

Best management practices for extensive grazing enterprises

Ron Hacker, Luke Beange,
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Peter Gray and Judy Warner



Cover: Sheep are the dominant livestock in the extensive pastoral zone.

Inset: Downs country of the West Darling supports extensive grazing enterprises. Elsewhere, tree cover is present as in gidgee and brigalow country.

Title page: Southern riverine woodland.

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NSW DEPARTMENT OF
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DISCLAIMER

The information contained in this publication is based on knowledge and understanding at the time of writing (February 2005). However, because of advances in knowledge, users are reminded of the need to ensure that the information upon which they rely is up to date and to check the currency of the information with the appropriate officer of New South Wales Department of Primary Industries or the user's independent adviser.

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INTRODUCTION

This publication describes, in broad terms, those arid and semi-arid areas of New South Wales commonly referred to as 'rangelands' and the management principles that underlie the sustainable utilisation of these areas by extensive grazing industries. These lands generally lie to the west of the 500 mm rainfall isohyet (Figure 1). Most are located within the Western Division, but significant areas occur in the Central Division. Both here and on the eastern and southern margins of the Western Division, extensive grazing of predominantly native pastures occurs in conjunction with broadacre cropping and areas of intensive irrigated agriculture. Collectively, the semi-arid and arid zones occupy about 60 per cent of the State. The Western Division alone accounts for 42 per cent of the State.

Over such a large area the soils and vegetation vary greatly. Average annual rainfall, and the expected seasonal distribution of rainfall and temperature, are also variable. At any particular location, rainfall fluctuates widely between

years. Under these circumstances it is not possible to describe sustainable management practices in detail. Some important management principles can be defined, but their application requires a decision-making framework that recognises the complexities of the biological system and the economic circumstances and aspirations of individual families.

MAKING DECISIONS IN EXTENSIVE GRAZING ENTERPRISES

Management is all about decision-making. The major components of extensive grazing systems are shown in Figure 2. All of these components interact, and decision-making is the central process that integrates them into a sustainable production system. Because many interacting parts are involved, a management decision for one component will always affect others. A decision about stocking rate, for example, will have implications for animal production, the impact on natural resources, and the risk of feed shortage if the season fails. In practice it is seldom possible to make decisions that are ideal from all perspectives. Trade-offs



Figure 1. Location of extensive grazing enterprises. (Note that on the eastern and southern margins, and at Bourke and Menindee, extensive grazing enterprises are interspersed with broadacre cropping and irrigation industries.)



Figure 2. The 'eight-ball' model, showing the components of the production system and the central role of decision-making

are almost always required and will have to be made by each business in the light of personal or family goals, economic circumstances, and personal risk preferences. However, while the decision is always personal, it is important to consider each component of the model. Only when this is done can a reasonable compromise be reached.

PERSONAL GOALS AND HUMAN, PHYSICAL AND FINANCIAL RESOURCES¹

Personal goals obviously affect any decision made on a property. Goals themselves are closely related to **values** and **vision**. Development of a vision must, in turn, consider human, physical and financial resources.

Property management planning allows all of these factors to be incorporated into decision-making. Briefly, the process involves:

- Identifying **values**. These stay relatively constant through life, but they may vary between people within a family business. They are fundamental principles that guide our actions: for example, ensuring that

livestock are always adequately fed and watered or that land is passed on to the next generation in better condition than we received it.

- Undertaking a comprehensive **stocktake** of the human, physical and financial resources of the property. Like a stool, the planning process rests on these three 'legs'. If too much emphasis is placed on any one of the legs the stool (the farm business) becomes unbalanced and falls over.
- Developing a **vision**. This may change during life, but is the point you are trying to get to for your family and business: the 'big picture'. Developing a vision requires consideration of your key values and the features of your personal life and business that you want to change. Areas that should be considered include: family relationships, financial management, retirement, business succession, production management systems, marketing, size of the business, enterprise mix and lifestyle. Vision is about what the farm business will look like in 5 or 10 years' time.
- Setting **goals**. These are stepping stones – small, achievable steps that advance you on the road to your vision. Without goals a vision remains a dream that may never be fulfilled. To be meaningful, goals need to be SMART

¹ Much of this section comes from Module 1, 'Creating your future', *Participant Workbook, Farming For the Future Workshop Series*, 2nd edition, July 1999. (Pages 1.4, 1.8 & 1.10)

(Specific, Measurable, Achievable, Realistic, Time constrained). Goals are about what needs to change in terms of skills, knowledge or behaviour, and who needs to make the changes within the farm business.

- Establishing **strategies** to achieve particular goals. Strategies are the products and/or services that are required to achieve the necessary changes in skills, knowledge or behaviour.

RISK MANAGEMENT

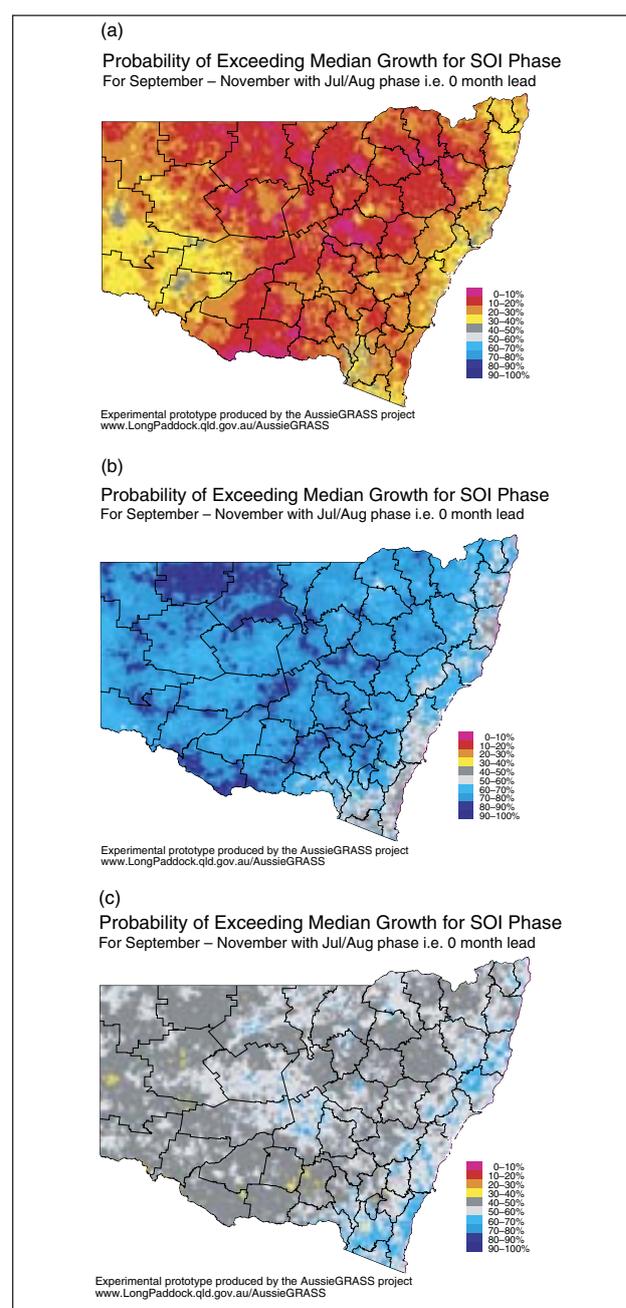
Much of the success of extensive grazing businesses is determined by factors that are beyond the immediate control of the operator. The most obvious of these are weather and prices. Woolgrowers, in particular, have often been prepared to chance almost their entire annual income on the fluctuations of the wool price on a particular day. In a deregulated market environment this is not sound business management. Studies of wool producing enterprises in the Western Division have shown the importance of short-term market price fluctuations in determining the final gross margin achieved. Much of the reward that should accrue to skilful management of the on-property production system can be wiped out by short-term price movements if there is no effective management of this market risk. The use of futures or forward contracts allows this risk to be minimised and should be seriously considered as a means of at least securing a guaranteed minimum price that can cover operating costs. To allow this price to be determined, the real costs of production must be known – another fundamental component of market risk management.

Exposure to seasonal risk is largely determined by stocking policies. However, although graziers who stock at low to moderate rates and take steps to control non-domestic herbivores will be less affected by seasonal fluctuations than heavy stockers, all will eventually experience periods of serious forage deficit.

Graziers can now access a considerable amount of information that can assist in managing seasonal risk. The Longpaddock web site (www.longpaddock.qld.gov.au), for example, provides three-monthly outlooks derived from a pasture growth model that has been calibrated for the major vegetation types of the NSW rangelands. These outlooks are updated monthly and indicate the probability that pasture growth

over the next three months will be greater than the median level (i.e. the amount that has been exceeded by 50% of historical values). Rainfall outlooks can also be obtained from this site, or from the Bureau of Meteorology site www.bom.gov.au

Recent research has shown that the 'SOI Phase system' — which describes the two-monthly pattern of the Southern Oscillation Index as consistently negative (phase 1), consistently positive (phase 2), falling (phase 3), rising (phase 4) or neutral (phase 5) — can at times

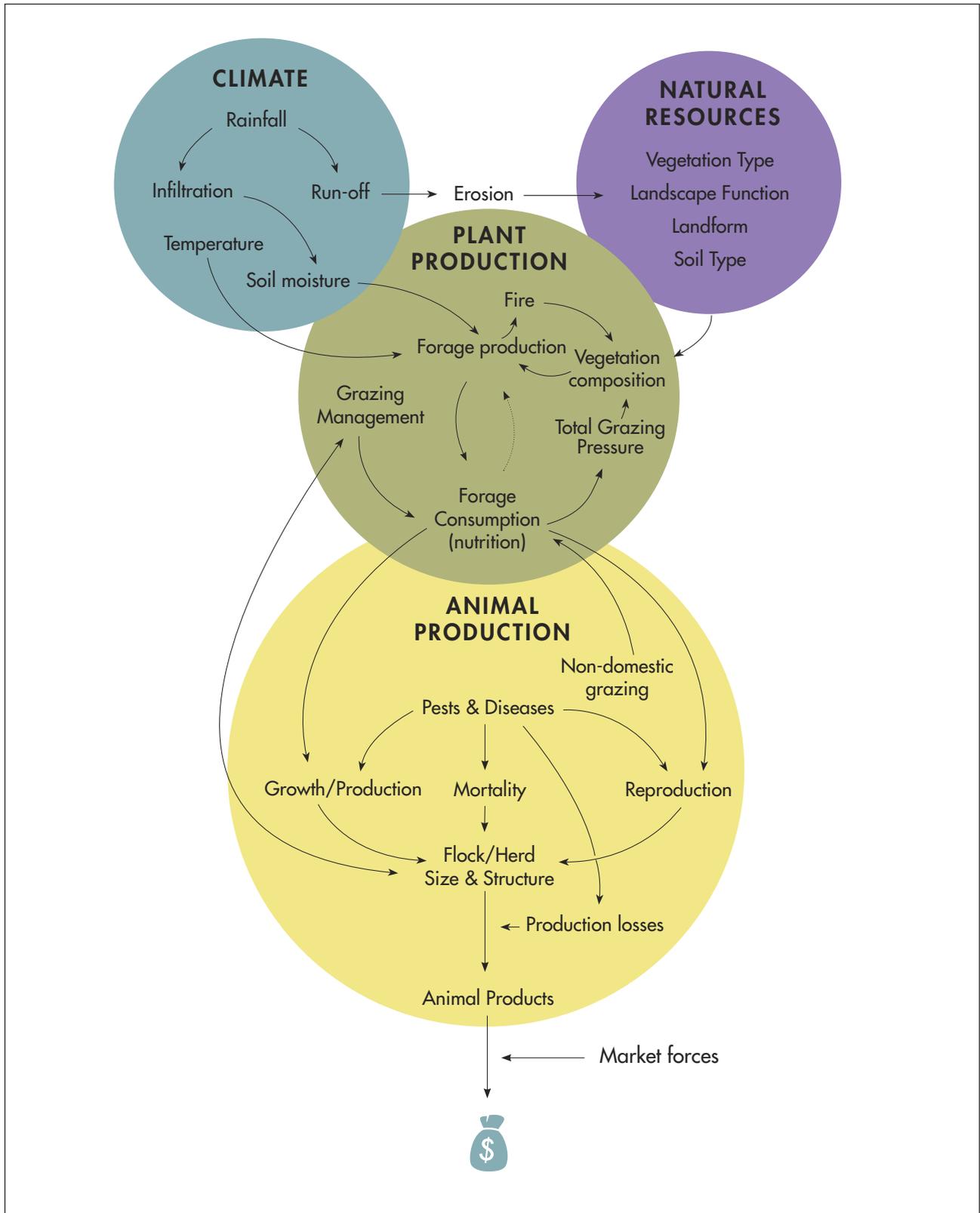


Probability of exceeding median pasture growth in the period September–November when the SOI phase for July–August is consistently negative (phase 1), consistently positive (phase 2) or neutral (phase 5), shown in (a), (b) and (c) respectively.

provide a useful indicator of pasture growth prospects in western NSW. In particular, the outlook for pasture growth in spring and early summer is strongly influenced by the SOI phase

in winter. An example is shown in the maps below. At other times of the year, however, the value of this indicator is reduced.

Figure 3. The physical production system in extensive grazing lands



Although such information can provide useful early warnings, management will ultimately need to respond to more certain indicators of forage shortage, for example the estimated number of weeks of grazing available without further rain or even a calendar date that is considered to indicate the end of the growing season. No strict rules of thumb are available but graziers should carefully consider indicators for their own properties. Studies of pastoral businesses have consistently shown that early response to developing drought conditions is an important factor in limiting the economic impact of these periods.

THE PHYSICAL PRODUCTION SYSTEM

All of the components shown in Figure 2 are interrelated, and four of them constitute the physical production system. These are shown in detail in Figure 3.

CLIMATE

Rainfall and soil moisture

In the rangelands, rainfall or soil moisture is the major factor limiting plant growth and pastoral production.

In NSW rangelands, the seasonal distribution of rainfall tends towards summer dominance in the north and winter dominance in the south (Figure 4). However, over much of the area there is no distinct seasonal pattern. Rainfall and pasture growth can occur at any time of the year. This complicates management decision-making, since it is difficult to judge when a dry period or drought has commenced.

A characteristic of semi-arid and arid rangelands is the marked variation in both monthly and yearly rainfall. This variation reduces the usefulness of averages in describing the rainfall of any particular location. Typically, for annual or monthly rainfall, the average is considerably higher than either the median or the modal (most common) value, as it is inflated by a few very wet years.

