting and monitoring pasture availability, quality and ground cover to identify and capture buying and selling opportunities of livestock and fodder as they arise.

Including a summer-active perennial

The productivity and environmental benefits of including lucerne as a summer-active perennial on significant proportions (20-40 per cent) of farming systems have been demonstrated at the Wagga Wagga EverGraze site near Tarcutta (Friend 2011) and the Hamilton EverGraze site at Hamilton research institute (Berhendt 2011). Preliminary analysis of data shows that including lucerne in the farming system is important for managing poor seasons and capitalising on good seasons. Both sites also showed that lucerne plays an important role in reducing leakage of water below the root zone (preventing salinity), with reductions of >50 per cent at both sites at depths of 3.25-4.25 metres.

At Hamilton, where lucerne was included on one third of the farm in a ‘triple system’ (with the remainder of the farm sown to perennial ryegrass and tall fescue), supplementary feeding costs were significantly reduced (by $297/ha) in a year with a failed spring (2006/07) compared with the system purely based on perennial ryegrass. Preliminary long term modelling results for a spring-lambing Merino x terminal system (producing store lambs) showed that while there was little difference in the overall profitability between the systems, the fluctuations in gross margins between years was less in the ‘triple system’.

In a September lambing system at Wagga Wagga, livestock production and supplementary feeding costs were compared for farms where 20 per cent or 40 per cent of the farm had been sown to lucerne (with the remainder of each farm sown to phalaris and tall fescue). While the 40 per cent lucerne treatment resulted in slightly less supplementary feeding and higher gross margins in drought years, the big difference was in a wet summer (2010) where the higher lucerne treatment provided quality feed to finish lambs (365 kg/ha lamb produced in the 40 per cent system compared with 197 kg/ha lamb produced in the 20 per cent lucerne treatment).

Flexible livestock systems for capitalising on feed excess and managing feed deficits
Also at the Wagga site, Friend (2011) demonstrated the value of flexibility in livestock systems for capitalising on opportunities to finish lambs while managing supplementary feeding costs in drought years. Three livestock systems were compared.

1. September lambing (100 per cent joined to a terminal sire to produce a store lamb; 8.5 ewes per hectare),
2. July lambing (Merino ewes joined 50 per cent to terminal sire and 50 per cent to Merinos; (6.2 ewes per hectare), and
3. split-joining (50 per cent joined in July to a terminal sire and 50 per cent joined to Merinos in September; 4.8 ewes per hectare).

Stocking rates were set to be even (11.5 DSE/ha) in winter across all systems, so the September lambing system had a higher number of ewes than the split-joining system which was higher than the July lambing system. Cumulative gross margin in the split-joining system was highest in the drought years of 2006-2009 and in the wet year of 2010. The lower number of ewes run in the split-joining system compared with the September lambing system meant that supplementary feeding costs were lower. More lambs produced in the split-joining system compared to the July lambing system meant that there was greater opportunity to capitalise on wet summers by finishing more lambs on lucerne.

Split-joining, combined with use of lucerne, represents one way to set up a system so that it can respond to variable conditions. A number of other options (e.g. use of trading stock and forage crops) could also be considered to play the same role.

Managing complexity
Complexity in grazing systems resulting from multiple enterprises and pasture types can make them difficult to manage due to the simple equation of the increased number of mobs required, limiting the number of paddocks that can be used in any one rotation (Sargeant and Saul *unpublished*). Having multiple lambing and/or calving times will also mean that there will be more periods of set stocking. So, graziers need to strike a balance between having some flexibility in the system such as trading stock or split-joining so that stocking rates can be adjusted with variable seasons, while keeping the enterprise mix simple enough to manage the grazing system.

Applying the basic principles of rotational grazing

Once paddock sub division, livestock enterprise and feed base selection, and allocation of livestock to appropriate pastures have been decided, the next step is to manage a rotation.

