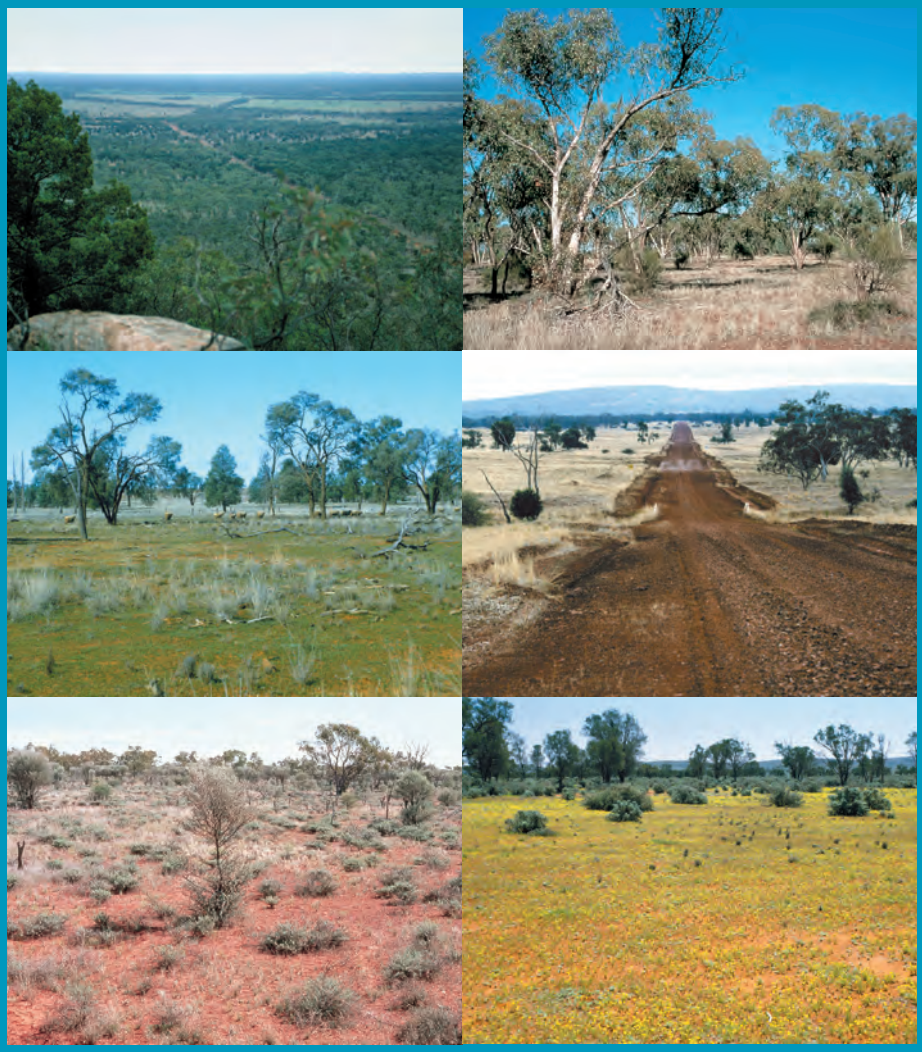
The Glove Box Guide to

TACTICAL GRAZING MANAGEMENT

for the semi-arid woodlands



Compiled by

'Tac' Campbell & Ron Hacker

The information contained in this publication is based on knowledge and understanding at the time of writing (June 2000). However, because of advances in knowledge, users are reminded of the need to ensure that information upon which they rely is up-to-date and to check currency of the information with the appropriate officer of New South Wales Department of Agriculture or the user's independent adviser.

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CONTENTS

INTRODUCTION

TACTICAL MANAGEMENT

This book has been prepared for graziers in the semi-arid woodlands who wish to practise tactical grazing management on their properties. It is a companion volume to The Glove Box Guide to Plants of the NSW Rangelands which provides graziers with an easy-to-use field guide to the most important pasture plants in the arid and semi-arid rangelands. Recognising the important species is the first step towards sustainable natural resource management by grazing enterprises. Managing the grazing of key species to ensure their survival and regeneration is the challenge facing all pastoral managers. This book contains a number of simple field techniques which will assist managers to better assess their pastures and animals, and make grazing management decisions which are aimed at maintaining or improving the long-term productivity of their pastures.

The approach to grazing management 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 will generally be for the pasture type which has the potential to contribute most to the pastoral productivity of the paddock. 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 unlikely 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. 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 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 which need to be applied to achieve the result required. Variable climatic conditions present graziers with both opportunities to progress towards the objective (e.g. good seasons which favour germination or seed set of desirable species) and hazards which may push the pasture away from the objective (e.g. drought which may kill desirable species, or intense rainfall which may cause excessive run-off and erosion). Strategies need to include the management principles which will allow managers to both exploit opportunities and avoid hazards.

No set formula exists for determining the strategy appropriate to any particular objective. But some of the factors which need to be considered include the:

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

- effect of heavy grazing on the competitive balance among plant species
- benefits of periodic resting to maintain vigour or allow recovery.

3. Implementing the strategy on a day-to-day basis as seasonal opportunities allow or dictate

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 (e.g. by adjusting stocking rate, or implementing appropriate action to control woody weeds). This continuous response, guided by a well thought out strategy, is the essence of tactical management. In order 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.

* * *

The process outlined above represents the 'ideal' of grazing management. In practice the ideal management required for a particular paddock may not be possible at all times. All management decisions on pastoral properties have consequences for the economic returns achieved by the business, the impact of grazing on land resources, and the seasonal and market risk to which the business is exposed. Balancing these competing factors may sometimes mean that the ideal management requirements for all paddocks cannot be met simultaneously. However, working through the 'tactical grazing' process will allow compromises to be made, when necessary, from an informed position in which the desirable grazing management for land resources is known.

By its very nature, tactical grazing can never be a recipe but the techniques described in this guide will assist graziers in implementing all four of the essential components.

Layout and use of the guide

The guide is divided into three parts.

Part 1 contains a range of techniques for landscape, pasture, grazing pressure, soil and animal assessment. These techniques can be used for a range of purposes which may, depending on the situation, be related to objective setting or tactical decision making.

Section A contains techniques for assessing the way in which the landscape is functioning in terms of its ability to provide the essentials for plant growth – water and nutrients. Understanding the state of the landscape, in these terms, is essential to setting realistic management objectives.

Section B contains a range of pasture and vegetation assessment techniques. These will be useful in determining management objectives, and in monitoring the impact of grazing on the pasture or the amount of pasture available, in order to make tactical grazing decisions.

Section C contains a method for estimating the components of total grazing pressure so that attempts to manage all of the herbivores grazing the pasture can be directed to the most important source of pressure.

Section D contains methods for assessing soil cover which can be used to assist in tactical decision making or to assess progress towards management objectives

Section E contains methods of assessing animal condition so that effects of pasture availability on animal productivity can be determined at the earliest opportunity.

The techniques described in Part 1 may be used individually or as part of a more formal monitoring system.

Part 2 outlines a procedure for establishing a comprehensive monitoring system for implementing tactical management on a whole property basis.

Part 3 moves beyond the observation of vegetation and soil characteristics to consider the major issue of stocking rate. Stocking rate is the most important variable in any pastoral management system and decisions regarding stocking rate have major effects on the viability and sustainability of pastoral enterprises. The technique outlined in Part 3 allows short-term variations in stocking rate to be calculated in a way which is consistent with the principles of tactical grazing management.

PART 1. – ASSESSMENT TECHNIQUES

SECTION A – LANDSCAPE FUNCTION ANALYSIS

In semi-arid landscapes the resources required for plant growth, particularly water and nutrients, are not distributed uniformly (see Lugwig et.al. 1997). They are patchy, with some areas providing good conditions for plant growth and others less suitable conditions. This concentration of resources into patches allows greater productivity than if they were uniformly distributed. The patchiness arises from run-off of rainfall from some parts of the landscape and its accumulation in other parts, along with litter and soil particles. Accumulation of wind-blown material around obstacles on the soil surface also contributes. The scale of this patchiness varies greatly. In some landscapes e.g. in mulga country on hard red soils, it is very obvious. Here vegetation is arranged in bands or groves separated by run-off areas where little growth occurs. On deep sandy soils e.g. woollybutt grasslands, it is much less obvious but even here run-off from patches with sealed surfaces onto adjacent areas with a sandy surface results in redistribution of resources.

In healthy and productive landscapes this patchiness operates to produce beneficial concentrations of resources but prevents the loss of resources from the local area. Run-off is trapped after only short distances and most wind blown material is not transported outside the local system. When pastures are overgrazed, patches begin to break down as loss of cover and litter reduce their effectiveness in trapping water and nutrients. Some resources are lost from the local area and eventually the functioning of the entire landscape may be disrupted.

Understanding how well your landscape is functioning is important in assessing whether it is achieving its productive potential by retaining the scarce resources essential for plant growth and distributing them in a way which will allow them to be used most efficiently.

Analysing how the landscape is functioning can help set management objectives for paddocks, and subsequent assessments can help demonstrate the response to management.

1. Landscape Organisation

Understanding how the landscape is organised is the first step in determining how well it is functioning in conserving resources for plant growth. Landscape organisation refers to the arrangement of features that control the overland flow of water and provide surface roughness for trapping wind-blown material e.g. vegetation (plants, shrubs, trees) and other obstacles (logs, rocks). The flow obstructions are called 'patches' and the region between successive patches is called an 'interpatch'. Patches tend to accumulate resources and so they can also be described as 'sinks', while interpatches are the 'sources' which provide them.

It is useful to apply this technique to several sites in each paddock but, for an initial assessment, select a site typical of the most important landscape type within a paddock which is

- at least 500 metres away from water
- at least 50 metres away from tracks and fences.

Carrying out the assessment when seasonal conditions are poor will be quickest, and probably most informative in providing a measure of the landscape's capacity to respond to rain.

Copy and use the Landscape Organisation Recording Sheet at the end of this section.

Copy and use the Landscape Organisation Summary Sheet at the end of this section.