Part of this variation can be explained by the Southern Oscillation Index which does provide a degree of predictability. Table 1 shows the probability of seasonal rainfall for several locations in relation to the average SOI in the preceding season. As with the outlooks for pasture growth described earlier the highest (or lowest) probabilities are usually for spring

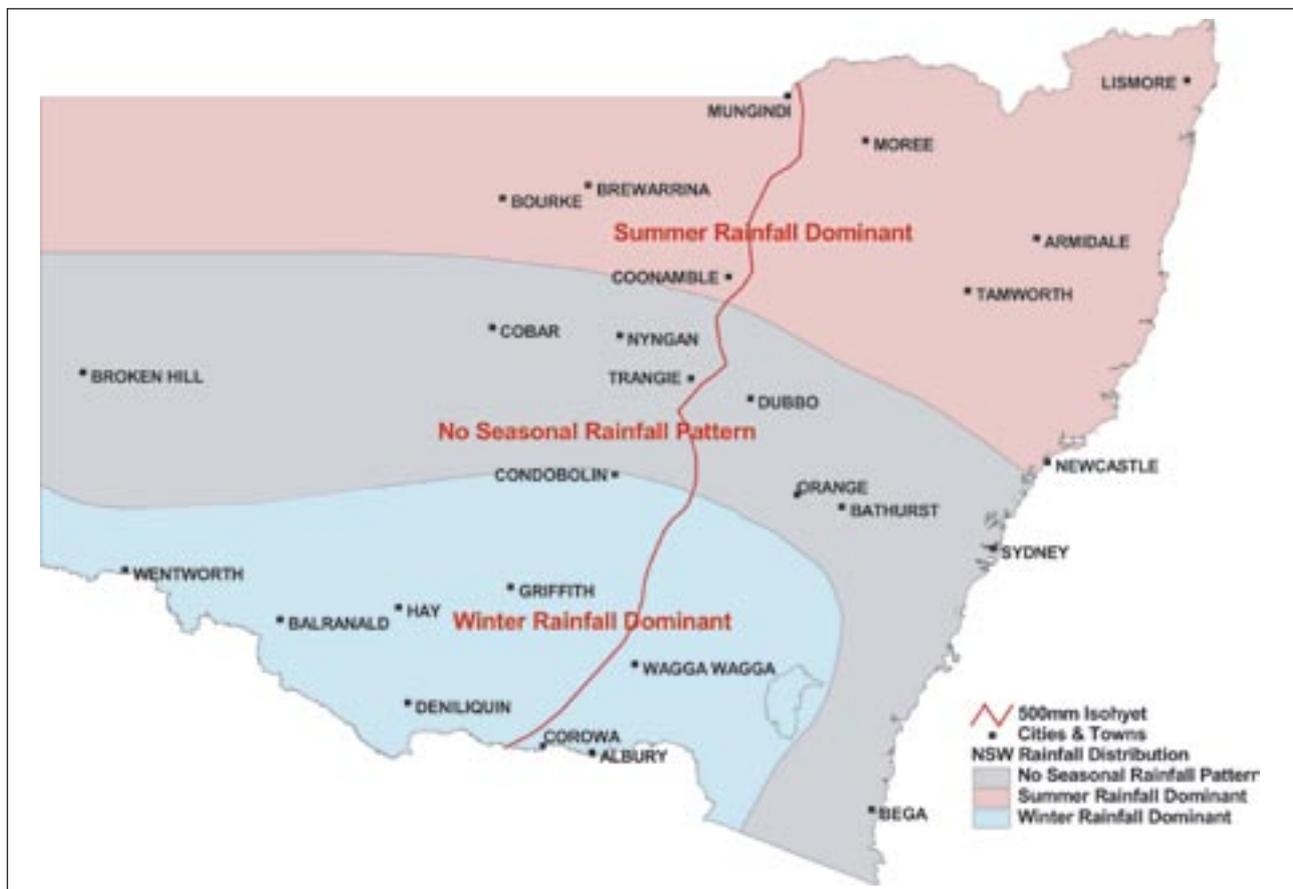


Figure 4. Seasonal distribution of rainfall in the rangelands

Table 1. Probability of exceeding median rainfall in summer (December, January, February), autumn (March, April, May), winter (June, July, August) or spring (September, October, November) in relation to the average Southern Oscillation Index (SOI) in the preceding season (for example, probability of summer rainfall related to average spring SOI).

Centre	Summer		Autumn		Winter		Spring	
	Average SOI in previous season							
	< -5	> +5	< -5	> +5	< -5	> +5	< -5	> +5
Bourke	47	61	59	56	41	48	33	71
Walgett	46	51	58	47	25	52	28	62
Cobar	53	61	55	51	36	55	26	78
Broken Hill	50	47	62	52	44	55	32	61
Wilcannia	46	63	61	50	39	58	38	62
Hillston	34	55	65	43	46	52	38	69
Wentworth	44	47	61	56	48	50	33	61
Balranald	49	51	55	58	39	58	34	71

rainfall in relation to the average SOI in winter. Analyses of this type are useful in providing an early warning of possible future conditions but are not in themselves a sufficient basis for management decision-making. Such analyses can be easily constructed from rainfall records of the property, or for a nearby centre, by using the RAINMAN computer program produced by Queensland Department of Primary Industries.

Infiltration and run-off

Rain falling at any point 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 altogether 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 hence the overall productive capacity of the land. In dry environments, concentrating water (and nutrients) in restricted parts of the landscape can result in higher overall plant production than an even spread. The scale of this mosaic varies widely. In some vegetation types (for example, mulga communities on hard red soils) it is very evident in the formation of groves of dense vegetation separated by relatively bare areas. In other situations (for example, grasslands on deep sandy soils) the scale may be much reduced. Nevertheless, redistribution of rainfall through run-off-run-on patchworks is an important part of the functioning of rangeland systems and underpins their production.

Temperature

Temperature is an important feature of the climate, since it determines both the effectiveness of rainfall and the growth response of plants. In dry environments evaporation is the major means of water loss, other than plant use. Temperature, which largely influences evaporative demand, is thus an important factor in determining how much of the rainfall received is available for plant growth (that is, effective rainfall). Similarly, it also largely determines the amount of water required by plants to maintain their growth under the prevailing weather conditions and thus how long growth can be sustained for a given amount of soil water. More directly, the growth rate of the plants themselves is influenced by temperature, with slower growth in winter than in spring or summer even if adequate soil moisture is available.

NATURAL RESOURCES

Vegetation type, landscape function, landform and soil type

The distribution of the major vegetation communities in the semi-arid and arid zones of western NSW is shown in Figure 5. Examples of these vegetation types are shown in Figure 6. Locally, of course, vegetation varies widely in response to variations in soil type and landform, which in turn determine the local distribution of water and nutrients. Particular combinations of landform, vegetation and soils form different 'types' of country, which can be readily recognised in the field and can be mapped from aerial photographs. These distinctive types of

country are called **land systems**. Some 251 land systems were recognised and mapped in the Western Division by the former Soil Conservation Service. Each consists of several **land units** (for example, dunes, swales, drainage lines, slopes and hills), which together give the land system its distinctive features. The same land unit may occur in different land systems, but the combination of units, and their relative proportions, is unique for each land system. Land system maps of the Western Division at 1:250 000 scale, and descriptions of the land systems and their component units, are available from the Department of Infrastructure, Planning and Natural Resources. Land units are the smallest natural resource units that can be practically mapped on extensive rangeland properties. At the regional scale these land systems themselves occur within larger biogeographic regions, which are shown in Figure 7.

Understanding the land systems and land units that make up a property is fundamental to effectively managing the natural resource base on which extensive grazing enterprises depend. Because similar vegetation types have similar management requirements, it is usually

desirable to fence similar land systems or land units together as far as practically possible. The common belief that stock prefer a good mix of country in each paddock often leads to uneven use of the available grazing. This can result in severe degradation of preferred areas, especially when relatively small patches of attractive vegetation types occur in combination with larger areas of less preferred types.

Overgrazing by excessive populations of domestic, feral and native herbivores, in combination with drought conditions, is the primary reason for the degradation of extensive grazing lands. Changed fire regimes under pastoral settlement have also contributed, particularly in those areas susceptible to encroachment of native shrubs (or 'woody weeds'). These changes are manifested in:

- the reduction of desirable pasture species
- reduced cover on the soil surface
- increased run-off
- accelerated soil erosion and associated changes in soil surface properties.

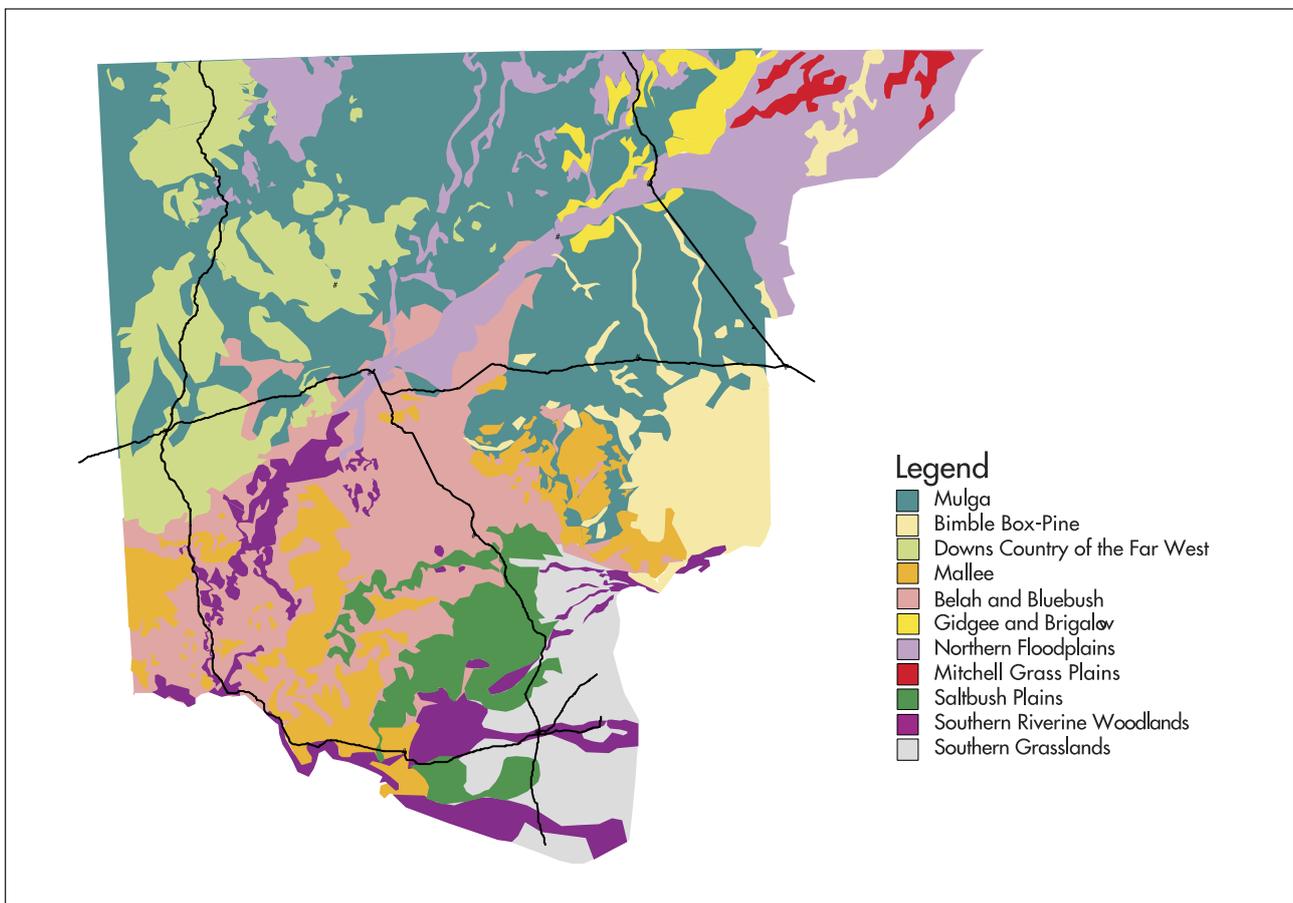


Figure 5. Vegetation map of the rangelands of New South Wales

Figure 6. The 11 vegetation types of the rangelands



Belah and bluebush

Associated with sandy to loamy soils, sometimes overlying clay subsoils. Often associated with rosewood and a grassy understorey. Soils are susceptible to wind erosion if shrubs have been removed. Grazing has prevented the regeneration of rosewood over extensive areas.



Gidgee and brigalow

North-east of Bourke on the alluvial clay soils of the Darling River floodplain and on neighbouring wind-blown sands, red earths and duplex soils. Much of this country has been cleared. Gidgee occurs in dense stands through to open woodlands, but the brigalow is restricted to small numbers of isolated stands with a sparse understorey, on sandier soils.



Bimble box-pine

Mostly occurs on hard red earths and granitic soils of the Cobar pediplain. There are areas of dense woodland with shrubby understorey ('woody weeds') and sparse pastures, as well as more open grassy areas.



Mallee lands

Characterised by multi-stemmed eucalypts with underground tubers that reshoot after fire or mechanical disturbance. In south and central areas, mallee occurs on windblown sands and red earths, often with a dense understorey of porcupine grass, or in open belah and rosewood areas with saltbush and bluebush underneath. In eastern areas mallee occurs on stony ridges with a sparse understorey.



Downs country of the far west

Occurs on level to undulating terrain in the north-west of the rangelands and supports saltbush, bluebush, Mitchell grass and scattered mulga and belah.



Mitchell grass plains

Located on the stable grey cracking clays of the irregularly flooded areas of alluvial plains in the north-east, and on adjacent duplex soils. The perennial Mitchell grass protects important annual grasses that grow in the spaces between the tussocks.

Figure 6 (continued). The 11 vegetation types of the rangelands



Mulga

Found throughout the northern parts of the rangelands on skeletal soils of hills and ranges, on soft red earths and sandplains, and on hardsetting red earths. Vegetation varies from grassland with scattered mulga to open grassy woodland to dense woodland with a bushy understorey.



Southern grasslands

Represents the annual and perennial grass communities with scattered low shrubs on the riverine plain bordering the Lachlan, Murrumbidgee and Edward rivers. These plains are composed of red-brown earths and clays, together with windblown sandy deposits bordering ancient streambeds. The current vegetation has probably replaced former saltbush stands and myall woodlands.