A review sorting the fact from fiction on the impact of rotational grazing versus set stocking was presented by Saul (2011) at last year's GSSA conference. In almost all rotational grazing experiments (e.g. Warn *et al.* 2001, Waller *et al.* 2001, Chapman *et al.* 2003), while set stocking had benefits for growing stock at certain times of the year, mobbing up animals and rotationally grazing had significant benefits to pasture utilisation, stocking rates, perennial pasture persistence, ground cover and pasture composition. The benefits are larger on farms with variable landscapes where even grazing and good pasture utilisation is more difficult to achieve.

Rest period

Research conducted by authors such as Donaghy and Fulkerson (1999) developed recommendations for rest periods which allow perennial grass tillers to recover to the three-four leaf stage (depending on species), regain root/stem energy reserves, achieve persistence and increased rate of recovery after grazing (Figure 5).

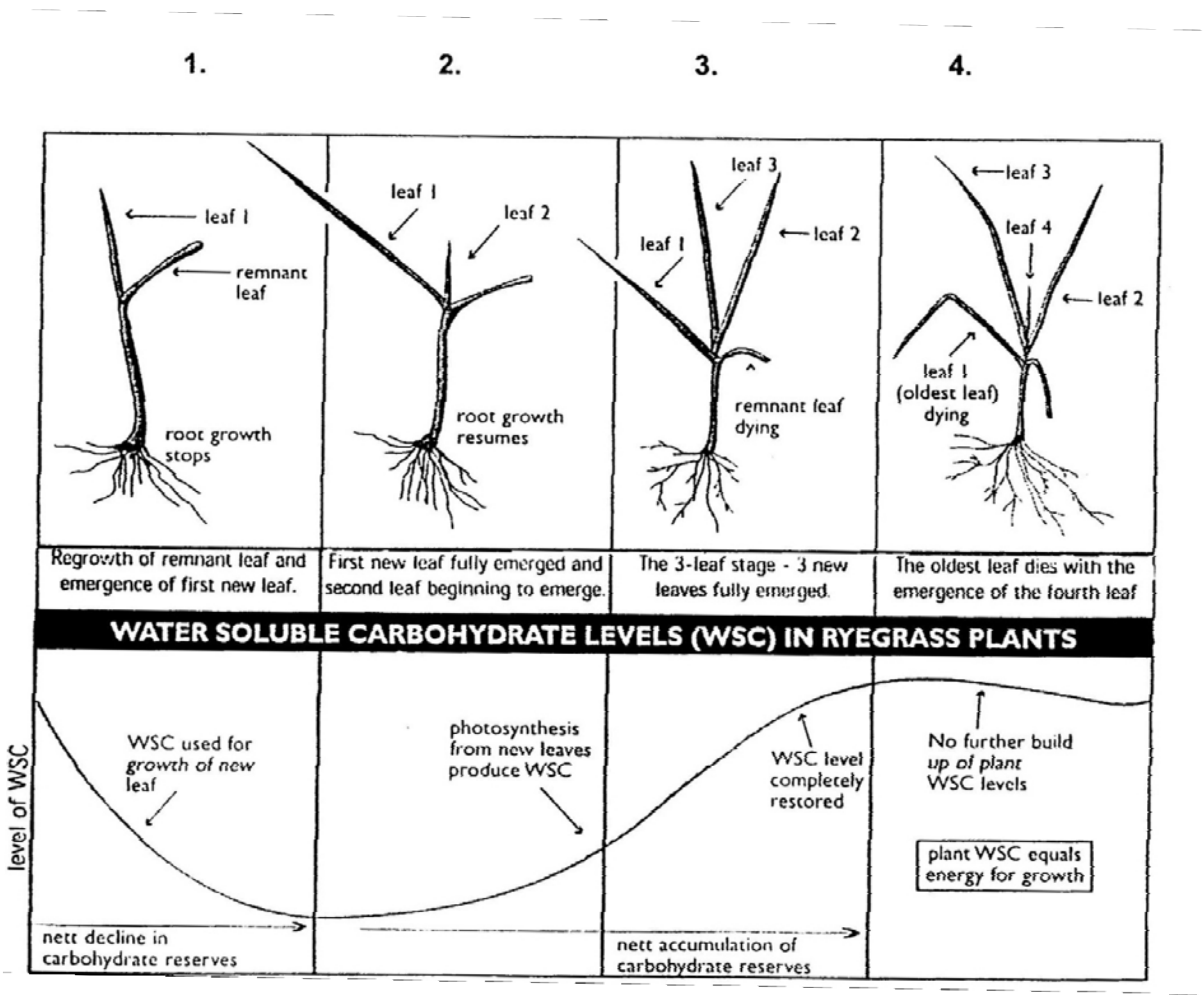

Figure 5: Depletion and recovery of energy reserves (water soluble carbohydrates) as a ryegrass plant regrows (Donaghy and Fulkerson 1999).

Allowing plants to go beyond leaf maturity can also result in loss of feed quality and death of the first grown leaves. Recommendations for leaf stages which capture feed quality while also recovering sufficient energy reserves are provided in Table 2.