- From the starting point (at the downslope edge of an obstruction) walk down the line of maximum slope counting the steps until the first obstruction is reached. On the recording form note
  - the step number where it occurs,
  - whether it is a perennial plant (usually a grass), log, shrub, or tree. Ignore annual plants.
  - its estimated size at ground level (length along the transect x width perpendicular to the transect). An obstruction may be a single feature (e.g. a grass tussock) or may consist of many plants (i.e. a grass patch) or multiple features (e.g. log + grass + shrub). One obstruction may extend over several steps but width is only recorded once.

Record each step as 'bare' if no obstacle is present.

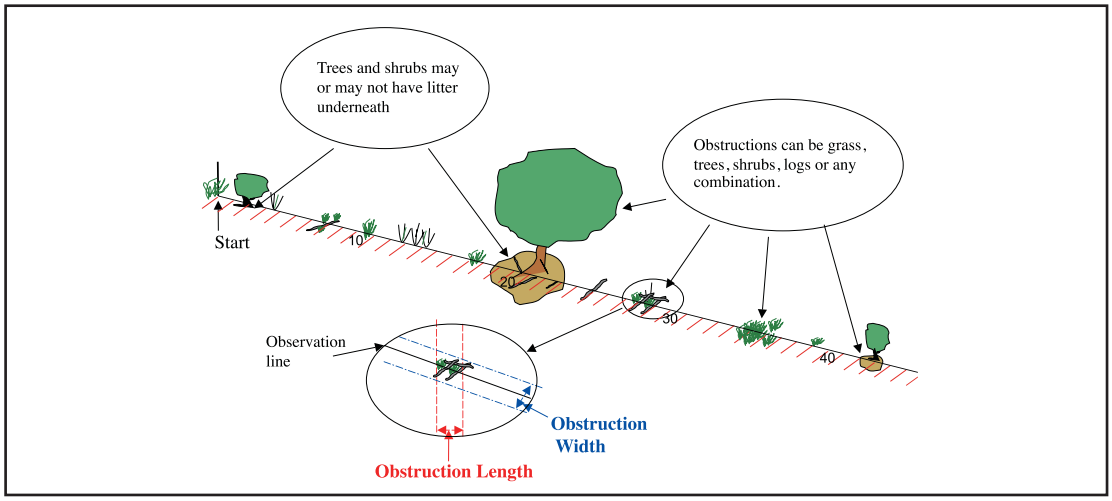
- Continue down the transect for a total of 50 paces, recording each obstruction.
- Summarise the landscape organisation by determining
  - the number of obstructions,
  - the distance between obstructions (or 'fetch') and
  - the size of obstructions (both down and across slope).

Examples of a walked line and a completed recording and summary sheet are given below and on the following pages.

Interpretation of this information is best done in a comparative sense. For similar types of landscapes, paddocks with more flow obstructions are more likely to be functioning effectively. Those with fewer obstructions are more likely to benefit from management aimed at restoring or improving landscape function.

For comparative purposes try to repeat these measurements in landscapes which have been both lightly and heavily grazed or are considered to be in good or poor condition e.g. at sites more remote from, or closer to, water.

Note that for on-going monitoring purposes sites on the edge of the 'sacrifice zone' around water are more likely to be sensitive to management than more 'representative' sites some distance away.



Example of a walked line in the direction of maximum slope. The data recorded are shown in the worked Landscape Organisation Recording Sheet, and summarised in the worked Landscape Organisation Summary Sheet.

LANDSCAPE ORGANISATION RECORDING SHEET

EXAMPLE

Step No.	Bare	Perennial Plant (PP)	Log (LG)	Tree/shrub mound (TS)	Length (L)	Width (W)
1	4					
2				4 *	30	50
3				4	20	
4		4			15	10
5	4					
6	4					
7			4+ grass		20	200
8	4					
9	4					
10		4			50	40
11	4					
12		4			5	5
13		4			5	5
14		4			5	5
15	4					
16	4					
17		4 patch			70	60
18				4	10	
19				4	80	
20				4 *	80	270
21				4	80	
22				4	80	
23				4	30	
24	4					
25			4		15	200
26	4					
27			4 + grass *		10	200
28			4 + grass		80	
29	4					
30	4					
31	4					
32	4					
33	4					
34		4 *			10	180
35		4			80	
36	4					
37	4					
38	4					
39		4			5	5
40	4					
41	4					
42				4	80	90
43				4 *	20	
44	4					
45	4					
46	4					
47	4					
48				4	30	30
49	4					
50	4					
Total		8	3	4	910	1350

* Count as 1 patch, therefore has only one width.

LANDSCAPE ORGANISATION SUMMARY SHEET

EXAMPLE

Estimated step length (SL)	0.8 m
Transect length (TL) = SL x 50	0.8 x 50 = 40 m
Obstruction length (OL) = Sum L	9.1 m
Fetch length (FL) = TL – OL	40–9.1 = 30.9 m
Total obstruction width (TOW) = Sum W	13.5 m
No. of obstructions (NO) = Sum PP + LG + TS	15
Mean obstruction length = OL/NO	9.1 / 15 = 0.61 m
Mean fetch length = FL/NO	30.9 / 15 = 2.06 m
Mean obstruction width = TOW/NO	13.5 / 15 = 0.90 m

2. Soil Surface Features

The following observations can be used to complete the assessment of how effectively the landscape is functioning.

Copy and use the Landscape Organisation Summary Sheet at the end of this section.

For the same area used to assess landscape organisation:

1. Determine the broad soil type in the general area as either – sandy, sandy loam, heavy loam or clayey.

From this classification rate the landscape, using the values in the table below, for

Texture – related to the rate at which water is absorbed

Surface Nature – related to the likely impact of trampling in making material available for erosion

Microtopography – related to surface roughness which affects capture of water and seed.

Record these values in the corresponding cells of the Landscape Function Summary Sheet.

Soil Type	Texture Score	Surface nature score	Micro-topography score
Sandy	4	2	2
Sandy loam	3	3	2
Heavy loam	2	3	2
Clayey	1	4	2

Note: Higher values indicate a greater potential input or effect e.g.

Texture 1 = slow absorption
4 = rapid absorption

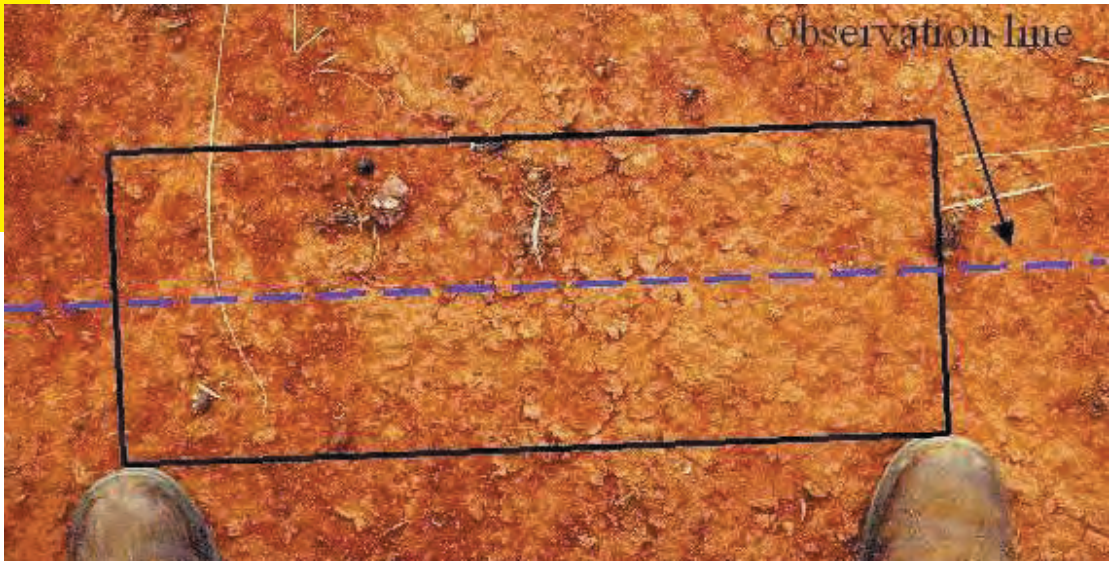
Surface nature 2 = less trampling effect
4 = more trampling effect

Microtopography – same score for all soil types unless the general surface contains depressions 8–25 mm (score 3); 25–100 mm (score 4) or deep and extensive cracks, >100 mm (score 5).

2. Assess the following soil surface features for both a typical patch (or sink) and a typical interpatch (or source).

The 'patch' will usually be a grass tussock or a clump of tussocks and the 'interpatch' will generally be an area of bare soil.

Look down with your feet comfortably apart and make your assessments on the rectangle



extending about 30 cm out from each toe. The line you walked to collect the Landscape Organisation information should run through the centre of the quadrat.

These observations should be made at several points along the line if no 'typical' location can be identified. Enter the observations in the appropriate cells of the Landscape Function Summary Sheet.

Soil cover – related to the degree of protection of the soil surface from rain splash erosion.

Use the photos 1 (a to d) (Note: Other techniques for assessing soil cover in relation to erosion hazard are given in Section D).

Soil cover. If soil cover is:

less than in photo 1a	score 1
more than 1a but less than 1b	score 2
more than 1b but less than 1c	score 3
more than 1c but less than 1d	score 4
more than in photo 1d	score 5

1a Soil cover score 2, lower limit

1b Soil cover score 3, lower limit

1c Soil cover score 4, lower limit

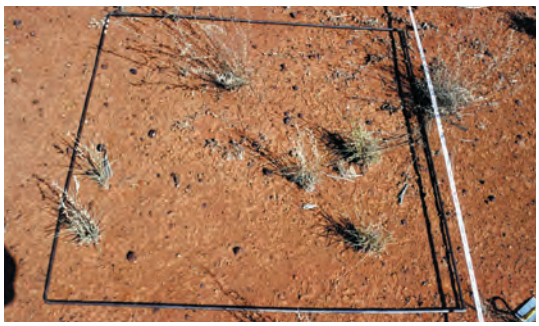
1d Soil cover score 5, lower limit

Perennial plant butt cover – related to the effect of plant roots on water infiltration and nutrient cycling. Interpatches score 1 for this factor.