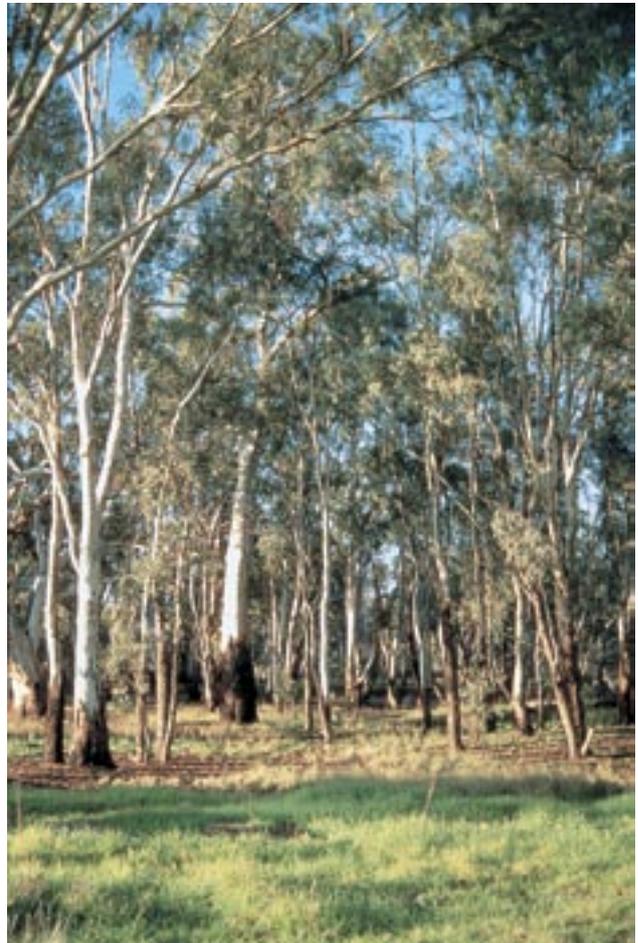
Northern floodplains

Cover the alluvial grey cracking clays and duplex soils associated with the floodplains, lakebeds and swamps of the upper Darling/Barwon, Narran, Warrego and Paroo rivers, and the Bulloo Overflow. Includes open woodlands of coolibah and black box; denser areas of belah, whitewood and wilga; low shrublands of lignum and canegrass; and perennial grasslands.



Saltbush plains

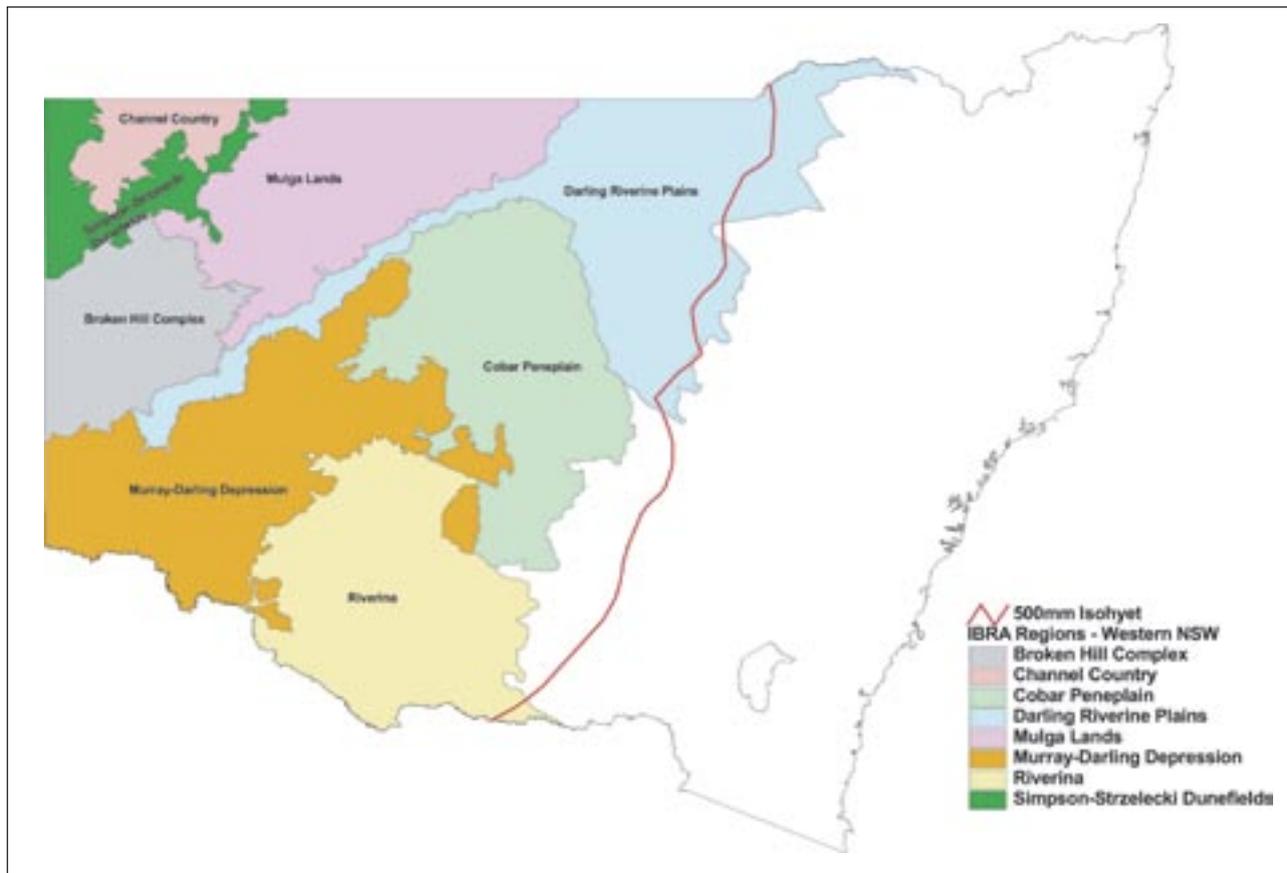
Found on the heavy clays of the alluvial plains surrounding Willandra Creek, the Lachlan and Murrumbidgee rivers, and Billabong Creek in the south. Scattered across the plains are ancient streambeds with sandy or duplex soils. Perennial saltbushes are interspersed with annual and perennial grasses and forbs.



Southern riverine woodlands

Forests and woodlands extending along the floodplains of the major rivers, creeks and lakes in the south of the area. The landfarm is complex, including alluvial plains, active watercourses, dunes, lakes and playas, lunettes and billabongs. Vegetation includes river red gum, black box and cooba, together with a variety of palatable shrubs and perennial grasses.

Figure 7. Interim biogeographic regions of Western NSW
 (based on the Interim Biogeographic Regionalisation of Australia – IBRA; Thackway and Cresswell 1995).



When these conditions apply, the ability of the landscape to retain the water and nutrients required for plant production is reduced. Overall productivity is lowered and the landscape is said to be dysfunctional. While some local concentration of these resources is desirable to maximise production in dry environments, excessive redistribution, leading to loss of resources from the local area, is harmful and must be prevented or reversed. Maintenance of ground cover (including plant bases, biological soil crusts and litter) above 40 per cent is essential to prevent accelerated loss of soil in semi-arid and arid lands (Figure 8). Further information on landscape function and its assessment may be found in *The Glove Box Guide to Tactical Grazing Management of the Semi-Arid Woodlands* (NSW Agriculture 2000) and in *Landscape Ecology, Function and Management: Principles from Australia's Rangelands* (Ludwig et al. 1997).

PLANT PRODUCTION

Forage production

The amount of forage available varies widely in response to changing seasonal conditions but rarely exceeds 2500 kg of dry matter/ha. Levels

of standing dry matter typical of the rangelands are shown in Figure 9. Soil fertility is generally less important than soil moisture in determining forage production, although sometimes the reverse may be the case. This is likely when several years of high rainfall occur in succession, and most of the available nutrient pool has been converted into non-available forms in litter and plant residues. Release of the nutrients held in these forms occurs during subsequent dry periods when limited falls of rain stimulate soil microbial activity but vegetative growth is insufficient to use all of the nutrients released. These dry periods are important in building up the fertility that makes the desert bloom when water is once more abundant.

Estimating how much forage is available, and how long it will last given current stock numbers, is fundamental to making decisions about stocking. Simple techniques for making these assessments, using photo standards like those shown in Figure 9, can be found in *The Glove Box Guide to Tactical Grazing Management of the Semi-Arid Woodlands* (NSW Agriculture 2000).

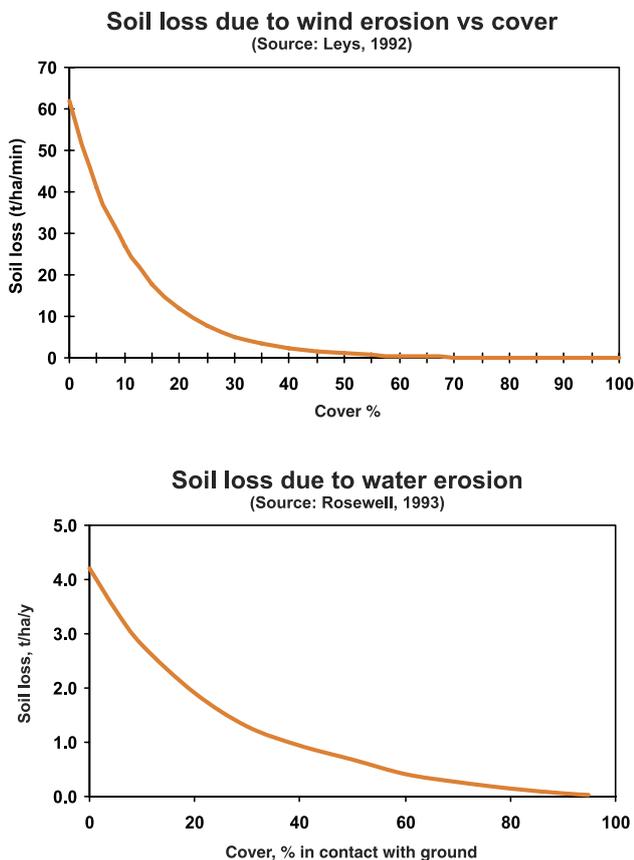
Vegetation composition

The composition of the vegetation, as well as the amount of standing dry matter, is important

in determining the level of animal production that is achieved. The presence of green material, even if only in small amounts, can substantially lift the level of animal performance (Figure 10). Under the climatic conditions of the rangelands, perennial species that can respond to small falls of rain are much better able to provide green material than annuals, which must germinate from seed and are absent during prolonged dry periods. Although annual species can support a high level of animal production when available, a high proportion of palatable perennial plants is very desirable for sustained production and should be promoted by management. Desirable perennial species may be either grasses or shrubs. Many of the more common ones, which should be recognisable by pastoral managers, are shown in *The Glove Box Guide to Plants of the NSW Rangelands* (NSW Agriculture 1998).

Thickening of woody vegetation. One particularly important aspect of vegetation composition over extensive areas of the rangelands is the thickening of native shrubs to the point where stock management is impeded and forage production is reduced. The result is reduced carrying capacity and land values. This

Figure 8. Relationships between wind and water erosion and ground cover



‘woody weed’ problem is particularly evident on the red earths of the Cobar pediplain (‘hard red’ country) and sandy red earths (‘soft red’ country) throughout the rangelands. It is less severe on the solonised brown soils typical of belah–rosewood country or the texture contrast soils and desert loams supporting saltbush and bluebush communities. Thickening of woody species has been occurring progressively since the early days of settlement, but major recruitment events, leading to substantial increases in the area affected, have been associated with wet periods such as the mid 1970s. The run of wet seasons in parts of the rangelands in the late 1990s again resulted in a major germination of woody species.

Fire. The major factors contributing to the establishment of woody weeds have been the control of natural (‘wild’) fires and the reduction of perennial grasses through high total grazing pressure. Although some woody weeds are resistant to fire as adults, the seedlings of all species are highly susceptible. There is little doubt that regular burning played an important role in restricting the distribution and density of shrubs before pastoral development. Shrub seedlings are also susceptible to competition from perennial grasses, especially in the first summer after germination, and this factor probably also acted to restrict shrub encroachment. The effectiveness of both fire and perennial grasses in restricting shrub growth has been severely reduced as a result of both past and current methods of pasture management. In the absence of these controls rabbits probably acted to limit shrub development by destroying seedlings. The reduction of the rabbit population by myxomatosis is generally thought to have contributed to shrub thickening. A similar situation may follow the introduction of rabbit calicivirus, and associated warren ripping programs, over extensive areas of western NSW. This is not to suggest, however, that rabbit control programs should not proceed.

Weeds. Although many species can act as ‘woody weeds’, the six main species are budda or false sandalwood (*Eremophila mitchellii*), turpentine (*Eremophila sturtii*), punty bush (*Senna artemisioides* subsp. *filifolia*), silver cassia (*Senna artemisioides* nothosubsp. *artemisioides*), narrow leaf hopbush (*Dodonea viscosa* subsp. *angustissima*) and broad leaf hopbush (*Dodonea viscosa* var. *spatulata*).

Figure 9. Standing dry matter levels
50–100 kg/ha



100–300 kg/ha



300–600 kg/ha

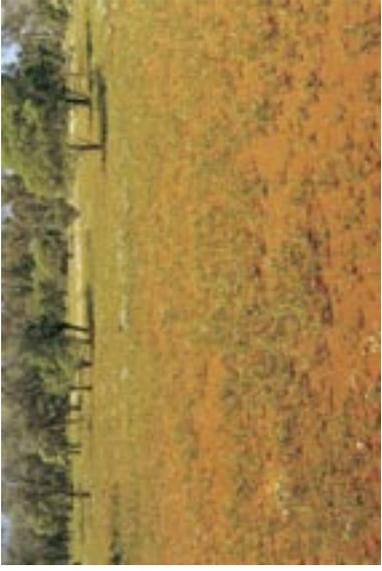
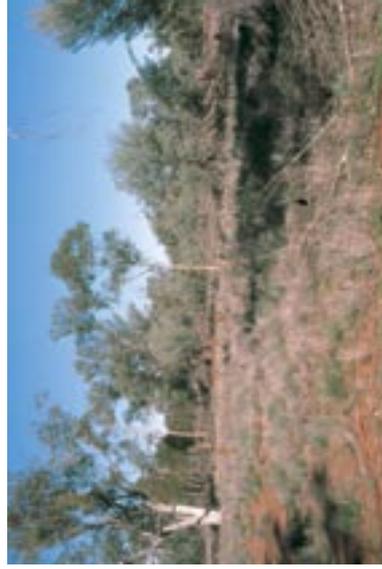


Figure 9. Standing dry matter levels (continued)
600–900 kg/ha



900–1200 kg/ha



1200–1500 kg/ha

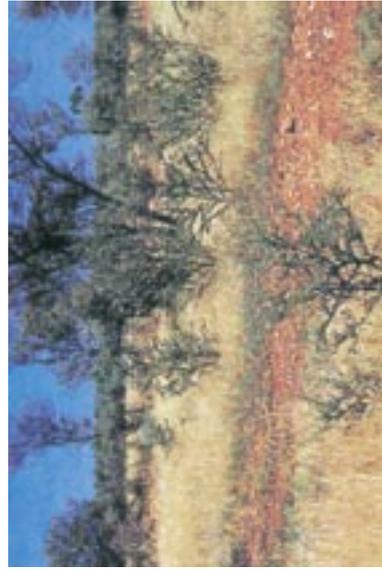


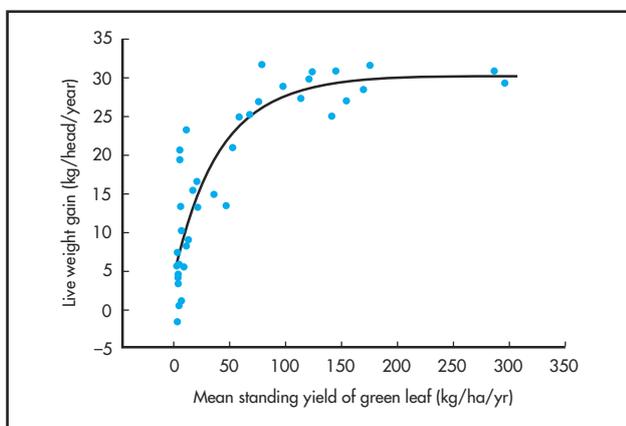
Figure 9. Standing dry matter levels (continued)
1500–2000 kg/ha