Table 2: Recommended leaf stages for grazing of perennial ryegrass (Fulkerson and Slack 1994), cocksfoot (Rawnsley *et al.* 2002), tall fescue (Raeside *et al.* 2012) and phalaris (Warn *et al.* 2001)

	Perennial ryegrass	Cocksfoot	Phalaris	Tall fescue
Leaf maturity	3-leaf	6-7 leaf	4-leaf	4-leaf
Recommended grazing time	3-leaf	4-5 leaf	4-leaf	3-leaf

If plants are allowed to be grazed at the one-leaf stage, as in set stocking, energy reserves are depleted, resulting in a smaller root system, poorer access to soil moisture and nutrients and consequently reduced growth, tillering and survival. In contrast, broadleaf weeds and sub clover favour high fertility, high light intensity conditions, and can grow very closely to the ground. This makes frequent grazing under set stocked conditions ideal for their growth habit.

Allowing phalaris sufficient rest to recover to four leaves was particularly important in autumn after hot dry summers at the Broadford Grazing Experiment (Warn *et al.* 2001, 2003, Sargeant *et al.* 2006). Phalaris thrived in both a simple (four paddock) rotation and intensive (twenty paddock) rotation while it declined significantly over time under set stocking (Figure 6). Rest periods required for phalaris to reach the 4-leaf stage at Broadford Grazing Experiment were approximately 70 days in summer, 30-50 days in autumn (depending on the break), 40-60 days in winter and 20-30 days in spring (Warn *et al.* 2003).