Use the photos 2 (a to c).

Perennial plant butt cover. If the perennial plant butt cover is:

less than in photo 2a	score 1
more than 2a but less than 2b	score 2
more than 2b but less than 2c	score 3
more than 2c	score 4



2a Perennial Plant Butt Cover score 2, lower limit

2b Perennial Plant Butt Cover score 3, lower limit

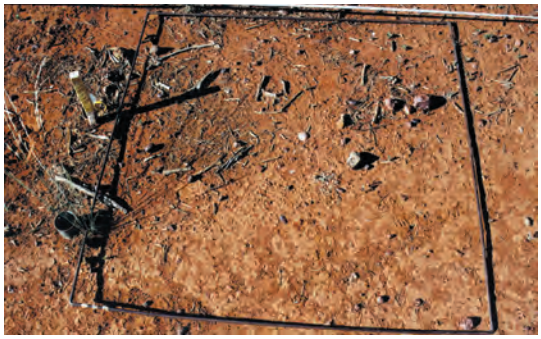
2c Perennial Plant Butt Cover score 4,lower limit

Litter cover – related to the amount of material (leaves, dry grass, twigs, fruit, dung etc.) available to be returned to the soil to maintain fertility. Litter cover is assessed in terms of its amount (C), its origin (T) and its degree of incorporation (I).

Use the photos 3 (a to d) to assess litter cover (C).

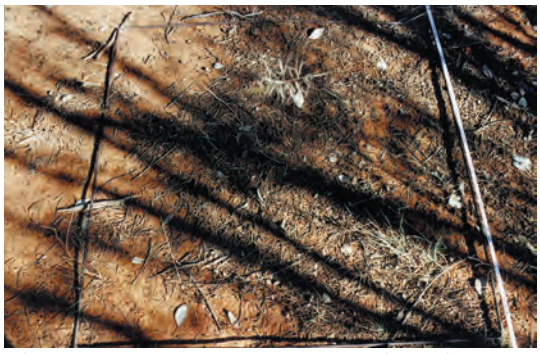
Litter Cover (C)
If the area of soil covered by litter is:

less than in photo 3a	score 1
more than 3a but less than 3b	score 2
more than 3b but less than 3c	score 3
more than 3c but less than 3d	score 4
more than in photo 3d	score 5



3a Litter Cover score 2, lower limit

3c Litter Cover score 4, lower limit



3d Litter Cover score 5, lower limit

Enter the litter cover score (C) on the Landscape Function Summary Sheet.

Use the photos 3 (e to f) to assess litter origin (local or transported) (T)

Litter Origin (local or transported) (T)
Has the litter been 'transported' by water and/or wind or is it 'local', lying where it fell?

3e – 'transported'	score 1
3f – 'local'	score 1.5

3e Transported score 1

3f Local score 1.5

Use the photos 3 (g to h) to assess the degree to which litter is being incorporated into the soil (I). If litter is lying loosely on the surface score 1.

Litter Incorporation (I)

Litter lying loosely on surface	score 1
3g – litter partly covered and 'connected' to the soil surface	score 1.5
3h – litter strongly bound to the soil surface and fungi present	score 2

3g Slight incorporation score 1.5

3h Extensive incorporation score 2

Calculate the Litter Incorporation Index (C x T x I) and enter on the Landscape Function Summary Sheet.

Lichens and mosses – related to the stability of the soil surface and probably to nutrient availability.

Use the photos 4(a to c) to assess the type and extent of cover present.

Lichens and mosses. If soil cover by lichens and mosses is:

absent, soil surface is sandy	score 0
less than in photo 4a	score 1
more than 4a but less than 4b	score 2
more than 4b but less than 4c	score 3
more than in photo 4c	score 4

4a Lichens and mosses score 2, lower limit

4b Lichens and mosses score 3, lower limit

4c Lichens and mosses score 4, lower limit

Erosion form and severity – related to how much soil is being lost, if any.

Use the photos 5(a to e) to determine the type of erosion present and its severity.

Erosion form and severity.

If the erosion is insignificant	score 4
If the erosion is less severe than the photo	score 3
If the erosion is the same as photo	score 2
If the erosion is more severe than the photo	score 1

5a Rill score 2

5b Pedestal score 2

5c Terracette score 2

5d Sheeting score 2

5e Hummocking score 2

a

a

Example of Degree of Development of One Form of Erosion (Terracettes) a – weakly developed Score 3; b – strongly developed Score 1.

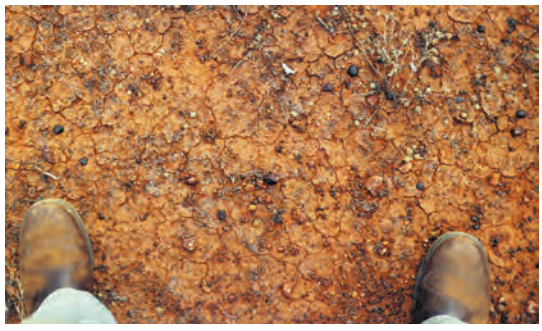
Crust broken–ness – related to susceptibility of the surface soil particles to removal by erosion.

Use the photos 6(a to c) to determine the extent to which surface crust materials are attached or available for erosion.

Crust broken-ness. If there is no crust e.g. sand	score 0
If the surface crust is broken more than than photo 6a	score 1
If the surface crust broken-ness is between photo 6a and 6b	score 2
If the surface crust broken-ness is between photo 6b and 6c	score 3
If the surface crust is broken less than photo 6c	score 4

6a Soil surface extensively broken score 1, lower limit

6b Soil surface moderately brokenscore 2, lower limit



6c Soil surface slightly broken score 3, lower limit

Surface stability – related to the stability of the soil surface during rain and its susceptibility to water erosion.

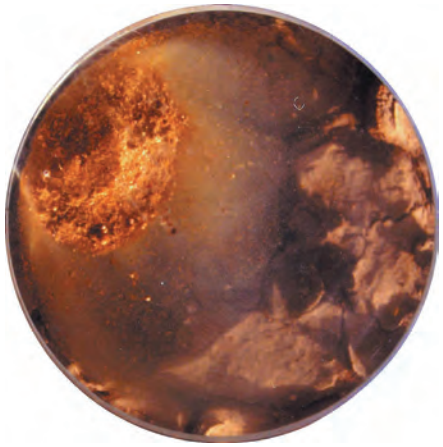
Take a small dish of rainwater and immerse fragments (approx. 6 – 8 mm cubes) of the surface crust. Observe for about a minute. (Note that saline water is unsuitable).

Use the photos 7(a to d) to assess the stability of the surface soil. If the surface is sandy or loose score 0.

Now summarise the results. Add the columns of the Landscape Function Summary Sheet to produce scores for Stability, Infiltration/Runoff and Nutrient Cycling.

As for landscape organisation, interpretation of these scores is comparative only. Higher scores are more desirable but scores are best used for judging the relative status of paddocks, or change over time, rather than the actual status of landscape function. Comparison with the scores for areas in good condition will assist in judging the condition of individual paddocks, and help set management objectives.

Surface Stability.
7a – soil crust is very unstable, completely collapses in 1 to 5 seconds score 1
7b – soil crust is unstable, only a thin surface remains after 5 to 15 seconds score 2
7c – soil crust is moderately stable, surface remains unchanged but 50% of the sub-crust has collapsed score 3
7d – soil crust is stable, sample remains unaltered score 4



7a Very Unstable score 1

7b Unstable score 2

7c Moderately Stable score 3

7d Very Stable score 4

LANDSCAPE ORGANISATION RECORDING SHEET

Step No.	Bare	Perennial Plant (PP)	Log (LG)	Tree/shrub mound (TS)	Length (L)	Width (W)
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
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38						
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40						
41						
42						
43						
44						
45						
46						
47						
48						
49						
50						
Total						

LANDSCAPE ORGANISATION SUMMARY SHEET

Estimated step length (SL)	
Transect length (TL) = SL x 50	
Obstruction length (OL) = Sum L	
Fetch length (FL) = TL – OL	
Total obstruction width (TOW) = Sum W	
No. of obstructions (NO) = Sum PP + LG + TS	
Mean obstruction length = OL/NO	
Mean fetch length = FL/NO	
Mean obstruction width = TOW/NO	

LANDSCAPE FUNCTION SUMMARY SHEET

Patch/Sink

INDICATOR	STABILITY	INFILTRATION/ RUN-OFF	NUTRIENT CYCLING
TEXTURE			
SURFACE NATURE			
MICROTOPOGRAPHY			
SOIL COVER			
PERENNIAL BUTT COVER			
LITTER COVER (C)			
LITTER INCORPORATION (C x T x I)			
LICHENS AND MOSSES			
EROSION SEVERITY*			
CRUST BROKEN-NESS			
SURFACE STABILITY			
TOTAL			

* Note the type of erosion present, if any; R – rilling; P – pedestals; T – terracette; S – sheeting; H – hummocking.

Interpatch/Source

INDICATOR	STABILITY	INFILTRATION/ RUN-OFF	NUTRIENT CYCLING
TEXTURE			
SURFACE NATURE			
MICROTOPOGRAPHY			
SOIL COVER			
PERENNIAL BUTT COVER		1	1
LITTER COVER (C)			
LITTER INCORPORATION (C x T x I)			
LICHENS AND MOSSES			
EROSION SEVERITY*			
CRUST BROKEN-NESS			
SURFACE STABILITY			
TOTAL			

* Note the type of erosion present, if any; R – rilling; P – pedestals; T – terracette; S – sheeting; H – hummocking.

1. FORAGE AVAILABILITY

Forage availability is a fundamental factor determining the stocking rate that can be carried, or how long current stock numbers can be sustained without further growth. Knowing how much forage is on hand, or how many days of grazing are ahead, are basic requirements for making decisions about buying, selling, drought management, or adjusting stocking rate in line with the paddock management objective and strategy.