> 2000 kg/ha



Figure 10. Relationship between green vegetation and animal production (Source: Freudenberger *et al.* 1999)

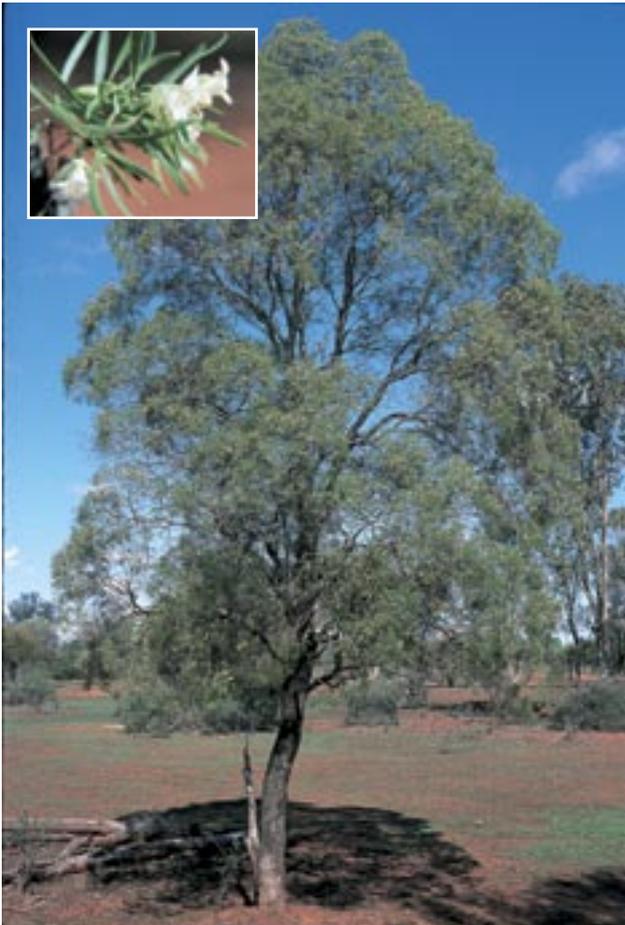


These species were previously listed as woody weeds in the regulations of the *Western Lands Act 1901*, and their clearing was subject to special provisions under the *Native Vegetation Conservation Act 1997* (which will soon be replaced by the *Native Vegetation Act 2003*.)

No single 'one-off' treatment is effective in the long term against woody weeds. Integrated management strategies are therefore recommended. They may include combinations of:

- management burns, particularly in autumn when conditions for burning are safer and shrubs are susceptible to defoliation
- mechanical treatment, including grubbing, chaining, or blade ploughing

Budda or false sandalwood (*Eremophila mitchellii*)



G. BROOKE

- chemical control, particularly of regrowth following other treatments
- goat grazing.

Careful consideration must be given to the economics of these treatments. Blade ploughing, in particular, is unlikely to be an economical large-scale control measure but may be useful in clearing laneways or other critical areas. Management burning is the most cost-effective treatment, but ideally two fires in quick

Silver cassia (*Senna artemisioides* nothosubsp. *artemisioides*)



G. BROOKE

L. MCGARVA

Turpentine (*Eremophila sturtii*)



T. GRICE

G. BROOKE

Narrow leaf hopbush (*Dodonea viscosa* subsp. *angustissima*)



L. MCGARVA

DEPARTMENT OF LAND AND WATER CONSERVATION

Punty bush (*Senna artemisioides* subsp. *filifolia*)



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Broad leaf hopbush (*Dodonea viscosa* var. *spatulata*)



G. BROOKE

succession are required initially. This is possible only in unusual runs of years, and so follow-up treatment after the initial burn by grubbing or spot spraying will usually be required for control of regrowth or new germination. Subsequent management burns will inevitably be required when seasonal conditions permit.

With all of these approaches, control of total grazing pressure is essential to allow the regeneration of a productive pasture following treatment, to minimise the time that ground remains bare after a burn, or to allow the accumulation of fuel. Reintroduction of seed of native pasture species, preferably harvested from local stands, may allow faster re-establishment of a desirable pasture.

Further information on these management techniques can be found in *Managing for Woody Weed Control in Western NSW* (Woody Weeds Task Force 1993), *Woody Weed Management Strategy* (Woody Weeds Task Force 1992), *Agfact P7.2.3. – Management burning of woody weeds: principles* (NSW Agriculture 1989), *Agfact P7.2.4. – Management burning of woody weeds – techniques* (NSW Agriculture 1989), and *Rangeland Management in Western NSW* (Simpson 1992).

In addition to native ‘weeds’ many exotic weed species are also present in the rangelands. Those causing most concern are described below. However, there are others that may cause problems in some areas.

Mesquite (*Prosopis* spp.). Mesquite is a thorny, introduced, invasive shrub that has an immense potential to seriously affect much of the Western Division. It was originally introduced into western NSW to provide ground cover and is still restricted to a relatively small number of properties.

It is a declared noxious weed in NSW, and under the *Noxious Weeds Act 1993* it must be controlled by landholders. Lessees are landholders under the Act and have a legal responsibility to fully control all mesquite on their leases.

It is vital that the control of mesquite receives top priority from all concerned.

African boxthorn (*Lycium ferocissimum*). African boxthorn is an introduced thorny shrub

that was originally introduced as an ornamental around homesteads and in urban areas. The main areas of concern are in the eastern part of the Western Division such as around the towns of Cobar and Bourke. It is not yet a serious problem in much of the rangelands, but is gradually spreading out from urban areas. It has the potential to become a serious problem in rangelands if left unchecked.

Noogoora burr (*Xanthium* spp.). Noogoora burr is an introduced annual weed that is a serious contaminant in wool. It has become endemic along waterways and the seeds are readily moved by water, particularly during floods. In much of the region it grows only after good rains and/or floods, and control is generally beyond the resources of landholders.

Mesquite (*Prosopis* spp.)



G. JOHNSON

B. AULD & R. MEDD

G. JOHNSON

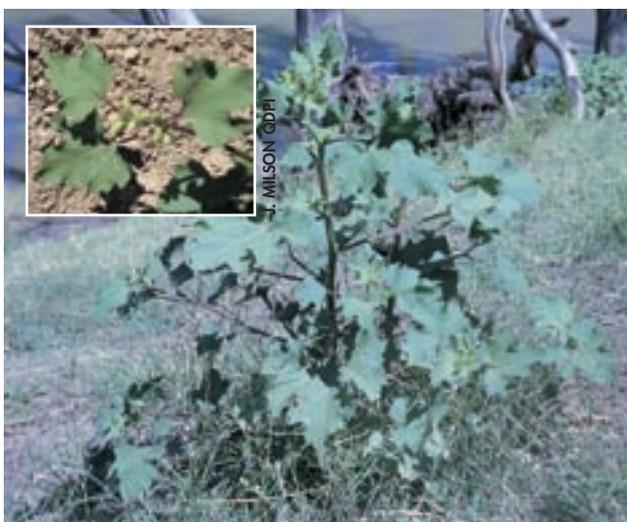
Onion weed (*Asphodelus fistulosus*). This weed is invading areas that have been bared by overgrazing, where native pastures have been weakened by adverse seasonal conditions or where the soil has been disturbed (for example, roadsides, cultivation). Chemical control of this weed is difficult to achieve and expensive for large areas.

African boxthorn (*Lycium ferocissimum*)



L. MCGARVA

Noogoora burr (*Xanthium* spp.)



J. MILSON GDPI

G. BROOKE

B. AULD & R. MEDD

Onion weed (*Asphodelus fistulosus*)



G. BROOKE

Parthenium weed (*Parthenium hysterophorus*). Parthenium weed is a declared noxious weed throughout the State. It is a very serious noxious weed in Queensland, and in recent years numerous isolated infestations have been discovered in NSW. The total control of all these infestations has received top priority from the State Government and the local councils concerned. Consequently there are no known infestations currently occurring in the State.

It is imperative that all landholders watch out for parthenium weed and report any suspected plants to the local noxious weed control authority (the local shire council, or the Department of Infrastructure, Planning and Natural Resources in the Unincorporated Area). If the weed became established in far-western NSW it would have devastating effects on the whole community.

Further information on weed control can be found in the publication *Noxious and Environmental Weed Control Handbook 2004*, available from NSW Department of Primary Industries.

Parthenium weed (*Parthenium hysterophorus*)



B. AULD & R. MEDD
J. DELLOW

Total grazing pressure

Total grazing pressure is the ratio of the total demand for forage by all herbivores, both domestic and non-domestic, to the forage supply. Total grazing pressure is low in periods when forage is abundant, and vice versa. In most grazing systems it is sufficient to consider the grazing pressure of livestock only. However, in the rangelands non-domestic herbivores consume a considerable portion of the available forage and total grazing pressure is a more appropriate concept. The major non-domestic herbivores are kangaroos, feral goats and rabbits (ignoring invertebrate herbivores such as locusts, which can exert great pressure on the vegetation for short

periods). These species can frequently account for over 50 per cent of the total grazing pressure.

Total grazing pressure is the primary means by which grazing animals have an impact on vegetation and ultimately on the landscape itself through alteration of landscape function and erosion.

A key requirement for pastoral management is to maintain total grazing pressure at reasonable levels by regulating the population of domestic and non-domestic herbivores in relation to the forage supply. Excessive grazing of preferred species, combined with drought, has been responsible for major changes to rangeland environments and pastoral productivity.

In large rangeland paddocks the distribution of total grazing pressure is controlled primarily by the location of stock waters, although other factors such as wind direction and topography also exert an influence. In many areas of western NSW, however, the abundance of stock watering points, in the form of ground tanks, troughs or bore drains, is so high that little if any of the landscape is beyond the reach of grazing animals. In these circumstances, the gradients in grazing pressure extending from watering points, which are familiar in other parts of the rangelands, are not obvious.

Control of watering points offers an important means of managing total grazing pressure. Provided surface water is not available, the establishment of self-mustering yards at watering points (see Figure 11), especially in association with small holding paddocks, provides a cheap and efficient mean of mustering both livestock and feral goats. Holding paddocks that are opened only when the trap is set for mustering, and that are completely destocked at other times, allow animals to be fed for several days without supervision. Temporary closure of watering points under hot, dry conditions provides a means of concentrating kangaroos for more efficient culling (see page 31). In the northern rangelands, where many properties are watered by flowing bores, use of water control for management of total grazing pressure is generally not feasible. However, for many reasons the continuing use of open bore drains is not encouraged. Capping and piping of bores throughout the Great Artesian Basin is currently progressing with government assistance. The ability to manage total grazing pressure more

effectively through control of watering points will be an important benefit of this program.

Grazing management

Effective grazing management is the key to sustainable pastoral production. The approach best suited to the highly variable climatic conditions of the semi-arid and arid rangelands is called **tactical grazing**. Tactical grazing involves four steps:

1. Setting a management objective. Before any pasture can be managed, a management objective needs to be set. In practice, since paddocks are the basic management units on pastoral properties, an objective needs to be set for each paddock. This objective will generally focus on the pasture type that has the potential to contribute most to the pastoral productivity of the paddock. Only two broad objectives are possible: **maintenance** or **restoration**. If the main pasture type is already close to its potential for long-term animal production, or is in a condition from which it is unlikely to be able to change readily in response to grazing management, the appropriate objective would be to maintain it in its present condition. If the pasture is not close to its potential long-term productivity but has the capacity to respond to management, then restoration is the appropriate objective.

Determining the management objective is not always easy, and few clear guidelines are available. However, one factor to consider is the density of desirable perennial plants that remain. For Mitchell grass pastures in the Walgett district, for example, areas with more than 1 mature plant/m² would be considered in good condition and a maintenance objective would be appropriate. Stands with 0.1 to 0.5 mature plants/m² should be capable of regenerating fairly rapidly in response to altered management, so a restoration objective would be appropriate. If plant density has dropped to about 0.02 mature plants/m², regeneration will be slow without an additional seed source, and maintenance may again be the appropriate objective.

Other factors to consider are the presence of relict plant stands, which may act as seed sources, and the effectiveness of the landscape in retaining nutrients and water for plant growth. In both cases, however, the thresholds for separation of maintenance from restoration objectives are not well defined. Objectives may change with time as regeneration is achieved or seasonal conditions provide opportunities not previously expected.

2. Determining a strategy. Grazing management in highly variable environments like the semi-arid rangelands cannot be based on simple

Figure 11. Self-mustering yards. Note the inlet and outlet 'spears' in the foreground.



Photo courtesy Department of Agriculture, Western Australia

recipes or implemented on calendar-based schedules. However, the management needed to achieve the objective can be formulated as a strategy or a statement of the principles and practice needed to achieve the desired result. Variable climatic conditions present graziers with both **opportunities** to progress towards the objective (for example, good seasons that favour germination or seed set of desirable species) and **hazards** that may push the pasture away from the objective (for example, drought, which may kill desirable species, or intense rainfall, which may cause excessive run-off and erosion). Strategies need to include the management principles that will allow both the exploitation of opportunities and the avoidance of hazards.

There is no set formula for determining the strategy needed for any particular objective, but some of the factors that should be considered include:

- the effect of defoliation on plants' ability to withstand drought
- the effect of soil cover on the rate of accelerated soil erosion
- the need for seeding opportunities to replenish the soil seed bank
- the likely benefit of plant species diversity for drought tolerance and recovery of pasture production
- the effect of burning on woody shrubs of various ages
- the effect of heavy grazing on the competitive balance among plant species.

As an example, a strategy to maintain a healthy perennial grassland on the eastern edge of the rangelands could be:

- Keep ground cover (plant bases, biological soil crusts, litter and other organic material on the surface) over 40 per cent when stocked.
- Use no more than 30 per cent of the production of key species (for example, curly windmill grass) on average over time.
- Spell for seed production if key species have not set seed for three years.
- Burn in April or October if fuel is over 1000 kg/ha of dry matter and shrub seedlings are present or shrub cover is increasing.

If the perennial grass population was depleted but regeneration was considered feasible, this strategy would be altered to require a lower

average level of pasture utilisation. However, if the pasture was essentially an annual sward, with perennial grasses severely depleted, the appropriate strategy for maintenance of the current level of productivity would simply require ground cover to be maintained above 40 per cent while the pasture is stocked.