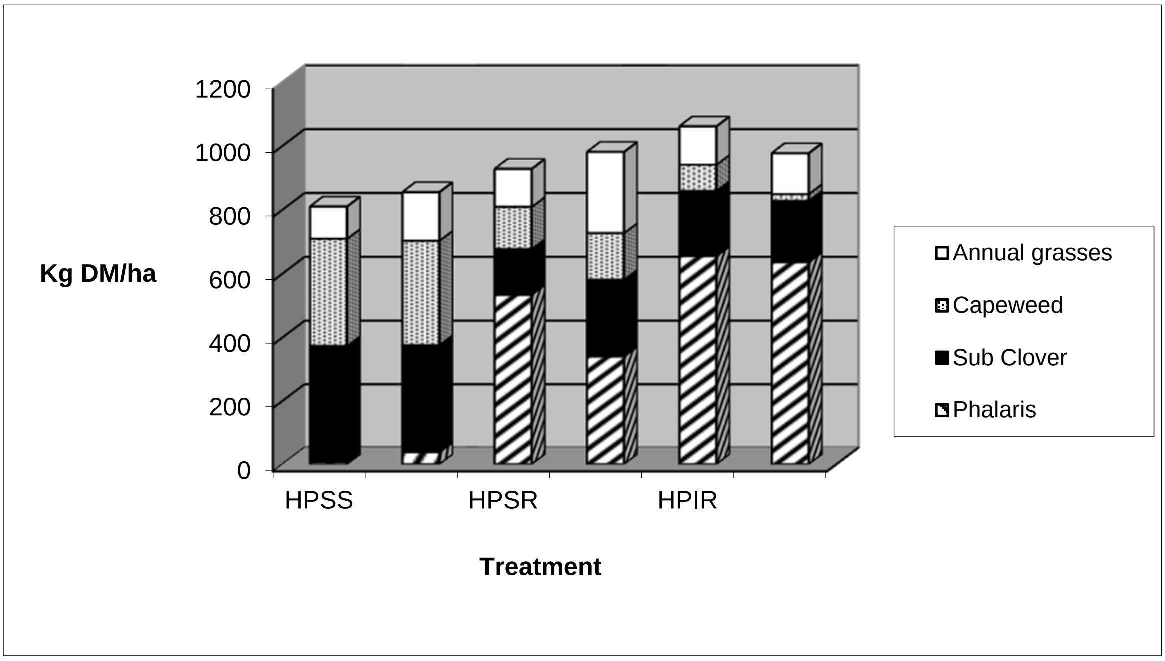

Figure 6. June 2001 pasture composition at Broadford Grazing Experiment after treatments (HPSS = set stocking; HPSR = simple rotation; HPIR = intensive rotation) had been in place for four years (Sargeant *et al.* 2006)

Feed-on-offer and ground cover targets

Although it is important to ensure plants have enough time to recover after grazing during the growing season, the feed-on-offer before and after grazing is also important. The targets depend on the aim. Some general considerations:

- Grazing to 800 kg/ha and a minimum of 70 per cent ground cover (80 per cent on hill country) will enable persistence of the perennials if they are provided with enough rest for recovery. These were the benchmark animal removal targets used for EverGraze. Grazing to these levels is often also necessary to open up the sward to allow clover to establish in autumn.
- Pasture growth will be maximised if stock are removed within growth stage two - when 1200 kg/ha remains (Saul and Chapman 2002). However, it is often impossible to achieve this level, especially early in the season, on farms which carry stocking rates high enough to achieve good spring utilisation.
- Grazing pastures before they get to 2000 kg/ha will reduce the amount of pasture wasted through decay, and will help to retain feed quality.
- In addition to pasture growth, composition, ground cover and persistence, livestock performance also needs to be considered. Programs such as Prograze and Lifetime Ewe Management provide recommendations for minimum pasture availability and quality required to reach livestock production targets.

The balancing act – rest and grazing pressure for persistence, growth, livestock production, utilisation and ground cover.

Managing pastures to provide them with optimum rest periods as well as managing appropriate feed-on-offer and quality for livestock performance can be challenging or sometimes impossible. Leaving stock for longer in each paddock to ensure adequate rest periods for the rotation can result in pushing utilisation to a point of inadequate production per head. On the other hand, moving stock too quickly can result in insufficient rest for the pastures, removing the benefits of the rotation. It is therefore usually necessary to compromise. Stock containment areas or sacrifice paddocks are often needed to slow the rotation down, particularly for development of an initial feed wedge in autumn.

Tools such as the EverGraze Feed Budget Rotation Planner, available on the EverGraze website, can assist with developing an initial plan, accounting for different paddock size, pasture growth rates, feed availability and quality of pastures across a rotation to determine approximately how many days each paddock will last. However, such tools are just a starting point and graziers need to monitor both livestock and pastures so they can respond to changing conditions. Some graziers report that the grazing charts were an essential component of their management, helping to plan ahead and manage the rotation. Others say they were an important starting point, but that over time, they had enough understanding of the system to use their own intuition for when to move stock to the next paddock.

Manipulating composition

In addition to implementing a rotation, manipulating pasture composition with grazing often involves grazing and resting at strategic times of the pasture growth cycle. Intervention with soil fertility and chemical or physical removal of weeds are also sometimes necessary. Strategies for manipulating composition in native pastures and through rotational grazing have been touched on above. A complete set of recommendations for manipulating pasture composition would require a separate review. Some of the important considerations are as follows:

- Phosphorus fertiliser will increase the germination and growth of clovers leading to an increase in nitrogen and annual grasses such as barley grass, and broadleaf weeds such as capeweed. Use of phosphorus to increase competition from grasses will also reduce incidence of low fertility weeds such as onion grass (Sargeant *et al.* 2009).
- Rotational grazing will maintain and/or increase the proportion of perennial grasses and reduce the clover and broadleaf weed component (Sargeant *et al.* 2006). Capeweed may require chemical control combined with heavy grazing in autumn (spray-grazing).
- Rotational grazing alone will not reduce the annual grass component (Sargeant *et al.* 2006). Heavy grazing (often combined with chemical) is required in spring to reduce annual grass biomass and seed production, favouring later flowering perennials (Kemp *et al.* 1996, Nie *et al.* 2005).
- Specific management techniques are required for particular desirable species. Examples include:
  - allowing new or degraded phalaris stands to go through stem elongation to form dormant tiller buds which will survive to the following autumn;
  - heavy grazing tall fescue pastures in spring to maintain feed quality;
  - allowing degraded perennial ryegrass pastures to go to seed for regermination.
- Using livestock to manipulate pasture composition needs to be balanced with meeting seasonal livestock requirements.

Putting it all together – 'Woomargama Station' case study

In a paper presented at the Grasslands Society conference in 2009 (Mirams 2009) and subsequent case study (FFI CRC 2012), Chris Mirams provides a great example of how the principles described in this paper can be applied to classification of production zones, selection of an appropriate combination of pastures and enterprise mix, allocation of livestock to pastures and management of rotational grazing through the seasons within the constraints of a real farm. The land classification and allocation of livestock at Woomargama Station is presented in Figure 7.

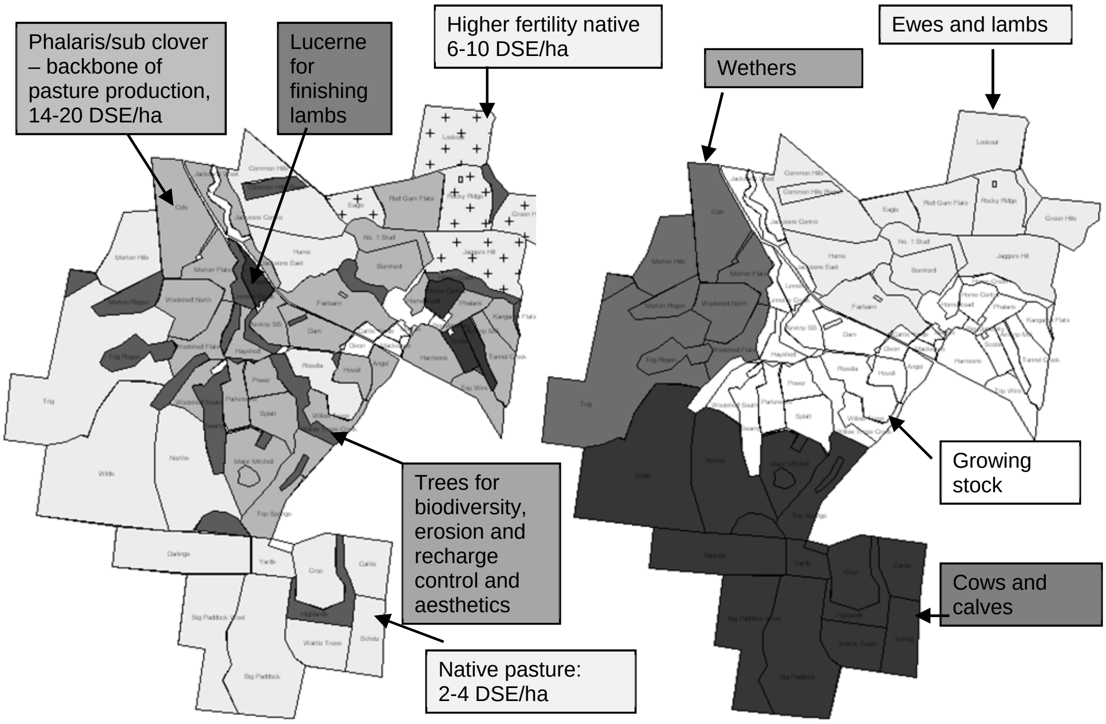

Figure 7. Division of production zones and allocation of livestock at Woomargama Station.