To estimate the amount of forage available in a paddock:

Copy and use the Standing Dry Matter/Fuel Recording Sheet at the end of section 2.

- Use the photo standards at the end of this section to estimate the total amount of standing dry matter present at intervals as you drive through the paddock. Try to estimate the dry matter available to the nearest 100 kg/ha by comparing the pasture with the standards. Making the estimates at shorter intervals will increase accuracy. At least 10 regularly spaced observations in each paddock will give a reasonable estimate.
- Calculate the average amount of standing dry matter (kg/ha) available in the paddock from the individual observations. Note: If there are a lot of leafy annual herbages (such as medics) in your paddock you will need to scale down your estimate. They look bulky, but don't weigh very much when dried. For saltbushes, bluebushes, copperburrs etc. you may need to scale up your estimate, they tend to weigh more.
- The amount of available forage is roughly one fifth of the standing dry matter
  OR
  Available forage = (average dry matter estimate in kg/ha)/5

Note: If much of the pasture is considered inedible you will need to scale this figure down. The balance of the standing dry matter is required for maintenance of the pasture, or is lost through trampling, termites etc.

To estimate the number of days each hectare can carry one Dry Sheep Equivalent (DSE)

Calculate the number of Animal Unit Days per hectare (AUD/ha) of grazing available in the paddock by dividing the available forage per hectare by 1.1 or consult Table 1. (An animal unit day is one dry sheep equivalent (DSE) grazing for one day. Each DSE requires approximately 1.1 kg of dry matter per day.

Table 1 – Number of Animal Unit Days (AUD)/ha for a range of standing dry matter and available forage

Standing Dry Matter (kg/ha)	Available Forage (kg/ha)	Animal Unit Days/ ha
100	20	18
200	40	36
300	60	54
400	80	72
500	100	90
600	120	108
700	140	127
800	160	145
900	180	163
1000	200	180
1100	220	198
1200	240	226
1300	260	236
1400	280	254
1500	300	270
1600	320	288
1700	340	309
1800	360	327
1900	380	345

Table 1 – Number of Animal Unit Days (AUD)/ha for a range of standing dry matter and available forage (continued)

Standing Dry Matter (kg/ha)	Available Forage (kg/ha)	Animal Unit Days/ ha
2000	400	360
2100	420	381
2200	440	400
2300	460	418
2400	480	436
2500	500	454

To determine the number of DSEs or animals which can be carried for the next planning period

- Calculate the total number of AUDs of grazing in the paddock by multiplying the AUD/ha by the total area of the paddock in hectares.
- Divide the total number of AUDs by the length of the planning period in days. Total AUDs / length of planning period (days) = no. of DSEs
- Use Table 2 to convert the number of DSEs determined above to numbers of particular stock types.
  e.g. 150 DSEs = (150/1.5) = 100 ewes in late pregnancy

Use the same figures for goats as sheep but be conscious of the differing dietary preferences of each species of animal. Different animals will eat different plants and in differing amounts.

To determine how long the available forage will last at the current stocking rate

- Calculate the total number of DSEs in the paddock. Use Table 2 to determine the DSE values for various livestock classes.
- Calculate the number of grazing days available without further pasture growth as shown in the example below.

Table 2. Dry sheep equivalent ratings for various livestock classes (After Elliot, 1996)

Merino sheep		Beef Cattle	
Wether	1.0	Weaner	6.0
Dry eve	1.0	Yearling	7.0
Weaner-at maintenance 1.0		Dry Adult	8.0
		Breeding cow	10.0
Weaner-for growth	1.5	Horses	
Ewe-late pregnancy	1.5	Varies with size	10–15
Ewe-single lamb at foot	2.2		
Ewe-twin lamb at foot	2.7		
Ram	2.0		

Example

A 2000 ha paddock with 750 kg/ha standing dry matter, 600 ewes in late pregnancy, 50 dry adult cattle and 5 horses.

(600*1.5) + (50*8.0) + (5*15)
= 1375 DSEs grazing the paddock

1375*1.1
= 1512.5 kg dry matter required per day

Standing dry matter
= 750*2000 = 1,500,000 kg

Available forage
= 20% of 1,500,000 kg = 300,000 kg

Grazing days ahead
= 300,000/1512.5 = 198 days

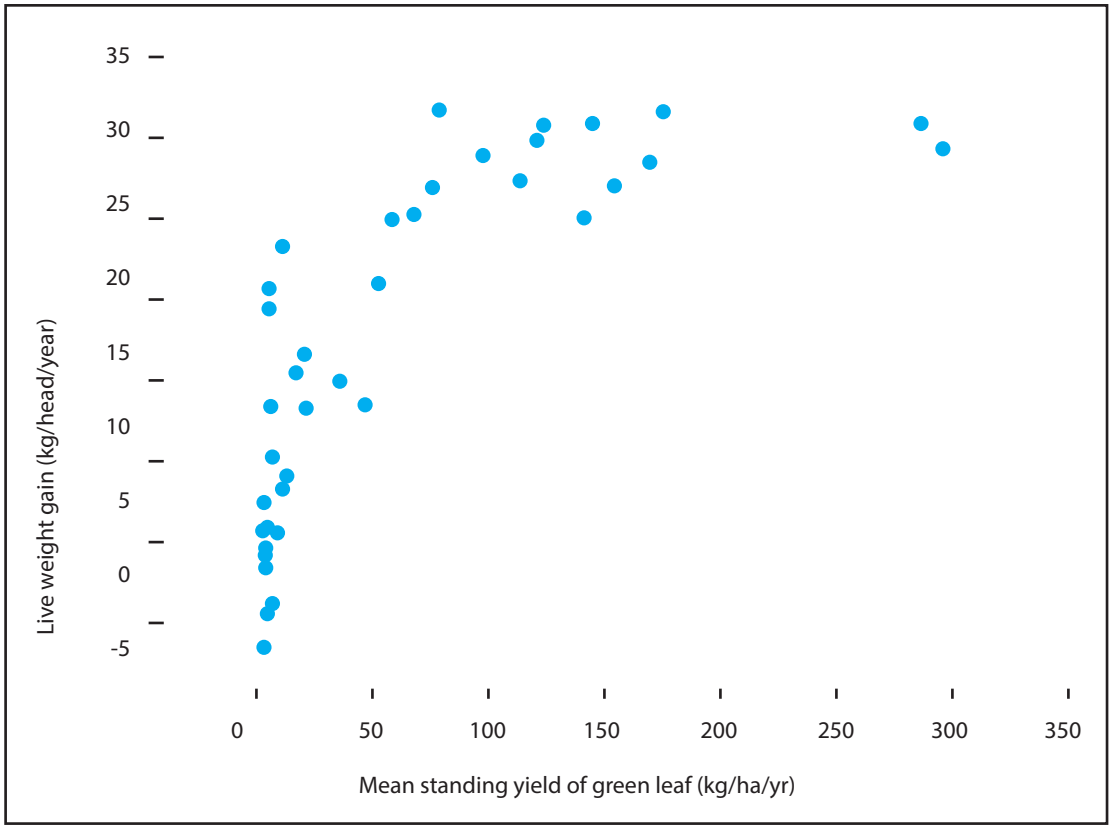
Note: The calculation of forage availability assumes that there is only a 'normal' background of non-domestic herbivore grazing. If the non-domestic component is high allowance will need to be made by reducing the estimate of forage availability. See Part 1 Section C for a method of determining the components of total grazing pressure.

You can take your own photographs of your pastures and write underneath them your estimate of the standing feed. These can be used to compare your paddocks from season to season.

Estimating available forage from standing dry matter is an appropriate method for determining the short-term carrying capacity of a paddock. However, actual animal production is related to the amount of green leaf within a pasture. The green leaf percentage of pasture is important because of its high protein content and digestible energy compared to dry leaf and stem. Animal production is therefore linked to the amount of green leaf available (see Figure 1).

Even a small amount of green leaf in a pasture can significantly increase animal production.

Figure 1 – The relationship between annual live weight gain and mean annual yield of total green leaf (Source: Freudenberger et al. 1999).



Standing dry matter standards

50–100 kg/ha

100–300 kg/ha

300–600 kg/ha

Standing dry matter standards

600–900 kg/ha

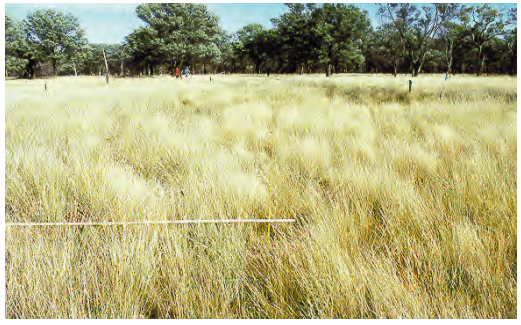
900–1200 kg/ha

1200–1500 kg/ha

Standing dry matter standards

1500–2000 kg/ha

> 2000 kg/ha



2. FUEL AVAILABILITY

Management burning is the most cost-effective method of woody shrub control but at least 900–1200 kg/ha of fuel is required for a successful burn.

Climatic conditions (such as humidity, temperature and wind speed) and condition of the pasture (such as moisture level and patchiness) are also important – if any of these conditions are not conducive to burning you will need more fuel to make sure the burn is successful.

To estimate the amount of fuel available in a paddock or proposed burn site, follow the procedure outlined in Section B(1) for estimating standing dry matter. All the standing dry matter is available for fuel.

Copy and use the Standing Dry Matter/Fuel Recording Sheet at the end of this section.

A few tips for woody shrub control by fire

- Woody shrubs need to be scorched to the top leaves. As long as the whole canopy is scorched the intensity of the fire is not important.
- The best time to burn for safety and good results is in autumn or spring.
- A single fire will not result in a permanent solution to the woody shrub problem. A second fire is desirable as soon as possible after the first for maximum effect. As an alternative, young regrowth can be sprayed with a foliar herbicide to mimic the effect of a second fire. Subsequently, fire will need to be used as an on-going tool to deal with new shrubs.
- The likely death rate for adult shrubs from a single fire is shown in Table 3 for the most common woody species.
- Seedlings of all species are highly susceptible to fire. It is important to observe shrub germination events and if possible burn such areas while the seedlings are still within the grass canopy. Close to one hundred percent kill rates can be achieved for all species if seedlings are no more than 30 cm high.
- A management burn is an extremely effective and economical treatment of regrowth following mechanical clearing, as there is usually much more fuel and uniformly small shrubs.