3. Implementing the strategy on a day-to-day basis as seasonal opportunities allow or dictate. Just as seasonal conditions vary widely and continuously, so the actual management required to implement the principles contained in the strategy will also vary continuously. Management will need to respond tactically to changing conditions in order to implement the strategy. This continuous response, guided by a well thought-out strategy, is the essence of tactical management. For the grazier to respond in this way, the important components of the strategy must be monitored with sufficient precision and frequency to allow timely management decisions.

4. Monitoring the results. Tactical management is aimed at stated objectives. Monitoring the results of management will allow progress towards these objectives to be judged and objectives to be changed as required.

Further explanation of these steps and assessment techniques that can assist the implementation of tactical grazing, can be found in *The Glove Box Guide to Tactical Grazing Management for the Semi-arid Woodlands* (NSW Agriculture 2000).

Short courses in tactical grazing can also be organised through the local office of NSW Department of Primary Industries.

ANIMAL PRODUCTION

The level of animal production achieved is determined by a number of interacting factors. These include:

- forage consumption and nutritive value
- rates of reproduction, growth or production, and mortality
- flock/herd size and structure
- pests and diseases
- non-domestic grazing.

The interactions between these factors are outlined in Figure 3. To take one example, forage consumption or the plane of nutrition

determines the condition of the ewe at joining and thus the reproduction rate, particularly through the level of twinning. This in turn will influence flock size and structure, as well as wool production per head, as the number of sheep available will determine the number that can be culled when classing and hence the quality of the flock. Income will also be influenced through the number of sheep available for sale. The size and structure of the flock will also determine the grazing pressure on pastures, and additional attention to the level of non-domestic grazing may be needed if the nutritional requirements of livestock are to be met. Pests (for example, feral pigs) and diseases may also play an important role in determining lambing success and may thus influence all of the other interacting factors.

Forage consumption (nutrition)

Animals must have access to sufficient quality and quantity of pasture and water to meet their nutritional requirements (to maintain their bodies, grow to maturity, mate, carry foetuses, give birth, rear young, recover any lost weight and finally produce a saleable product). If pastures cannot meet the animals' needs for nutrition, supplementary feeding may be required. Rangeland pastures in NSW are frequently deficient in digestible energy during dry periods or droughts, but usually provide adequate protein levels for sheep and goats from chenopods (saltbushes and bluebushes), other browse species and medics, if present in sufficient quantity.

In the past, the most common health and production problems of livestock were related to inadequate nutrition – plant poisonings, malnutrition and starvation. With better water supplies, control of rabbits, and a better understanding of what the country can safely carry, these problems are becoming less common.

Graziers can ensure the nutritional requirements of their animals are satisfied by:

- guaranteeing that water of adequate quality is available
- balancing the current and future needs of stock and other grazing animals for pasture and water with the needs of the land to maintain itself, recover any lost condition, and improve. Getting the balance right may

involve agistment of stock off or on, sale or purchase of stock, reduction of non-domestic grazing pressure, changing numbers of stock or non-domestic animals in particular paddocks, or feeding supplements. Monitoring how each strategy works in terms of both the animals and the land is essential for refining management practices.

- managing for the frequent dry times by having pasture and/or financial reserves and a destocking strategy.

Viewed in these terms, meeting the nutritional needs of animals is obviously closely related to the 'tactical grazing' management of pastures outlined earlier.

In addition, some specific nutritional issues will need to be addressed from time to time:

- Phosphorus deficiency in cattle is common and requires routine supplementation with licks or blocks.
- Salt may be required on the degraded soils of the Cobar uplands.
- Phosphorus and protein deficiency is common in young sheep on dry feed.
- Vitamin A and E deficiencies are likely when diets lack digestible green material for periods in excess of six months. A combined vitamin A and E injection is usually cost-effective for cattle and rams.
- Energy deficiencies in late pregnancy or early lactation (pregnancy toxemia in sheep, and in cattle) are likely if feed is limited. The best management is to ensure that pregnant animals have access to adequate quality and quantity of pasture, as treatments have a relatively low chance of success.
- Excessive salt intake may result from high levels of chenopod shrubs in the diet and/or salty water. Managing pastures to promote a balance of low-salt species is often the best solution.
- Feeding on scrub or chenopods appears to create a variety of nutritional problems. Providing molasses, small quantities of grain or hay and selected mineral supplements can help animals to digest and balance the nutrients available in scrub. Stock fed on mulga scrub may require additional sulfur.

Molasses is a useful supplement for animals on dry feed, in droughts, or when faced with pastures that may have trace mineral deficiencies. Molasses appears to help animals digest dry or hard feed, and its array of trace minerals can be helpful. It can also be used to attract cattle and other stock to home-made licks.

Reproduction

Systems used to manage Merino sheep reproduction are well developed in the rangelands, as sheep have traditionally been the major source of income. Management of cattle reproduction is less well developed, with cattle often being a secondary enterprise. Systems to manage the reproduction of cattle, goats and introduced South African sheep breeds will become more advanced as income from sales becomes more important.

The levels of reproduction that can reasonably be expected for sheep and cattle with good management are shown in Table 2. The principles that should be applied to achieve or exceed these levels of performance are discussed below.

Joining. The efficiency of the whole reproductive process depends on the success of joining. Issues for management consideration include:

- The heavier the dam at joining the higher the ovulation rate, and the higher the percentage of twins in sheep and goats.
- Sires should be in good condition at joining (but not over-fat), and free of disease.
- Sires need to be in good health at least seven weeks before joining to ensure full sperm development.
- Males and females need to be able to find each other: choose smaller open paddocks, use the right balance of males to females, and, if needed, periodically mix the mob.
- Joining periods need to be long enough for all dams to be mated. This usually means six to eight weeks for sheep and six to 12 weeks for cattle.

Pregnancy. The nutritional requirements of the dam are greatest in late pregnancy and early lactation. About 90 per cent of foetal growth of lambs occurs in the last six weeks of pregnancy. The density of wool follicles, which determines

life-long wool production potential, is also determined at this time. Adequate nutrition in this period is thus critical. In managing the reproductive cycle, graziers need to assess carefully when their pastures are most likely to meet these nutritional requirements, while allowing for the demands of markets, the effects of heat, labour availability and health problems (such as grass seed, fly strike, pink eye and poisonous plants). The best pastures for reproduction are a diverse mix of annuals and perennials, with a balance of green and dry material, few or no poisonous plants, and low salt content.

Lamb survival. Post-natal mortality is the greatest source of reproductive loss in pastoral flocks. Usually 25 to 30 per cent of newborn Merino lambs die, with losses rising to 50 to 90 per cent with poor feed conditions and/or predation (see below). The level of nutrition available to the ewe in late pregnancy and early lactation is critical. This will determine the birth weight of the lamb and the milk supply and mothering behaviour of the ewe – all of which strongly influence lamb survival. Management of pastures and the timing of the reproductive process to ensure that there is a high probability of green feed at this time are important for reproductive success.

Marking and mulesing. Marking (especially of lambs or kids) and mulesing are among the most important management procedures carried out in extensive grazing enterprises. Losses can be high without proper planning, good hygiene, a suitable site and appropriate equipment. Issues for management consideration include:

- timing of the operations (for sheep) to avoid periods of blow fly activity and high risk of post-mulesing arthritis
- use of the correct marking and mulesing procedures
- avoiding long-distance driving of livestock after marking
- preventing recently marked/mulesed animals from lying down, thus avoiding contamination of wounds with urine or faeces
- avoiding disturbance soon after marking, and up to four weeks after mulesing, to allow wounds to heal.
- reducing the size of mobs to minimise the chance of mismothering.

Weaning. The decision of when to wean offspring is important. There comes a time when offspring are getting little of their nutritional requirements from the dam's milk but their suckling is placing unnecessary stress on the mother, decreasing the period in which she can recover before the next joining. By this time, the dams and their offspring are often competing for the available pasture to their mutual disadvantage. In dry times it may be necessary to wean offspring earlier than normal to avoid these problems. For lambs, weaning usually occurs at about 12 to 14 weeks, and for calves at 24 to 28 weeks. Yearlings or steers for bullock production can be weaned when feed is available, even at five months. Early weaning can improve cow fat score dramatically when autumn feed is poor and unweaned calves are placing heavy demands on their dams. First-calvers falling to fat score 1 or 2 should have their calves removed regardless of age. Excessively long joining periods, or uncontrolled joining, make it much more difficult to wean offspring at a suitable age.

Growth/production and mortality

Mortality rates in the rangelands are difficult to estimate accurately. However, rates are strongly dependent on seasonal conditions in the absence of any major predation problem, and

Table 2. Levels of reproduction that may be expected in extensive grazing enterprises under good standards of management

	Poor season	Average season	Good season
Lambing			
- open country	< 70%	85%	> 100%
- scrubby country	< 50%	70%	> 85%
Calving	85%	90%	95%

Table 3. Estimated overall mortality rates for sheep flocks and cattle herds in the rangelands, in the absence of major predation

	Poor season	Average season	Good season
Sheep			
- open country	2%-8%	2%-6%	3%-8%
- scrubby country	3%-10%	3%-8%	4%-10%
Cattle	1%-2%	1%-2%	1%-2%

the youngest and oldest animals and pregnant or lactating females will be at greatest risk as seasonal conditions deteriorate. Mortality in sheep flocks may increase in wet years as a result of fly strike or other disease and parasite problems. Estimated overall mortality rates are given in Table 3.

Wool production per head varies mainly among bloodlines. Differences between vegetation types will influence production per head to some extent but will be reflected more in production per hectare, given reasonable seasonal conditions and proper grazing management. With good management, rangeland wool producers should be able to achieve wool cuts per head within the ranges illustrated in Table 4.

Few growth data are available for either sheep or cattle in the NSW rangelands. Growth rate varies greatly with seasonal conditions from year to year. This variation will determine the capacity to meet the market requirements outlined in Tables 5 and 6.

Flock/herd size and structure

The net result of the processes discussed above will be the size and structure of the flock or herd. This will determine the overall productivity of the enterprise.

Table 4. Estimated clean wool cuts per head for rangeland producers

Micron	Wether clean fleece weights		
	- 15%	Average	+ 15%
19	3.28	3.87	4.45
20	3.57	4.20	4.83
21	3.74	4.40	5.06
22	3.90	4.59	5.27
23	3.99	4.70	5.40
24	4.11	4.84	5.56
Micron	Breeding ewe clean fleece weights		
	- 15%	Average	+ 15%
19	2.95	3.48	4.00
20	3.21	3.78	4.34
21	3.36	3.96	4.55
22	3.51	4.13	4.75
23	3.59	4.23	4.86
24	3.69	4.35	5.00

Source: Wether data are derived from Coelli et al. 2000. Data for breeding ewes represent 90% of wether values.

Table 5. Specifications for main sheep meat markets accessible to rangeland producers

Market	Age	Carcase weight (CW)/live weight (LW)	Fat score	Comment
MUTTON				
Heavy export	NA	> 20 kg CW preferred	1 to 4	25% higher value than domestic market, no price difference between hogget and mutton
Light export	NA	14–16 kg CW	1 to 2	Low value market
Domestic	NA	17–21 kg CW	1 to 3	25% higher value for hoggets as compared with mutton
Live export	4 tooth or less	> 48 kg LW preferred	1 to 4	Same as heavy export
LAMB				
Store lambs (grass-fed)	< 6 months preferred	< 30 kg LW preferred, no grass seed	1 to 3	Terminal sire preferred (Dorset, White Suffolk and Texel)
Store lambs (feedlot)	< 10 months preferred	30 kg LW, no grass seed	2 to 3	Terminal sire preferred (Dorset, White Suffolk and Texel)

Table 6. Likely market options for rangeland beef producers

Class	Age (months)	Live weight (kg)	Likely market
Weaners	7–10	180–200	Grass fattening, feedlot backgrounding on grass
Weaners	7–10	200–240	Grass fattening, domestic feeders
Yearling	10–12	250–300	Feeders for Japan (British breeds and their crosses)
Yearling	12–15	300–350	Local butchers, grass fattening, feeders for Korea and Japan (British breeds)
Yearling	12–18	350–400	Butchers and supermarkets; feeders for Japan (British breeds)
Steers	24–30	450–500	Grass fatteners (age limits for Japan); feeders for Japan, grass-fed for Korea; hotel/restaurant (early maturing types)

However, flock/herd size and structure are also determined fundamentally by strategic decisions relating to enterprise type, which in turn reflect the natural resources of the property and market forces. Rangelands encompass a great variety of vegetation types with varying carrying capacities, both regionally and within individual properties. Some of these are suitable only for dry stock, whereas others can support self-replacing flocks or herds.

There are no hard and fast rules that can be followed when deciding on size and structure of a grazing enterprise. Each situation needs to be assessed individually, taking into consideration factors such as market demand and specifications, the minimum/maximum quantity of product that the customer requires, transport efficiencies, infrastructure, natural resources and their suitability, climate, labour availability, risk, cash flow, skill and experience, and the vision and goals of the family.

Pests and diseases

Pests and diseases can have major impacts on the success of animal production systems

in the rangelands. Their influence may be exercised through both increased mortality rates and production losses resulting from reduced performance of individual animals. In dry-to-average years some would say that generally these impacts are low, when compared with the more intensive, higher rainfall areas of the State. However, some anecdotal evidence suggests that this is not always the case. Problems with anthrax and plant poisonings, for example, may be more common in drier years.

Predators. Predators such as foxes and feral pigs kill and eat newborn lambs, and can severely reduce marking percentages. They also destroy native animals, harming environmental balances, and increase the risk of disease spread.

Although losses due to foxes are often relatively minor, recent studies (including one in western NSW) have shown that they may be as high as 30 per cent in some areas. Foxes are primarily controlled with 1080 poison in meat or manufactured baits. Baiting is normally carried out before lambing. However, recent recommendations suggest that fox baiting should

be undertaken twice a year to target pregnant and lactating females in spring and dispersing juveniles in autumn. It is at these times that food demands and fox movement are greatest.

Loss of newborn lambs to feral pigs can be significant. A number of studies in the rangelands have indicated that the loss of lambs to feral pig predation may be as high as 32 per cent in some areas, with some properties losing 80 to 90 per cent.

Damage to water sources can be important in many areas, with feral pigs rooting bore drains and outlets and fouling dams and waterholes through wallowing and defecation. Although pigs do not compete strongly with livestock for food, they may cause damage in some areas by rooting, reducing available pasture, and also affecting pasture composition.

If pig control is necessary, local Rural Lands Protection Boards should be contacted to seek assistance in developing the most effective year-round program. Control programs are much more effective when graziers work together in a regional approach.

Blowflies. Blowflies are probably the second most important cause of ill health in sheep in the rangelands (after poor nutrition). Serious blowfly waves are common following good rains in spring and autumn, but wet seasons can result in some level of impact at any time

Feral goats roam freely over most of the New South Wales rangelands.

Sheep blowfly (*Lucilia cuprina*) can cause devastating losses in wet, humid springs and autumns. Early preventative treatment with effective insecticides, together with crutching, can minimise flystrike.