In the Woomargama example, all pastures are rotationally grazed with strategic rests of the native pastures. By allocating each livestock class to a different 'block' of the farm, Chris is able to run less mobs and allocate a significant amount of paddocks to each mob. This has labour and ease of management advantages as the number of mobs is significantly reduced.

Spring-calving cows and calves are rotationally grazed predominately on native pastures, with some improved pastures to manage nutrition prior to joining. Spring-lambing ewes are rotationally grazed around higher quality native pasture in combination with improved pastures. Ewes are joined 50 per cent to a terminal sire to provide options for selling stores or finishing some lambs on lucerne in good seasons, and 50 per cent to Merinos as replacements. Wethers graze predominately native pastures, with some improved areas to maintain their condition, preventing a break in the wool. Having the wethers in the system reduces the amount of lambs needing to be carried over summer, since summer activity in the pastures is limited to the small amount of lucerne (sown wherever the soils are suitable), and some fodder crops sown as part of a renovation program.

The highest production areas are sown to phalaris/sub clover pastures which have proven to persist through time. These areas, together with the lucerne and fodder crops, are reserved for growing stock. The limited area available for growing lucerne and the high proportion of phalaris on the farm means that it is not as easy to capitalise on good springs as was demonstrated at the Wagga EverGraze site. Chris manages the surplus by cutting silage which helps minimise the impact of dryer seasons. The area reserved for silage is determined based on seasonal conditions leading up to spring.

Summary of key principles

In summary, the following important principles need to be considered in planning a grazing system:

- Fencing to land class, mobbing up animals and integrating the management of different pasture species/land classes across the farm gives more control, allowing for implementation of management strategies to meet objectives.
- The largest benefits from mobbing up animals and using smaller paddocks will occur from utilisation of variable landscapes with multiple aspects, soil types and pasture species. Reducing the number of mobs also has advantages for labour efficiency.
- Including a summer-active perennial in the feed base can provide options for managing variability - finishing lambs in good seasons and reducing supplementary feeding in poor seasons.
- Increased complexity in grazing systems resulting from multiple enterprises makes them difficult to manage, but simplification needs to be balanced with having some flexibility in the system such as trading stock or split-joining so that stocking rates can be adjusted with variable seasons.
- Setting trigger points, feed budgeting and monitoring pasture availability and quality enables managers to identify and capture buying and selling opportunities.
- Rotationally grazing to provide perennial grasses with enough rest after grazing to reach the 3-4 leaf stage and maintaining 70 per cent ground cover will encourage persistence.
- Target feed-on-offer before and after grazing requires a compromise between achieving persistence, pasture utilisation, pasture growth and livestock production objectives.
- Manipulating pasture composition requires strategic grazing and resting (combined with fertiliser and chemical management) at specific growth stages of the target species. Large mobs are useful for achieving this but livestock requirements also need to be considered.
- Using tools such as the Feed Budget Rotation Planner to develop a rotation plan based on leaf stage (rotation length) and feed-on-offer targets is a great way to get started with rotational grazing but close monitoring of livestock is essential to ensure production targets are met.

Key steps for setting up a grazing system

Following is a process for developing a plan for applying the above principles for implementation of a grazing strategy which was piloted and reviewed by a group of Holbrook Landcare Grazing Group participants. This process is being applied to a training program currently under development for EverGraze.

1. Map the farm and identify pastures, soils, slopes, aspects and land classes to be managed separately.
2. Identify on-farm productivity, risk, natural resource management and lifestyle goals and priorities.
3. Develop objectives and strategies for seasonal management of different enterprises, pastures, soils and land classes.
4. Identify where capital investments such as fencing and water infrastructure and pasture establishment needs to take place and assess the pros and cons of investment.
5. Develop feed budgets and trigger points for feed-on-offer, ground cover and livestock condition. Monitor and respond early to changing conditions.
6. Prior to each season, list the mobs on the farm and allocate them to suitable areas/rotations which match the feed availability and quality required.

7. Develop rotation plans or grazing charts for each rotation.

Acknowledgements

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