Table 3 – The percentage of mature shrubs expected to die after burning (Sources: Hodgkinson, 1979; O'Shea 1989, 1993)

Species	Expected Mortality (%)
Turpentine (Eremophila sturtii)	13–30
Budda (Eremophila mitchellii)	12–38
Broad-leaf hopbush (Dodonaea viscosa subs. spatulata)	54–71
Punty bush (Senna artemisioides)	27–85
Narrow-leaf hopbush (Dodonaea viscosa subs. angustissima)	60–91
Mulga (Acacia aneura)	60–84
White cypress pine (Callitris columellaris)	98–100

STANDING DRY MATTER/FUEL RECORDING SHEET

PADDOCK										
ESTIMATES OF STANDING DRY MATTER (SDM-kg/ha)										
DATE										
Site 1										
Site 2										
Site 3										
Site 4										
Site 5										
Site 6										
Site 7										
Site 8										
Site 9										
Site 10										
TOTAL										
Average SDM (equals average fuel)										
Average Available Forage (Av. SDM/5)										

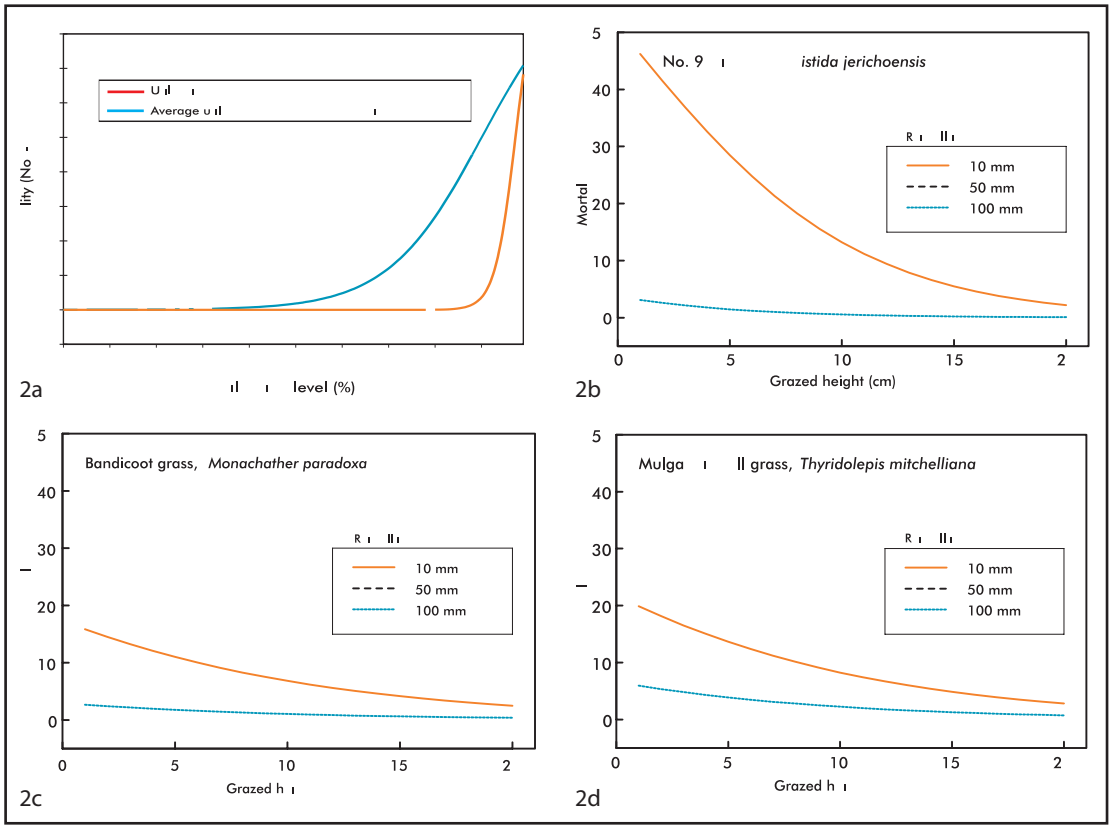
3. UTILISATION OF KEY SPECIES

Estimating the overall amount of forage available in paddocks can provide a useful guide to short term stocking rate but does not account for selective grazing of the more palatable species. To ensure better management of a pasture it is desirable to assess the level of utilisation of the important perennial pasture species, the 'key species', as well as the overall amount of forage present. These species are the earliest to show signs of overgrazing, and may be eaten out well before stock condition drops.

Perennial pasture species are most at risk during drought periods. The level of grazing a plant has experienced prior to the onset of drought will determine its chances of survival because this will affect the size of the root system and hence its ability to obtain water. The level of carbohydrate reserves available to maintain living tissue may also be affected.

Perennial grasses have a good chance of surviving drought if no more than 30% of their foliage has been removed (or 70% remains) before the start of the next growth phase. If grazed below this level they will survive good seasons but their capacity to withstand drought will be reduced. The longer plants are kept in a closely grazed condition the less their chance of surviving a bad season, particularly over summer (see Fig. 2a). Since most of a plant's weight is concentrated at the base 70% of the weight is not the same as 70% of the height (see Fig. 3).

Figure 2a – Effect of utilisation on mortality of mulga Mitchell grass during a summer drought (November to January). (Source: Hodgkinson and Hacker 1996)
Figure 2 (b–d). Effect of grazed height and following rainfall on mortality of a susceptible species (No. 9 wiregrass) and two moderately tolerant species (bandicoot grass and mulga Mitchell grass) (Source: K. Hodgkinson, CSIRO)



The techniques described below will allow you to estimate the utilisation level of the important species and assess the risk to pastures if drought conditions develop.

To estimate the level of utilisation of key species:

Method 1

Copy and use the Utilisation Recording Sheet at the end of this section.

- Choose a 'typical' area in your paddock that hasn't been over-utilised (e.g. near a watering point) or under-utilised (e.g. in a far corner), compared to the rest of the paddock.
- Estimate the utilisation of each key species by comparing individual plants with the photos at the end of this section. If a particular species is not shown, use the photos for a similar species. Look at 20 plants, at least, of each species. (Not all plants will be grazed equally so an average figure is required.)
- Calculate the average utilisation level for each species

Method 2

Copy and use the Grazed Height Recording Sheet at the end of this section.

- Choose a 'typical' area of the paddock as for Method 1.
- Measure the grazed height of the foliage on a sample of 20 or so plants of each key species. The grazed height of an individual plant is the 'average' height of the foliage allowing for uneven grazing.
- Calculate the average grazed height for each species and read off % weight remaining from the graphs shown in Fig. 3.
- Calculate utilisation as (100 – % weight remaining)

To assess the risk of pasture loss from drought

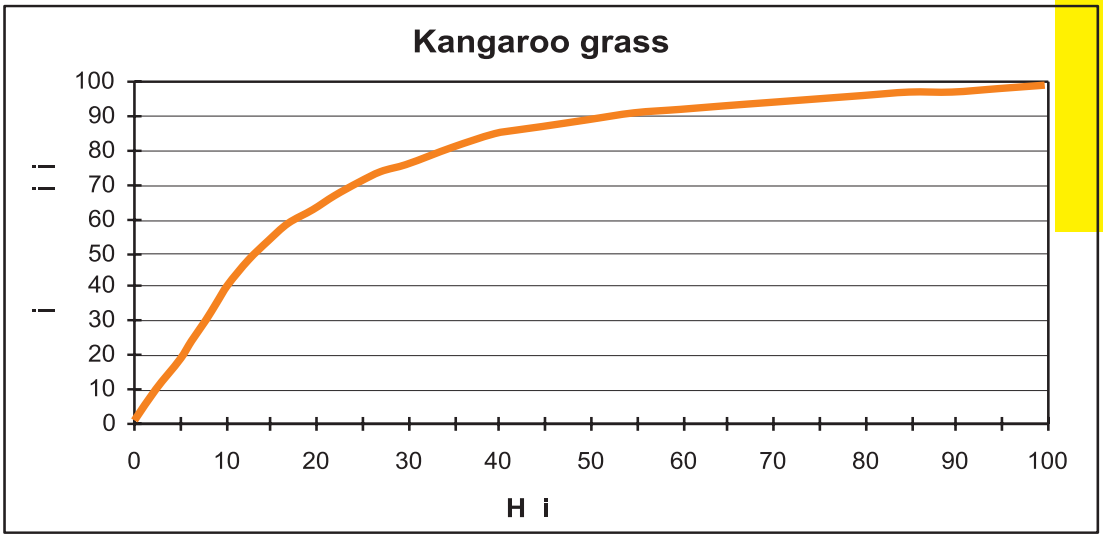
(a) Based on utilisation

- Estimate utilisation several times a year – preferably every two months.
- For utilisation assessed only at the beginning of summer – refer to the red line in Fig 2a
- For utilisation assessed over the previous year (average of readings at intervals of 2 months or so) – refer to the blue line in Fig. 2a

(Note: These assessments will be indicative only except for mulga Mitchell grass)

(b) Based on grazed height

- Grazed height recorded in Method 2 can be used directly to estimate drought risk although some evidence suggests that utilisation may be a more sensitive indicator.
- Use average grazed height and Fig 2b to estimate the likely mortality of No 9 wiregrass, or similarly sensitive species, for a range of seasonal conditions over the next 3 months.
- Use Fig 2c or Fig 2d to assess the likely mortality of bandicoot grass or mulga Mitchell grass respectively, or similar moderately sensitive species.