Feral pigs in a weldmesh trap.



of the year. Mulesing and crutching are the standard preventive measures for breech strike, with backline treatment or jetting used tactically in higher-risk situations. Body strike is more difficult than breech strike to manage by routine practices.

Preventative jetting or backline treatments require use of the appropriate insecticide, taking into account withholding periods (for both meat and wool) and blowfly resistance to certain chemicals, especially organophosphates. Newer, long-acting fly treatments offer opportunities to prevent flystrike in high-risk situations, or where sheep cannot be easily re-mustered if fly waves eventuate.

When flystrike is detected, all wool around the area must be removed as close to the skin as possible (electric shears are more effective than hand shears), because it is the removal of wool, not the application of fly dressing, that kills the maggots. Hand-dressing of strikes will prevent re-infestation. Struck wool should be collected into a plastic bag and left in the sun to kill maggots.

Selection emphasis in breeding or classing programs can increase a flock's resistance to

***Bovicola ovis*, the sheep body louse. An effective control program can eradicate lice from a flock and careful attention to fences and 'quarantining' of introduced sheep can avoid the need to treat for lice.**



flystrike. Animals can be scored for fleece rot (the precursor of body strike), and assessed for conformation and type prone to flystrike, and culled accordingly. Resistance may also be improved by purchase of rams from studs that incorporate fleece-rot resistance in their breeding objectives. Further information may be found in Agfact A3.3.41 (2001) – *Scoring sheep for fleece rot*. Selection for resistance to flystrike may become more important if mulesing is progressively phased out.

Lice. Lice cause loss of wool production and may at times be a source of considerable friction between neighbours. Chemical treatments can eradicate lice from a flock provided that:

- all sheep are treated (clean musters are essential)
- correct procedures and dosages are used (follow directions on the label)
- any lambs born in the weeks or months after shearing are treated, or cannot be infested because of the type of chemical used at shearing
- infested sheep are prevented from entering the flock whether by purchase, agistment, or from neighbouring properties by checking history of lice at purchase or agistment, and by attention to fences with neighbours.

Graziers purchasing sheep can insist on a vendor declaration that they are from a flock that is free of lice. Rural Lands Protection Board rangers can advise on suitable treatments and procedures, and can help coordinate groups of graziers wishing to eradicate lice.

Worms. Worms are not a routine problem in western NSW. Some years and seasonal conditions can cause a marked rise in worm burdens. Barber's Pole worm (*Haemonchus*), black scour worm (*Trichostrongylus*), and small brown stomach worm (*Ostertagia*) are those most likely to cause problems. Routine drenching in western NSW is not warranted and merely encourages the development of drench-resistant populations. Unnecessary drenching is costly. Worm testing kits, available from stock and station agents, Rural Lands Protection Boards, and NSW Department of Primary Industries, can be used to monitor worm numbers and types either routinely or when worm problems are likely. Worm monitoring six or seven weeks after a significant rainfall event can detect the beginnings of a serious

worm burden. Tests are available to detect worm burdens that are resistant to particular drenches. Results of worm tests can help you to decide whether drenching is necessary and which drench to use. Drenching in hot, dry conditions provides best results, as few larvae survive on pastures to re-infest stock.

Diseases. The relatively hot, dry conditions and low stock densities in western NSW mean that livestock are generally healthy compared with those in cooler, wetter areas with high stock densities.

Anthrax occurs sporadically in a belt of country running from near Bourke to Cobar, down to Euabalong and the Hillston area. The organism lives in soil for long periods, appearing to become a problem in the warmer months in certain drier years, after showers or periods of high humidity. Sheep, cattle, goats and sometimes pigs are most commonly infected. Anthrax bacteria are normally eaten on pasture or soil, or drunk with water infected when birds or scavenging animals wash pieces of infected carcass. Grass seed damage to skin can provide sites of entry for the bacteria. An effective vaccine is available to prevent the disease, or to deal with an anthrax outbreak. As anthrax can infect and sometimes kill people, great care must be taken when handling any unexplained sudden deaths in the anthrax belt. Contact a veterinarian or your Rural Lands Protection Board.

Clostridial diseases such as tetanus, pulpy kidney (enterotoxaemia), blackleg and malignant oedema can occasionally cause major losses. Botulism is seen occasionally in cattle, especially those chewing bones because of low phosphorus levels in feed. Pulpy kidney usually occurs when pastures contain lush green growth high in medics or clovers, or when sheep change rapidly from dry low-quality feed to high quality green pasture or grain. Blackleg occurs particularly in young cattle on quality pastures containing good medic, clover or lucerne. As cattle dying from blackleg have very swollen abdomens after death, this condition is easily confused with pasture bloat. Livestock can be protected from clostridial diseases by vaccination. For full protection, livestock need to receive two doses four to six weeks apart, either as lambs (starting at marking) or as older sheep. It is particularly important to vaccinate valuable animals at higher risk, such as rams and cattle.

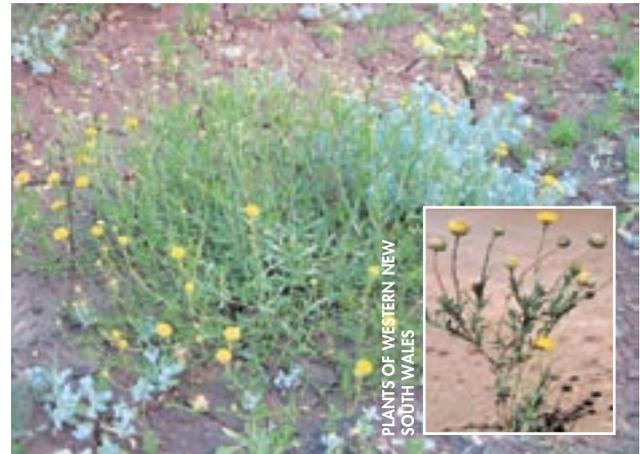
An annual booster is required to maintain an adequate protection. This booster is best given to ewes and cows some weeks before giving birth, as this will give the offspring protection for eight to 12 weeks after birth.

Cheesy gland (shearers' boils) is transmitted in pus from abscesses caused by a bacterium. The abscesses can form throughout the body in lymph nodes, and may break out into surrounding organs. This can cause downgrading of carcass value at abattoirs. Some flocks or areas known to have high levels of cheesy gland in sheep meat may suffer permanent downgrades in prices offered. Cheesy gland is prevented by vaccination. Cheesy gland vaccine is normally combined within clostridial vaccines.

Plant poisoning. The major plant poisonings seen in recent years are:

- flat billy button poisoning of young sheep and sometimes cattle on the central Darling floodplains. Signs are gait changes, especially in the hindlimb, staggering, and later collapse.

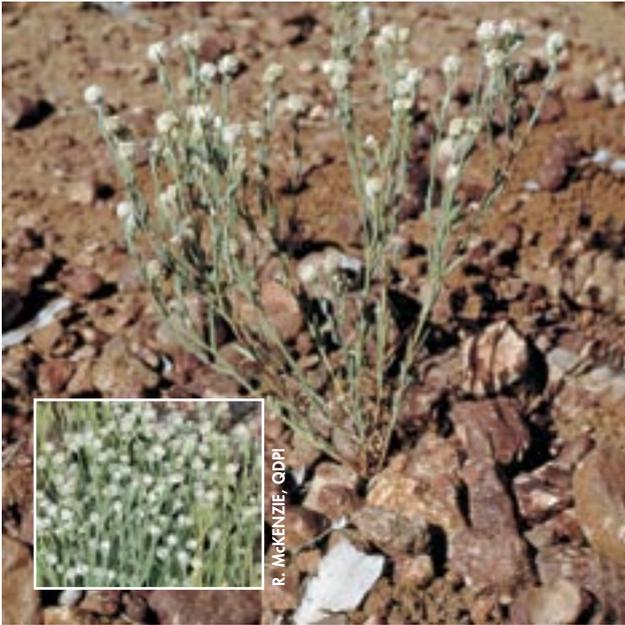
Flat billy button or plains plover-daisy (*Ixiolaena brevicompta*)



G. BROOKE

- pimelea (desert riceflower) poisoning of cattle in north-western NSW. Signs are a soft swelling under the jaw ('bighead') and later the brisket, and/or diarrhoea with weight loss and roughened greasy coat, with occasional sudden death.
- floodplain staggers in cattle, sheep and goats grazing infected blown-grass on the Bogan and northern Darling floodplains. Signs are gait changes, especially in the hindlimb, and later staggers, with episodic nervous convulsions.
- rock/mulga fern poisoning of cattle on the Cobar pediplain and in the mulga lands of

Desert rice-flower (*Pimelea simplex*)



north-western NSW. Signs are sudden death, or, later in the outbreak, sick cattle standing with heads lowered and outstretched, sometimes with blood in the dung, about six to 10 weeks after good rains in a drought.

- oxalate poisoning of sheep grazing soft, lush feed growing immediately after good rains, usually in cooler months.
- nitrate/nitrite poisoning of sheep or cattle grazing soft, lush feed growing immediately after good rains, usually in cooler months.

These poisonings are usually managed by having the illness diagnosed correctly, then removing stock to paddocks with little or none of the poison plant, or by handfeeding hay. Rock/mulga fern cases later in an outbreak may respond to antibiotics, but mortality rates are high.

Blown grass (*Agrostis avenacea*)



Pregnancy toxaemia (lambing sickness) is a nutritional disease seen in the weeks before lambing. It is triggered by stress from poor nutrition during the pregnancy, or by a sudden drop in feed intake due, for example, to yarding or trucking. Twin-bearing ewes are particularly susceptible. In the weeks before lambing, ewes should be handled as little as possible. Animals displaying symptoms of the disease may:

- appear semi-conscious and blind
- lean against fences, or stand with the head near the ground
- lie down, unable to rise.

Sheep can be treated with injectable glucose and electrolyte solutions. However, treatments are often unsuccessful.

Non-domestic grazing

The major non-domestic herbivores that require active management are kangaroos, feral goats and rabbits. All of these species need to be managed, in addition to domestic livestock, if sustainable production is to be achieved.

Mulga fern (*Cheilanthes sieberi* subsp. *sieberi*)



Kangaroos. Kangaroo populations in the sheep-grazed rangelands are generally considered to have increased following European settlement, because of the widespread establishment of livestock watering points and elimination of the major predator, the dingo.

In NSW, kangaroos are managed under a Commonwealth-approved kangaroo management plan, which sets annual quotas for the four commercially harvested species: the red

kangaroo, eastern and western grey kangaroos, and the euro. The goal of the NSW Kangaroo Management Program 2002–2006 is to ‘*maintain viable populations of kangaroos throughout their ranges in accordance with the principles of ecologically sustainable development*’.

On the western plains, the combined density of the commercially harvested species, on a regional basis, generally ranges from about 10 to 20/km², unless reduced by severe drought as occurred in 2002. Local densities can at times be considerably higher – in excess of 60/km². Historically, the kangaroo population has ranged from 45 to 60 per cent of the livestock population (all species expressed on a dry sheep equivalent basis and assuming one kangaroo = 0.75 DSE) for those parts of the Western Division where the available data can be compared. The kangaroo proportion of the total animal population (livestock plus kangaroos) has thus ranged from approximately 28 to 40 per cent.

Kangaroos have both direct and indirect effects on pastoral production. Direct effects arise from competition for forage under conditions of limited forage availability. Some evidence suggests that sheep and kangaroos are unlikely to compete for forage when the level of standing biomass exceeds about 300 kg/ha. While any direct effect on pastoral productivity will therefore be limited to specific conditions, modelling studies have shown that in mulga woodlands annual kangaroo harvesting for maximum yield may substantially increase the long-term average wool production per head, compared with a ‘no harvest’ situation. In other vegetation types, however, the benefit may be less. In chenopod shrublands, for example, sheep commonly consume shrubs that are not heavily grazed by kangaroos, and the opportunity for competitive interaction may be reduced as a result.

Indirect effects on pastoral productivity arise through the limitations that kangaroos impose on grazing management owing to their tendency to graze in destocked paddocks. In the long run this impact may be larger than the direct effect, since the potential to increase total production by increasing the carrying capacity of pastures is much greater than the potential to increase production per head. Temporary destocking of paddocks is a fundamental requirement of tactical grazing, and during these periods it is essential that kangaroo grazing be monitored and numbers controlled if necessary. Commercial

kangaroo harvesters may be able to help here. Nevertheless, stock waters should be shut off whenever paddocks are destocked to discourage ingress of kangaroos. If this is not possible, short-term closure of waters under hot conditions by using ‘Finlayson troughs’² or similar arrangements can concentrate kangaroos in the vicinity of the water for easier culling. Graziers are able to obtain permits from the National Parks and Wildlife Service (now part of the Department of Environment and Conservation) to cull kangaroos in these circumstances, but the carcasses cannot be sold. Further information on kangaroo biology and management can be found in *Living with Kangaroos: a guide to kangaroos and their management in the Murray–Darling Basin* (NSW Agriculture, 2003).

Feral goats. The diets of feral goats and domestic livestock overlap, the extent varying between habitats. Feral goats eat shrubs, grasses and herbs, the proportions of each type and the species eaten depending on availability, quality and palatability. Although goats are often regarded as non-selective browsers, they are actually highly selective if choice is available, and they commonly eat ground-storey species in preference to, or in combination with, browse species.

Dietary overlap causes competition for food, although the extent of this competition is unclear. The survival of feral goats when food is limited may indicate that competition is severe, although their ability to browse on shrubs and to survive on poor quality food may also contribute to their persistence. Feral goats also compete with livestock for water, particularly when this is limited during drought.

Estimates based on average goat densities for much of the rangelands indicate that feral goats consume between 10 and 25 per cent of the food eaten by large herbivores.

Feral goats may cause long-term changes to the perennial vegetation. They eat established plants and prevent regeneration through eating seedlings and preventing established plants from seeding. The overall effect of feral goats on perennial shrubland is not clear. However, it is likely that even low densities will prevent the regeneration of the most palatable shrub species. The impact of feral goats on grasses and herbs

² Finlayson troughs consist of electrified wires surrounding troughs intended to prevent access by kangaroos.

is also important in some habitats, although the impact on shrubs is usually more significant. For some shrubs, domesticated ferals can be used as an effective means of control. Hopbushes and punty, in particular, can be destroyed by heavy, continuous goat grazing, especially under drought conditions. However, such grazing will also severely damage the desirable forage species, and extended resting after the shrubs have been destroyed will be necessary to restore a productive pasture. Goats, even at high densities, rarely graze other 'woody weeds' such as turpentine and budda.

In the rangelands the most useful methods of feral goat control are mustering or trapping at watering points, so that the cost of control can be offset by the sale of captured goats. Where there are too few goats or the terrain makes mustering and trapping impractical, shooting from the air or ground can be an effective control technique. Sale of feral goats can make a very worthwhile contribution to the cost of establishing self-mustering facilities for livestock at artificial watering points. Once established, these facilities will reduce the cost of livestock mustering while allowing trapping of feral goats to continue as required.