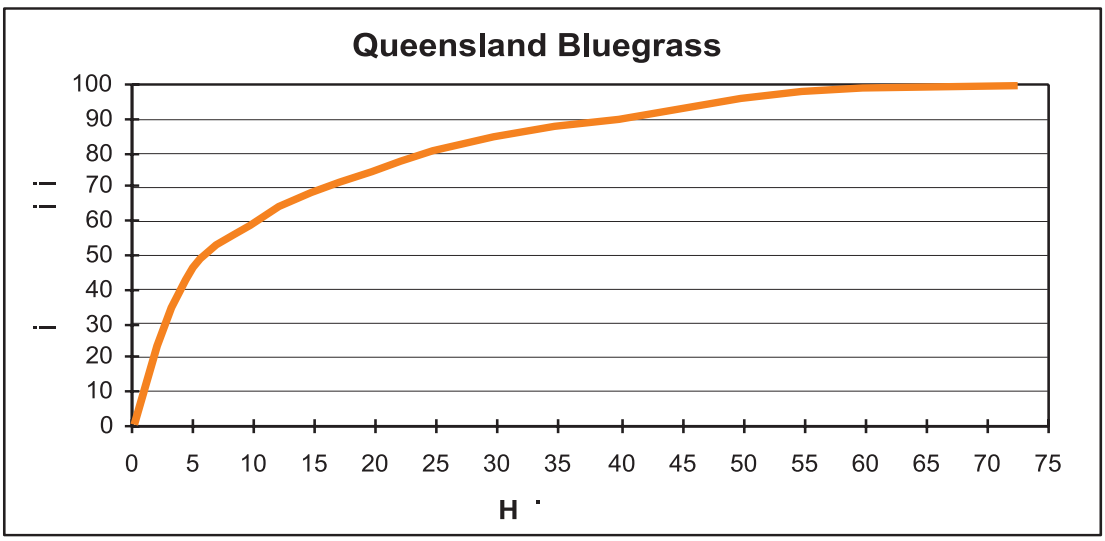
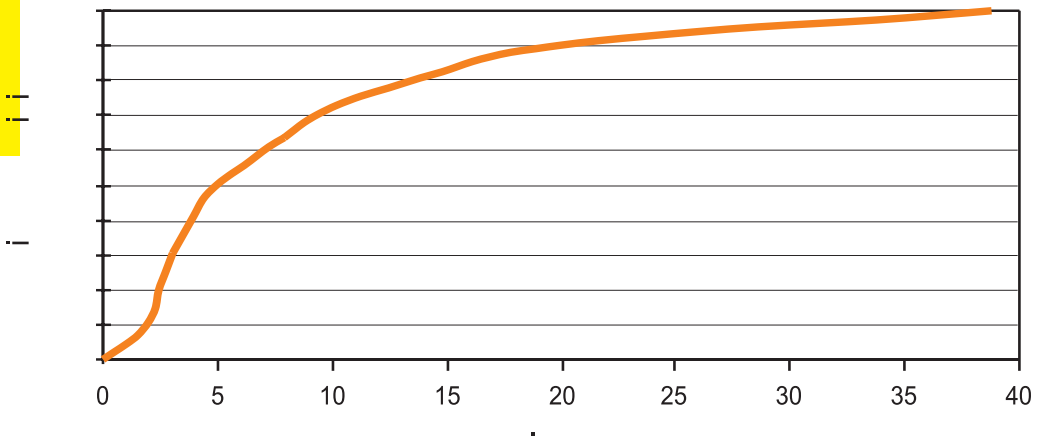
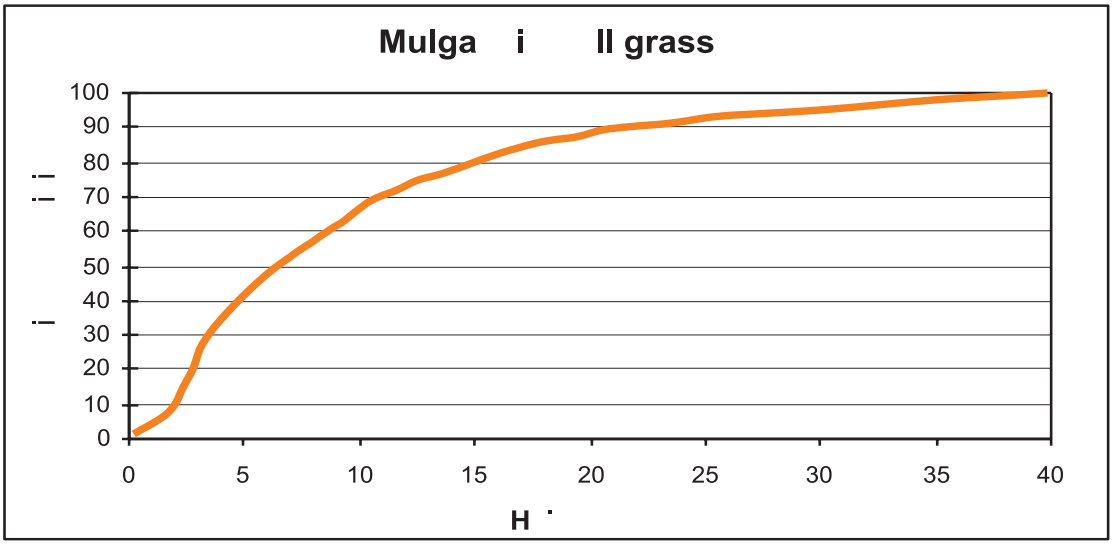
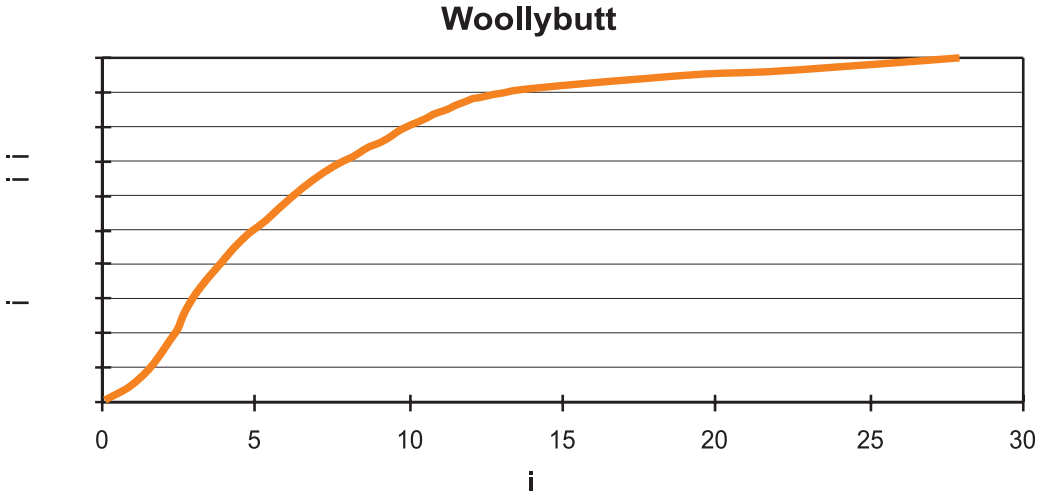


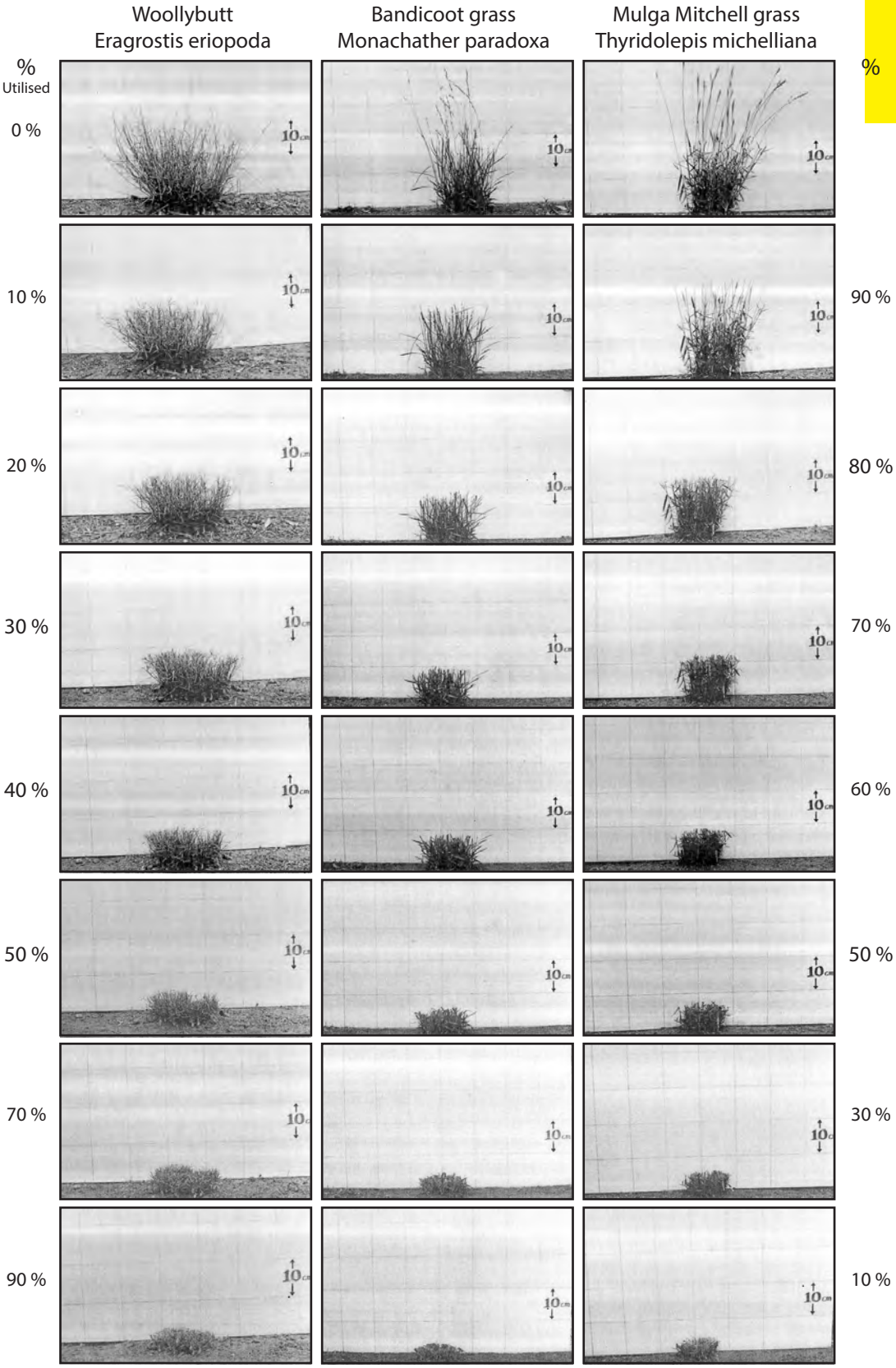
Figure 3 – Height-weight profiles for a number of key perennial grasses.