Rabbits. The diets of rabbits and domestic livestock overlap. Rabbits consume a range of grasses, herbs and browse species. In the rangelands a significant proportion of available pasture is consumed by rabbits, which usually select the most nutritious components available. At high densities rabbits can consume over 60 per cent of available pasture.

Studies have shown that competition for food tends to be low until pasture biomass is less than 250 kg/ha. Competition is particularly severe during and coming out of drought. The definitive impact of this competition on production is difficult to determine, but a range of anecdotal evidence indicates that pastures have an increased carrying capacity for sheep following rabbit control.

Intense rabbit grazing removes perennial grasses and shrubs, which are replaced with annual species and then, increasingly, by weeds. Noticeable changes in plant composition are obvious up to 300 m from a rabbit warren, which is usually covered in unpalatable weed species.

The impact of rabbits on the composition of rangeland vegetation is severe. Many species

have disappeared almost completely owing to the combined impact of rabbits and introduced domestic species over the years. Many species are still at risk, and some are facing extinction.

Rabbits prevent the regeneration of many species, as they are capable of destroying even shrubs and small trees. An apparently successful regeneration can be wiped out by rabbits many years later. The extent of the effect rabbits are having on the vegetation of the rangelands is also being masked by the lengthy lifespan of some plant species. If the current generation of these species dies without successful recruitment, the full impact of rabbits will become apparent.

Even low densities of rabbits may have a significant effect on many species that are particularly palatable to them. For some tree and shrub seedlings there may be no safe rabbit density.

The release of the rabbit calicivirus has resulted in a substantial reduction in rabbit populations in many parts of western NSW. However, follow-up treatments are desirable to capitalise on the initial impact of the disease. In much of the rangelands warren ripping is the most effective means of controlling rabbits. Ripping can be conducted in a range of soil types and is particularly appropriate where warrens cover a large area. Like all techniques, ripping should be followed up with other methods such as fumigation or further ripping, as rabbits have the ability to quickly recolonise even well ripped areas.

Poisoning can be used as a knockdown technique when numbers are high, but should always be followed up with harbour removal or fumigation. Fumigation is normally used as a follow-up technique, but it is also suitable for small areas where ripping or other harbour removal techniques are impractical.

EXTERNAL FORCES

MARKET FORCES

Typically, rangeland pastoralists produce for a small number of markets. In NSW these are predominantly wool, beef and sheepmeats. Goat production, initially from feral flocks but increasingly from domesticated animals, has been significant in recent years.

Wool

The market is rewarding finer-micron wool, but traditionally semi-arid rangelands have produced

strong wool. To take advantage of this trend requires attention to flock genetics and effort over time. It would be worth learning from other producers in the rangelands who have already made the change to finer wool. New bloodlines need to be tested in the rangeland environment to ensure that they perform to expectations. There are other factors, such as fleece weight, flystrike resistance and dust penetration, that need to be considered when making a change. Contact NSW Department of Primary Industries wool specialists for assistance.

Sheepmeat

Sales of excess sheep can be very important for cash flow on-farm, and it is therefore important to achieve good reproductive performance. There is currently considerable interest in new breeds of meat sheep, for example, 'fat-tails', and some of these are showing promise. However, these industries are still developing and will take time to achieve good returns. Producers need to understand the market and produce what it requires. Some producers are supplying store sheep to higher rainfall areas for growing out.

Goats

Goats have traditionally been seen as an alternative income source when normal income sources have failed. Prices have fluctuated considerably. However, good prices have been quite sustained in recent years. This, together with the depressed wool market through much of the 1990s, has prompted increased interest in farming goats. Farming involves improved fencing and management, plus the use of improved breeds such as the South African Boer goat.

Any decision to allow feral goat numbers to rise for harvesting has to be balanced against the environmental damage goats can do to rangelands by their grazing behaviour.

Beef

Many NSW pastoralists have run beef cattle as a secondary enterprise to wool. However, as wool returns declined in the 1990s, beef increased in importance. Cattle require quantities of taller feed, and are unsuited to the short, sparse cover that sheep utilise effectively. Knowing the specifications for the market you are targeting is crucial to maximising returns. Store cattle production is an option for areas where finishing cattle to market specifications will be more difficult.

For all industries (with the current exception of goat meat), processors and manufacturers are now placing more emphasis on purchasing product that meets their precise specifications. If products fall out of specification they are discounted accordingly. This process also allows information to flow back to the producer (from the customer) on how well his/her product has performed. The producer can then (if required) modify or fine-tune the production system to meet the customer's requirements more closely.

Emphasis is currently placed not only on producing a quality product, but also on producing it consistently. This is to ensure the consumer doesn't turn to competing products to fill gaps in supply or quality. One of the ways in which industry is ensuring consistency is through the increased use of forward contracts and the formation of alliances. Members work together to fill forward contracts and in return are assured of a buyer for their product at an agreed price (as long as the product meets specifications).

GOVERNMENT LEGISLATION³

There is a wide range of government legislation and policy that land managers need to take into consideration when making management decisions and conducting activities. This section provides a brief summary of some of the major Acts. It does not attempt to cover all relevant legislation. Several books are available that provide a comprehensive summary of legislation relevant to rural land managers. Individuals should contact the relevant authority if they are uncertain whether an Act applies to them, or if they need further information.

The ***Western Lands Act 1901***, as amended, is the primary act under which leasehold land in the Western Division is administered. It was formerly the major act that controlled natural resource management on pastoral leases, but much of this control has now been brought under the *Native Vegetation Act 2003* (see below). However, for lessees in higher rainfall areas who wish to diversify into cropping, a cultivation permit is still required under the Western Lands Act. Amendments to the Act introduced in 2002 made provision for

³ Disclaimer: Material in this section was not compiled by a legal officer. It is written as a guide only and has been couched in layman's terms. Any person involved in a situation associated with any of the Acts listed should seek further advice and/or read the Act.

- establishment of a legal road network in the Western Division;
- a more equitable basis for determining lease rentals;
- conversion of agricultural and similar leases to freehold;
- improved flexibility in some aspects of lease transactions (e.g. agistment); and
- establishment of a broadly-based Western Division Advisory Council to advise the Minister on all aspects of the use and management of land in the Division.

The ***Native Vegetation Act 2003*** (NVA) will soon replace the ***Native Vegetation Conservation Act 1997*** as the major instrument governing the management of native vegetation in NSW. Although the NVA has been passed by the NSW Parliament, regulations that will guide its operation are still being finalised. The NVA divides native vegetation into three classes

- Regrowth — any vegetation that has grown since 1990, or 1983 in the Western Division.
- Remnant Vegetation — all vegetation in existence before these dates and
- Protected Regrowth — vegetation that is younger than the prescribed dates but which is protected in order to achieve the objectives of the Act.

Clearing of regrowth will not be subject to regulatory control under the NVA but 'broad-scale clearing' — defined as the clearing of Remnant Vegetation or of Protected Regrowth for a new land use — will require either the approval of a Property Vegetation Plan (PVP) by the local Catchment Management Authority or alternative development approval. In either case consent will only be given if the clearing maintains or improves environmental outcomes. Once approved, a PVP will allow clearing to occur for up to 15 years, although the plans may be reviewed after 10 years. The Act also makes provision for financial incentives to assist landholders conserve native vegetation where a PVP conforms to the objective of the catchment action plan.

Landholders who are uncertain about how the NVA applies to their enterprises should seek advice from their local office of the Department of Infrastructure, Planning and Natural Resources.

- The ***Environmental Planning and Assessment Act 1979*** provides a system for forward planning for development through long-term plans such as Local Environmental Plans, Regional Environmental Plans and State Environmental Planning Policies. It also deals with development control for individual projects. Landholders wishing to significantly change the nature of their agricultural enterprises, and in particular to establish intensive agricultural operations, need to consult with their local council as to whether this is a permissible development and whether they are required to make a formal application to the council for consent.
- The ***Protection of the Environment Operations Act 1997*** makes it an offence to produce noise, odour or water pollution unless you are licensed to do so. The Environment Protection Authority (now part of the Department of Environment and Conservation) issues licences for scheduled developments, whereas councils administer other activities, both existing and new, that have the potential to emit pollution.
- The ***Rural Lands Protection Act 1998*** requires land occupiers to eradicate any pest animals or insects on their land by any lawful method. Pest animals include rabbits, wild dogs and feral pigs, and pest insects include spur-throated, migratory and Australian plague locusts.
- The ***Game and Feral Animal Control Act 2002*** defines a game animal (under Section 5.2) as any pig, dog (other than dingo), cat, goat, rabbit, hare or fox that is living in the wild. Other animals, less common in the rangelands, are listed in Section 5.1. The Act also defines the circumstances in which a game hunting licence is not needed. These include the hunting of the animals listed above in accordance with a duty imposed by the Rural Lands Protection Act or the Wild Dog Destruction Act, and hunting on land owned or occupied by the individual, a member of his/her household, or a corporation by whom the individual is employed. Control or culling of feral animals must be done humanely. The ***Prevention of Cruelty to Animals Act 1979*** sets penalties for cruelty to animals.
- The ***Noxious Weeds Act 1993*** requires all occupiers of land in NSW to control declared

noxious weeds on land that they occupy. This responsibility extends to adjoining unfenced roads and to any adjoining watercourse, river or inland water. The Act is enforced by the local government council for the area (local control authority). In the Unincorporated Area, the responsibility for enforcing the Act rests with the Western Lands Commissioner.

‘Noxious weeds’ are weeds that have been declared noxious by the Minister for Primary Industries in the Government Gazette. Each declaration will specify the area, usually a local government council district, to which the declaration applies. Each noxious weed is assigned to one of four categories, namely:

- W1: the presence of the weed on land must be notified to the local control authority and the weed must be fully and continuously suppressed and destroyed.
- W2: the weed must be fully and continuously suppressed and destroyed.
- W3: the weed must be prevented from spreading and its numbers and distribution reduced.
- W4: the action required for the weed is specified in the declaration.

Further information as to what weeds are declared noxious and the implementation of the Act can be obtained from the local council or, in the case of the Unincorporated Area, from the Department of Infrastructure, Planning and Natural Resources. In addition, advice can be obtained from offices of NSW Department of Primary Industries.

- The ***Pesticides Act 1999*** introduced new regulations for the use of pesticides from 1 July 2000. The broad term ‘pesticide’ includes herbicides, insecticides, fungicides, baits, external parasite treatments and repellents. Farmers, and anyone involved in using or deciding to use a pesticide, are affected by the Act to varying degrees. Under the Act:
 - Compulsory training and record keeping requirements will apply to farmers and others who use pesticides as part of their business.
 - Everyone involved in deciding how to use a pesticide may also share the liability for any misuse.

- Harm to non-target plants and animals can be an offence.
- Maximum penalties for most offences have increased to \$60,000 for individuals and \$120,000 for corporations. Fines for offences committed wilfully or negligently are \$120,000 and \$250,000, respectively.
- There are penalty notices (like on-the-spot fines), rather than prosecution, for minor offences.
- Lower application rates are permitted unless it is specifically disallowed.

Observing the label and taking sensible precautions are essential under the new Act. Safe use of chemicals requires that you:

- select the right pesticide for the job
- read and follow the directions on the pesticide label or National Registration Authority permit
- check for people, crops, livestock and sensitive areas downwind of the application and ensure they will not be exposed
- spray only in appropriate weather conditions
- watch for and respond to changes in conditions while spraying
- use, maintain and properly operate the correct equipment and
- train all employees to use pesticides correctly.

Since pesticides are Hazardous Substances under the Occupational Health and Safety Act, it is important that graziers are aware of these obligations also (see below).

- The ***Water Management Act 2000*** provides for the protection, conservation and ecologically sustainable development of water. It applies to all waters in NSW and provides for licences to be separated into an access licence, and approvals for the work and water use. Most irrigation licences will be for 15 years. The Act also establishes a right for domestic and stock use as well as a harvestable right that allows for 10% of the average regional runoff to be captured. Starting in July 2003, holders of licences under the *Water Act 1912* will be issued with new licences under the *Water Management Act 2000*. Licences are administered by the

Department of Infrastructure, Planning and Natural Resources.

- The ***Threatened Species Conservation Act 1995*** makes it an offence to pick or harm any threatened species (including endangered and vulnerable species), endangered populations or ecological communities unless a licence has been obtained from the National Parks and Wildlife Service (now part of the Department of Environment and Conservation).
- The ***Stock Diseases Act 1923*** principally concerns owners and persons in charge of stock, and persons engaged in the movement and selling of stock. It provides for the making of Proclamations regulating the entry of stock into NSW on account of certain diseases, including cattle tick from Queensland and northern Australia. It also provides the legislative authority for programs to control or eradicate cattle tick from NSW. Other programs under this Act have resulted in the eradication of tuberculosis and brucellosis from cattle in the State. A current program aims to eradicate footrot from sheep and goats in NSW. Management programs for ovine Johne's disease (OJD) and bovine Johne's disease (BJD) are also conducted under this act and involve the establishment of defined areas that regulate or help manage movement of livestock that are or could be diseased. The Western Division OJD Exclusion Areas, Footrot Protected Area, and BJD Protected Zone are established under this act. In 2004 flockowners voted to establish the 10 Western Division Rural Lands Protection Boards as OJD Exclusion Areas. The risk of OJD being present in any of these Boards is nil or very low. Flockowners and their Rural Lands Protection Boards work to keep OJD out of Exclusion Areas by using Animal Health Statements to assess the risk of OJD in sheep entering an Exclusion Area, and by controlling and eradicating the disease when it is detected. For further details, contact your Rural Lands Protection Board or go to <http://www.agric.nsw.gov.au/reader/ojd>
- The ***Stock (Chemical Residues) Act 1975*** makes provisions:
 - to prevent the slaughter for human consumption of stock that contain certain concentrations of chemical residues or that are otherwise chemically affected

- to prevent stock from becoming chemically affected and
- for related purposes.

- The ***Exotic Diseases of Animals Act 1991*** provides for the detection, containment and eradication of foot and mouth disease, rabies, and any other declared exotic animal disease. These diseases are not endemic to Australia. If introduced they would result in serious and widespread damage to animal populations, and major economic loss. The Act requires persons in charge of, or in possession of, an animal, and veterinary surgeons consulted in relation to an animal or animal product, and who suspect infection of the animal by an exotic disease, to notify their suspicion to the Chief Veterinary Officer of the Department of Primary Industries by the quickest means of communication. Persons are also required to keep such animals and animal products separate from animals and products that are not so affected. It is an offence under the Act for a person to be in possession of an exotic disease agent or to cause or permit, or threaten to cause or permit, its administration directly or indirectly to an animal.

OCCUPATIONAL HEALTH AND SAFETY

Safety must be a consideration in every task undertaken. Statistics show that agricultural and pastoral industries are among the most dangerous in NSW. Not only are individuals surrounded by hazards, but many today work and even live alone, far from their families and medical help, as a result of economic circumstances.