0
5
10
15
20
25
30
35
40


Mulga i ll grass
100
90
80
70
60
50
40
30
20
10
0
0
5
10
15
20
25
30
35
40
H

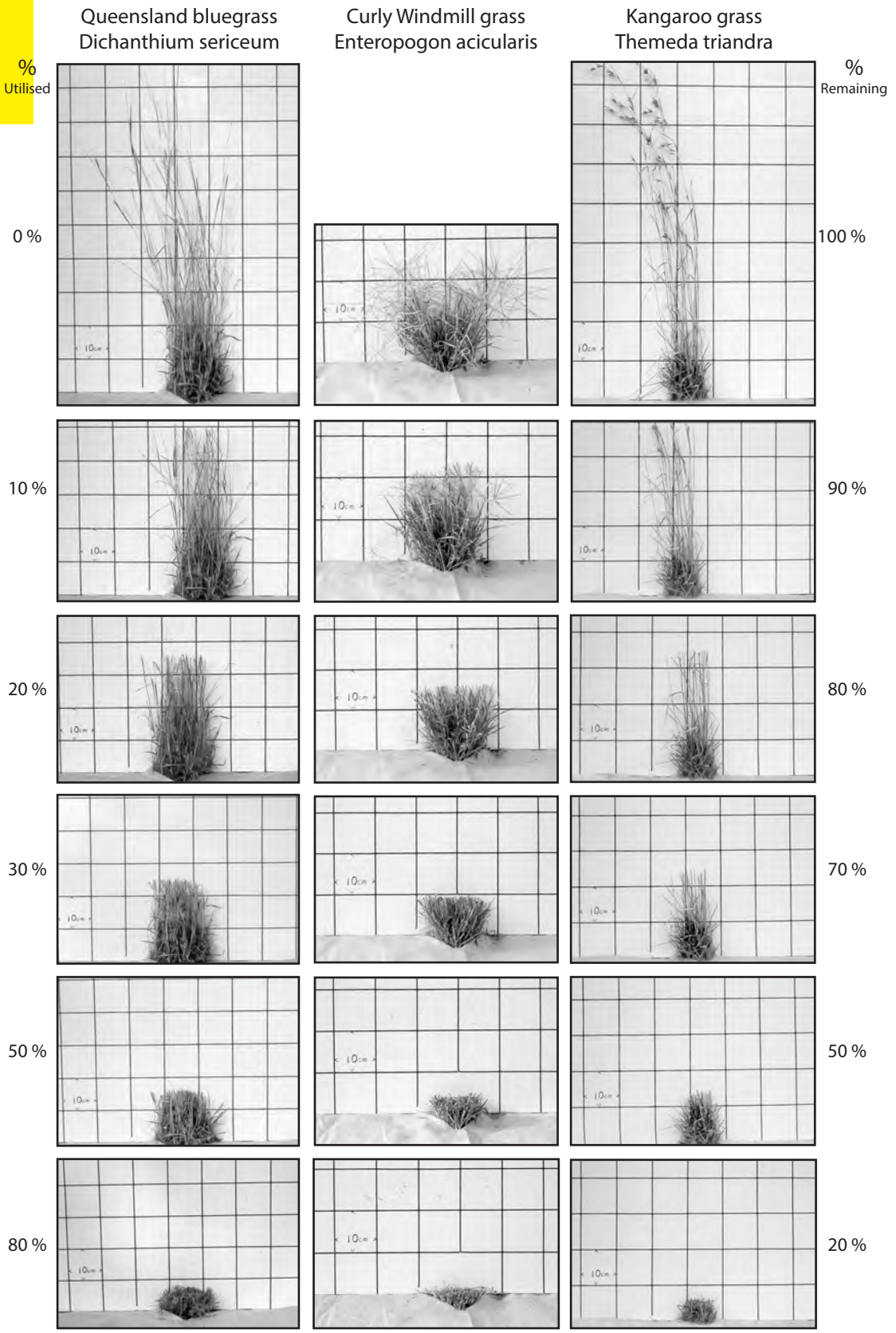

Woollybutt
0
5
10
15
20
25
30
i

Utilisation Level Photo Standards



(Source: Anderson et al. 1994)

Utilisation Level Photo Standards



UTILISATION RECORDING SHEET

PADDOCK											DATE											
KEY SPECIES	UTILISATION ESIMATES (%)																				TOTAL	AVERAGE

GRAZED HEIGHT RECORDING SHEET

PADDOCK															DATE			
KEY SPECIES	GRAZED HEIGHT (cm)														TOTAL	AVERAGE GRAZED HEIGHT	% Weight Remaining (from Fig. 3)	Utilisation (%) (100 – % wt remaining)

4. SHRUB COVER

Shrubs compete with grasses for water and nutrients although the degree of competition probably varies with soil type and shrub species. Competition is probably minimal on deep sandy soils. As shrub cover in a paddock increases, the amount of forage available for stock decreases, reducing the carrying capacity. Also, grasses which are competing with shrubs for nutrients and water appear to be more susceptible to grazing and are thus easily grazed out.

A small increase in the amount of shrub can cause a disproportionately large reduction in the amount of forage available to stock. Note that the relationship is not a straight line and that small increases in shrub or tree cover can cause large decreases in herbage production (See Fig.4). Even if mature shrubs are 10 m apart the grazing capacity may be less than half of what it would be without shrubs. It is therefore important to monitor shrub cover while it is still low.

To estimate the shrub cover in a paddock or over the property:

Method 1

Copy and use the Shrub Cover Recording Sheet (Photo method) at the end of this section.

- Use the photo standards at the end of this section to assess shrub cover at regular intervals along tracks through the paddock, or cross-country.
- Calculate the average shrub cover from the individual observations. At least 10 observations in a paddock should give a reasonable average.

Note: Above about 20% cover use of photo standards is difficult and the Bitterlich gauge, with a wide cross-arm, may be easier to use.

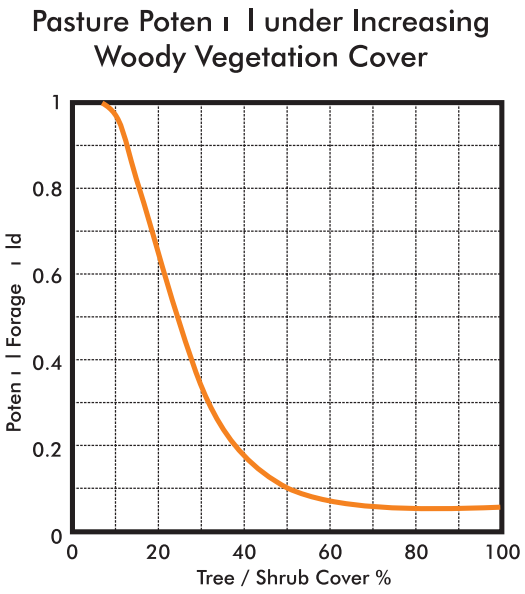
Method 2

Use the 'Bitterlich' gauge described in Appendix 1.

Copy and use the Bitterlich Shrub Cover Recording Sheet at the end of this section.

- Select a series of sample sites throughout the paddock. Since this technique is more time consuming than Method 1 it may be preferable to use it at a small number of fixed monitoring sites (as described in Part 2, page 54) so that trends over time can be more easily appreciated.
- Holding the gauge to the eye, rotate through 360 degrees and count all shrubs whose canopy equals or exceeds the width of the crossarm. Calculate the shrub cover using the division factor for the gauge (e.g. if a 1:10 ratio gauge is used, then shrub cover % = number of shrubs counted divided by 4).
- Calculate the average shrub cover for all samples in the paddock.

Figure 4. Graph of potential pasture yield versus tree/shrub cover in mulga country. (Source: I.F. Beale, pers. comm.)



SHRUB COVER
RECORDING SHEET (Photo method)

PADDOCK					
ESTIMATES OF SHRUB COVER (%)					
DATE					
Site 1					
Site 2					
Site 3					
Site 4					
Site 5					
Site 6					
Site 7					
Site 8					
Site 9					
Site 10					
TOTAL					
/10 = Average Shrub cover					

SHRUB COVER
RECORDING SHEET (Photo method)

PADDOCK								
Division factor								
DATE								
	Count	% Cover	Count	% Cover	Count	% Cover	Count	% Cover
Site 1								
Site 2								
Site 3								
Site 4								
Site 5								
Site 6								
Site 7								
Site 8								
Site 9								
Site 10								
TOTAL								
/10 = Average Shrub cover								

% COVER = COUNT/DIVISION FACTOR

DIVISION FACTOR	RATIO OF CROSS ARM LENGTH TO DISTANCE OF CROSS ARM FROM THE EYE
1	1:5
2	1:7.07
3	1:8.66
4	1:10
5	1:11/18
6	1:12.27
16	1:20

Shrub Cover Photo Standards

NOTE: Cover refers only to the area in front of the steel pickets

1.5% Shrub cover

2.5% Shrub cover

4% Shrub cover

6% Shrub cover

7.5% Shrub cover

9% Shrub cover

10% Shrub cover

19% Shrub cover

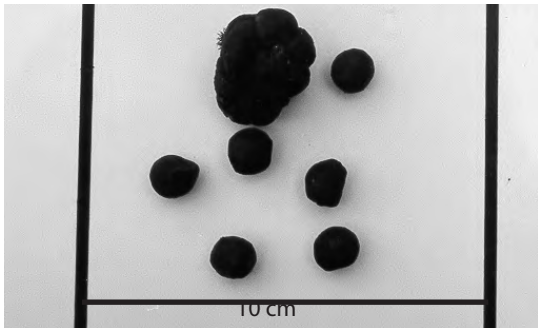
SECTION C – TOTAL GRAZING PRESSURE

The grazing pressure due to livestock can at times be exceeded by the grazing pressure of other animals (e.g. kangaroos, rabbits and feral goats). The number of non-domestic animals on a property is usually underestimated. Kangaroo numbers can be much larger than expected and sightings of feral goats may account for only a relatively small fraction of the number present.