Although individuals operating extensive grazing enterprises generally have only limited exposure to agricultural and veterinary chemicals, care is still required. Pesticides can have long-term effects, some of which can be fatal. Unfortunately, the long-term nature of these effects often leads to complacency, but precautions, including the following, should be observed:

- Read and comply with the material safety data sheets that should be supplied with chemical purchases.
- Keep chemicals and pesticides secured and away from children and unskilled persons.
- Do not overstock – keep the minimum quantities on site.

Physical effort, particularly when you are not used to the specific job, can result in body strain, particularly back injury. Dehydration will increase the risk. Individuals working in the pastoral industry should:

- maintain body fluids by drinking water often, and in small amounts
- wear comfortable clothing that suits the climate and the job at hand
- use sun protection, such as a broad-brimmed hat and sun screen.

Working long hours increases the injury risk.

Risk can be reduced by:

- taking regular breaks
- maintaining energy levels by regularly eating and drinking (water, tea).
- planning the workday to do the more difficult tasks first and the easier, less risky jobs last.

Some general precautions should always be observed:

- Ensure that someone knows where you are at all times.
- Use mechanical aids, rather than physical effort.
- Remind yourself of your own value to the farm and family.
- Make sure you take adequate breaks.
- Drink plenty of water – always have some with you.
- Make sure you are warmed up before doing heavy physical work.

The law says that every property must be a safe workplace. This applies not only to your employees, but also to contractors engaged on your property.

Under the *Occupational Health and Safety Act 2000*, all employers are required to ensure the health, safety and welfare of employees or any person at the employer's place of work. To achieve this, the employer must develop and implement safe systems of work, which include consultation with employees, training, supervision, instruction, information, and the risk management process.

The *Occupational Health and Safety Regulation 2001*, made under the Act, requires all employers, in consultation with their employees, to identify any foreseeable hazards that may

arise and that have the potential to harm the health and safety of employees or any person at the employer's place of work. The employer must ensure that hazards and risks are identified and that effective procedures are in place and implemented to assess and control those hazards and risks. Employers should be familiar with the OH&S Regulation, as well as Australian Standards, Industry Codes of Practice, and Industry Guides associated with their industry or workplace.

EXAMPLE: RISK ASSESSMENT FOR AGRICULTURAL CHEMICALS

- Is there a register of hazardous substances used on the farm?
- Are material safety data sheets available on the farm for those using hazardous substances?
- Are the users of agricultural chemicals trained in the safe use of those chemicals?
- Are appropriate respirators, gloves, safety glasses and clothing provided when using chemicals?
- Is safety equipment regularly inspected and maintained as recommended by the manufacturer?
- Are chemicals stored in a secure location?
- Are procedures in place to handle chemical spills?
- Are all flammable liquids (Class 3) stored away from ignition sources?
- Are fire extinguishers located near chemical/fuel storage areas?
- Are chemical containers labelled correctly (for example, not in soft drink bottles)?

ANIMAL WELFARE

Community concern about animal welfare is increasing. To help allay concerns, most industries now have codes of practice that describe accepted management practices. Where they are developed, these codes have legal standing in that failure to comply may constitute a breach of the *Prevention of Cruelty to Animals Act*.

Research has demonstrated that reducing stress improves animal performance in terms of growth rate, and also improves meat quality. With the introduction of the Meat Standards Australia

grading system, animals will need to be well treated in terms of management and handling at every step of the production chain, if they are to meet the better grades. Most producers are trying to do this and are concerned for the welfare of their animals.

Australia's unreliable climate, particularly in the rangelands, places added responsibility on producers to ensure that their stock are adequately fed and watered.

LAND-USE CONFLICTS

Land-use conflict arises from the co-location of land uses that adversely affect each other. In the rangelands, land use conflicts are generally minor. However, the intensification of agricultural production on the margins of the area, or through irrigation along the Barwon–Darling and Border Rivers systems, has the potential to create such conflicts in some situations. Urban development may also result in some local land-use conflict.

Sources of land-use conflict include:

- noise from extensive and intensive agriculture or urban areas
- odour from intensive animal industries
- pesticide spray drift from agricultural areas
- dust from agricultural activities
- failure to control weeds
- risk to stock from uncontrolled domestic animals, for example, dogs.

To those affected, land use conflict is a major problem, as it may adversely affect important issues such as health, visual amenity, property values, product quality (for example, by chemical contamination), lifestyle, safety and security.

A fundamental tool in avoiding conflict is to plan strategically for the location of various agricultural developments as well as non-agricultural land uses. This approach will preclude certain land uses in certain areas and has the advantage of enhancing opportunities for sustainable agricultural development.

COMMUNITY EXPECTATIONS

Although the natural ecosystems of the rangelands have been extensively modified since European settlement, they are still among the least disturbed environments used

for agricultural production. Clearing of native vegetation has been minimal except along the margins, where cropping is practiced in conjunction with extensive grazing. The wider community is now coming to appreciate the value of rangelands for nature conservation. Respondents to one national survey nominated conservation of flora and fauna more frequently than production of food and fibre as a valuable service that rangelands provide. This community interest is stimulating the expectation that extensive grazing lands will be managed in a sustainable way, especially since most of the land is owned by the State and made available for grazing under perpetual leasehold title.

While increasing community interest in land management may appear threatening to some, it also brings opportunities in the form of payments for changes to management that are in the community interest. Government subsidies for piping and capping artesian bores, for example, offer considerable advantages to graziers in terms of stock management and kangaroo or feral goat control while conserving a major natural resource and reducing the impact of total grazing pressure on native vegetation communities.

In the longer term, the community requirement for pastoral production to be closely integrated with conservation of biodiversity could see a range of other innovations incorporated into extensive grazing enterprises. These may include, for example, stewardship payments aimed at compensating graziers for income foregone in managing parts of their properties for conservation. There may also be a stronger tendency to support the maintenance and restoration of native vegetation communities rather than the introduction of exotic pasture species. Given that some native species are known to be disadvantaged by grazing, the conservation of biodiversity may also require the closure of stock-watering points in some areas where specific conservation objectives are sought.

ALTERNATIVE ENTERPRISES

Economic conditions in the wool industry in particular have stimulated much interest in alternative enterprises in recent years. These have included exotic sheep breeds, Boer goat production, aquaculture, and various forms of dryland agriculture.

There is currently some interest in organic production. Extensive grazing enterprises are well suited for conversion to organic production, since grazing involves only native, or at least unfertilised, pastures, and few chemicals are required in the normal course of animal husbandry operations. This is particularly so for beef production. However, even in extensive grazing operations the management adjustments necessary to achieve and maintain organic certification should not be underestimated. Although the market for organic products appears to be quite variable, certified organic producers can gain worthwhile premiums. Since organic certification involves a commitment to sustainable land management as well as freedom from artificial chemicals, these premiums represent an excellent market mechanism for encouraging the conservative use of rangeland resources while improving the public image of rangeland livestock industries. Certification for organic production is available through several organic certifiers that are licensed by the Australian Quarantine Inspection Service. Any producer considering organic conversion should discuss their situation in detail with a certifying organisation before finally embarking on this alternative. Standards vary somewhat between certifiers and to some extent will be specific to the individual property.

A move to any alternative enterprise, particularly one that requires development of additional skills, needs careful consideration and planning. Below are things to consider and questions to answer if you are considering moving into new industries.

- Make contact with industry bodies.
- Who are your competitors?
- Is there an established growers' group or cooperative, or potential to establish one?
- Will you need to make changes to your existing system (for example, fencing, buying rams)
- Is there the possibility of forward contracts?
- Investigate whether your land is suitable. What are the testing requirements?
- Calculate the costs of establishing a new enterprise and the likely returns.
- Look at your financing requirements.
- Is there a need to prepare a business plan?

- How does the new enterprise affect the environment?
- What are the legal requirements or permits needed?
- Does the industry fit in with your lifestyle?
- How intensive is it? What are the hours required per week?
- Do you have the skills and resources to manage the enterprise and meet market requirements consistently?
- Investigate transport issues.
- Investigate any processing issues.
- Are there any value-adding opportunities?
- Look at quality control and packaging issues
- Is there a market, how big, what are the specifications?
- What technology and equipment are needed?
- Look at industry trends.
- Make a succession plan.

If, after careful consideration, you make a decision to develop an alternative enterprise, it is wise to start off with small changes that can be monitored. Once you have gained some experience in how your decision is performing and you are confident of its success, it is then safer to make larger changes.

REFERENCES AND FURTHER READING

- Campbell M.H., Bowman A.M., Bellotti W.D., Munich D.J. and Nichol H.I. (1996). Recruitment of curly Mitchell grass (*Astrebla lappacea*) in north-western New South Wales. *Rangeland J.* 18:179–87.
- Choquenot D., McIlroy J. and Korn T. (1996) *Managing Vertebrate Pests: Feral Pigs*. Australian Government Publishing Service, Canberra.
- Coelli K.A., Atkins K.D., Casey A.E. and Semple S.J. (2000). *Merino Bloodlines: the comparisons: 1989–99*. Agnote DAI-52, 2nd edition, NSW Agriculture. 7 pp.
- Connelly P., Horrocks D., Pahl L. and Warman K. (2000). Cost-effective and multipurpose self-mustering enclosures for stock. Dept of Primary Industries, Qld. 33 pp.
- Environmental Defender's Office (1998) *Law of the Land – A Guide to Environmental Law for Farmers* (2nd edition) (Anonymous; Published by Environmental Defender's Office, Sydney).

- Freudenberger D., Wilson A. and Palmer R. (1999). The effects of perennial grasses, stocking rate and rainfall on sheep production in the semi-arid woodlands of eastern Australia. *Rangeland J.* 21(2):199–219.
- Hacker R.B., Barclay R.M., Brill B.J., Curran G.C., Norris D.A. and Woods G.R. (1995). The Western Uplands Landsafe Management Project. Final Report. Project N061, Murray–Darling Basin Natural Resources Management Strategy. 115 pp.
- Hacker R.B., McLeod S.R. and Druhan J.P. (1999). Evaluating alternative management strategies for kangaroos in the Murray-Darling Basin. In *The 1999 Strategic Investigations and Education Forum Proceedings* (ed. Phillip A. Jones), pp. 45–48, May 2000, Murray-Darling Basin Commission, Canberra ACT.
- Hacker R.B., McLeod S. and Druhan J. (2000). An exploratory analysis of the impact of commercial kangaroo harvesting on pastoral productivity in the Murray-Darling Basin. Paper presented to the Annual Conference of Queensland Nature Conservation Councils, Dalby Qld, 29 April–1 May.
- Heywood J., Hodgkinson K., Marsden S. and Pahl L. (2000). *Graziers' Experiences in Managing Mulga Country*. Information Series QI00078. Department of Primary Industries, Queensland.
- Leys, J.F. (1992). Cover levels to control soil and nutrient loss from wind erosion on sandplain country in central NSW. In *Australian Rangelands in a Changing Environment*. 7th Biennial Conference, Australian Rangeland Society, Cobar NSW, pp. 84–91.
- Ludwig J., Tongway D, Freudenberger D., Noble J. and Hodgkinson K. (eds) (1997). *Landscape Ecology, Function and Management: Principles from Australia's Rangelands*. CSIRO Australia.
- NSW Agriculture (1998). *The Glove Box Guide to Plants of the NSW Rangelands*. Compiled by G Brooke and L McGarva. NSW Agriculture, Orange.
- NSW Agriculture (1989) *Management burning of woody weeds: principles*. Agfact P7.2.3. O'Shea R.H., NSW Agriculture, Orange.
- NSW Agriculture (1989) *Management burning of woody weeds: techniques*. Agfact P7.2.4. O'Shea R.H., NSW Agriculture, Orange.
- NSW Agriculture (2000). *The Glove Box Guide to Tactical Grazing Management of the Semi-Arid Woodlands*. Compiled by T. Campbell and R. Hacker. NSW Agriculture, Orange.
- NSW Agriculture (2001). *Scoring sheep for fleece rot*. Agfact A3.3.41. Murray W. and Mortimer S., NSW Agriculture, Orange.
- NSW Agriculture (2004). *Noxious and Environmental Weed Control Handbook 2004*. R. Ensbey (ed.) NSW Agriculture, Orange.
- NSW Agriculture (2004). *Living with Kangaroos. A guide to kangaroos and their management in the Murray–Darling Basin*. Hacker R. and McLeod S. NSW Agriculture, Orange.
- Parkes J., Henzell R. and Pickles G. (1996) *Managing Vertebrate Pests: Feral Goats*. Australian Government Publishing Service, Canberra.
- Partridge I. (1992). *Managing Native Pastures: a Grazier's Guide*. Information Series QI 92009, Department of Primary Industries, Queensland.
- Partridge I.J. (ed.) (1994). *Will it Rain? The Effects of the Southern Oscillation and El Nino on Australia*. 2nd edition. Information Series QI 94015, Department of Primary Industries, Queensland.
- Partridge I. (1996). *Managing Mitchell Grass: a Graziers Guide*. Information Series QI 96009, Department of Primary Industries, Queensland.
- Partridge I. (1996). *Managing Mulga Grasslands: a Grazier's Guide*. Information Series QI 96072, Department of Primary Industries, Queensland.
- Rosewell, C.J. (1993). *Soiloss. A program to assist in the selection of management practices to reduce erosion*. Department of Conservation and Land Management, NSW.
- Saunders G., Coman B., Kinnear J. and Braysher M. (1995) *Managing Vertebrate Pests: Foxes*. Australian Government Publishing Service, Canberra.
- Short J. (1987). Factors affecting food intake of rangeland herbivores. In Caughley G., Shepherd N. and Short J. (eds). *Kangaroos: their Ecology and Management in the Sheep Rangelands of Australia*. Cambridge University Press, Melbourne. pp. 84–99.
- Simpson I. (Ed.) (1992). *Rangeland Management in Western New South Wales*. NSW Agriculture. 142 pp.
- Smith T (1998). *Bush Law Handbook*. Redfern Legal Centre Publishing, Redfern, NSW.
- Thackway R. and Cresswell I.D. (eds) (1995). *An Interim Biogeographic Regionalisation of Australia: a Framework for Establishing the National System of Reserves. Version 4.0*. Australian Nature Conservation Agency, Canberra.
- Walker P.J. (1991). *Land Systems of Western New South Wales*. Technical Report No. 25. Soil Conservation Service of NSW. Sydney. 615 pp.
- Williams K., Parer I., Coman B., Burley J. and Braysher M. (1995) *Managing Vertebrate Pests: Rabbits*. Australian Government Publishing Service, Canberra.
- Woody Weeds Task Force (1992). *Woody Weed Management Strategy*. Proceedings of National Workshop, June 17–19, Cobar.
- Woody Weeds Task Force (1993). *Managing for Woody Weed Control in Western NSW* (ed. R Harland). ISBN 0 7305 6708 7.



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