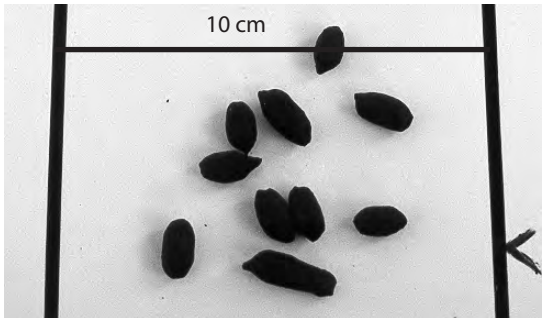
However, reasonably accurate assessments of the grazing pressure due to various species can be made by observing the dung they leave behind. Differentiating between various types of dung is relatively easy with practice.

Sheep and goat: rounded, oval or cylindrical pellets, usually produced in clumps (these may fall apart as they hit the ground); usually dark brown to black when fresh.

Sheep (below): the ends of the pellets are dimpled, or both ends may be rounded.

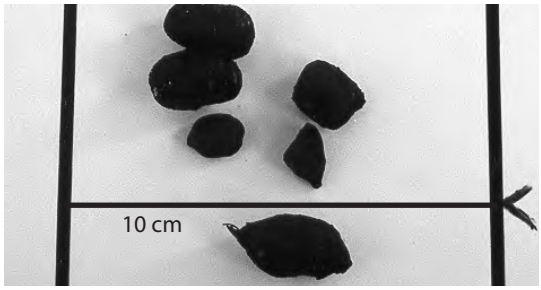


Goat (below): the ends of the pellets are pointed or the pellets are cylindrical.

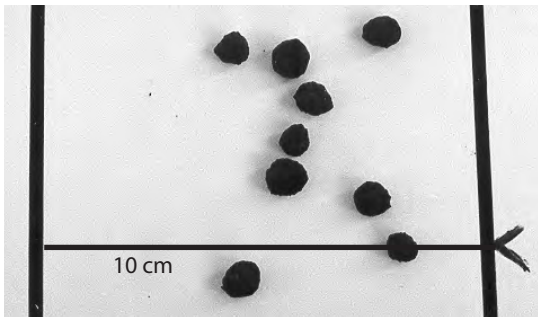


Cattle: very distinctive, hard to mistake for anything else; large brown flat 'cake' or several smaller, layered pats

Kangaroo (below): pellets are oval, round or square, with a shiny black to dark brown coating when fresh.



Rabbit (below): round, slightly flattened and light to dark brown when dry, generally less than 1 cm across.



Pig (below): depends on their diet, often cylinders of flat round 'cakes'.

The relative grazing pressure of sheep and other species in an area may be estimated by comparing the respective amounts of dung. For kangaroos at least, an estimate of the actual population can be obtained if the number of sheep in the paddock is also known.

To estimate the relative grazing pressure of sheep and kangaroos in a paddock, and the actual population of kangaroos, use the 'step-point transect' procedure outlined below.

Copy and use the Step Point Transect Recording Sheet at the back of this section

- Select representative sample sites within the paddock which cover the major vegetation types. Include any vegetation types or areas which are favoured by kangaroos as well as those favoured by sheep. At least 10 sites are required. Twenty five (25) or more is desirable.
- At each sample site:
  - walk a transect in any direction from the starting point, in representative country, avoiding kangaroo or sheep camping sites.
  - at every second footfall, identify the type of dung (sheep or kangaroo) which is closest to a mark on the tip of the boot, within a semi-circle of 1 m radius immediately in front of the foot. Do not look at the ground until the boot has come down. If there is no dung within this area, or if the point falls within a sheep or kangaroo camp, ignore the point and move on. Record only recent dung which still has the black outside layer (or patina) more or less intact. If recent dung is present, tick off the appropriate type as a 'hit' on the recording sheet.
  - continue walking in the one direction until you have recorded 50 'hits'.
  - now move 20 paces to one side and repeat the process back towards the starting point, ensuring that you record another 50 'hits' on the way back.
  - tally the number of 'hits' on sheep and kangaroo dung.

To estimate the proportion of sheep and kangaroos in the 'total' (sheep + kangaroo) grazing pressure,

Apply the following formula:

Formula 1

Proportion of kangaroo grazing pressure (%) $= 2.26 + 63.6 \left(\frac{N_k}{N}\right)$

Proportion of sheep grazing pressure (%) = 100 – proportion of kangaroo grazing pressure (%)

where

Proportion of kangaroo grazing pressure (%) $= \frac{\text{DSE (kangaroo)}}{\text{DSE (total)}} \times 100$

N_k – Total number of points with kangaroo dung closest

N – Total number of points over all sites

DSE – Dry Sheep Equivalents

To estimate the number of kangaroos in the paddock

Apply the following formula:

Formula 2

No. of kangaroos (DSE_k) $= 16.434 + 0.534 \times DSE_s \times N_k / N_s$

No. of kangaroos (actual) $= DSE_k / 0.75$

where

DSE_k – Kangaroo population in Dry Sheep Equivalents (average for last 2 months)

DSE_s – Sheep population in Dry Sheep Equivalents (average for last 2 months)

N_k – Total number of points with kangaroo dung closest

N_s – Total number of points with sheep dung closest

1 Kangaroo = 0.75 Dry Sheep Equivalent

Example

- The paddock has carried an average of 500 DSE of sheep over the last 2 months.
- 15 step-point transects (1500 points) have been recorded over the paddock.
- Sheep dung was closest at 900 points and kangaroo dung at 600 points.

The terms in the equations are:

N = total number of points = 1500

N_k = number of points with kangaroo dung closest = 600

N_s = number of points with sheep dung closest = 900

DSE_s = average sheep DSE over last two months = 500

Formula 1

Proportion of kangaroo grazing pressure (%)

$= 2.26 + 63.6 \times N_k/N$

$= (2.26 + 63.6 \times 600/1500)\%$

$= 27.7\%$

Proportion of sheep grazing pressure (%)

$= (100 - 27.7)$

$= 72.3\%$

Formula 2

Number of kangaroos (DSE_k)

$= 16.434 + (0.534 \times DSE_s \times N_k/N_s)$

$= 16.434 + (0.534 \times 500 \times 600/900)$

$= 194.4$ DSE

Actual number of kangaroos

$= 194.4/0.75$

= 259 kangaroos (on average for the last two months)

Note: the proportion of kangaroo grazing pressure based on the result of Formula 2 will be:

Proportion of kangaroo grazing pressure (%) $= 194.4/(500 + 194.4) \times 100$

$= 28\%$

which is comparable to the estimate provided by Formula 1.

Note:

1. Sheep and kangaroo dung weather at varying rates depending on climatic conditions. As a rule of thumb, 'recent' dung assessed in this technique is assumed to be up to two months old. Some errors will occur in the estimates of kangaroo grazing pressure and kangaroo populations if the rate of weathering is much faster or slower than the assumed rate.
2. Use Table 2 (page 22) to calculate the DSEs for sheep in the paddock. If sheep numbers have changed over the last two months be sure to use the average number of DSEs present per day in the calculations.

To estimate the proportions of all species in the total grazing pressure

Copy and use the Composition of Total Grazing Pressure Work Sheet at the back of this section.

Note that this table is an integral component of the stocking rate estimation procedure described in Part 3. For calculating stocking rate the 'Total Paddock DSE' figure required is the average over the previous 12 months. The Work Sheet should therefore be completed at about two monthly intervals to provide average data for stocking rate assessment.

Modifications of the step-point transect procedure and assessment of other species

At the time of publication, the step-point transect procedure is only known to provide reasonable estimates of species proportions and abundances for the combined population of sheep and kangaroos.

In principle, the procedure could be extended to rabbit and feral goat populations by including dung of these species in the assessment of the 'nearest species' at each point. In this case, the best estimate currently available of the percentage of each species in the total grazing pressure will be obtained simply by tallying the 'hits' on each species

at each site, and calculating the percentages by simple arithmetic.

If this modified procedure is not used, and if feral goats and/or rabbits are considered a significant part of the total grazing pressure, their abundance may need to be estimated directly.

For rabbits: by estimating the density of active rabbit warrens and the number of rabbits per warren as 2.4 times the average number of open entrances (with each rabbit equivalent to 0.1 DSE).

For feral goats: by estimating the population relative to the sheep population based on number of sighted animals of each species (with one feral goat equivalent to 1 DSE).

STEP POINT TRANSECT RECORDING SHEET

PADDOCK																							DATE
Transect	Example		1		2		3		4		5		6		7		8		9		10		Average
	Tally	Total	Tally	Total	Tally	Total	Tally	Total	Tally	Total	Tally	Total	Tally	Total	Tally	Total	Tally	Total	Tally	Total	Tally	Total	
SHEEP	𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸	70																					
KANGAROO	𝍸 𝍸 𝍸 𝍸 𝍸 𝍸	30																					
RABBIT																							
GOAT																							
		100		100		100		100		100		100		100		100		100		100		100	100

COMPOSITION OF TOTAL GRAZING PRESSURE WORK SHEET

Species	Percentage of species estimated from step-point transects	Average no. of animals over previous 2 months (DSE)	COMMENT
Sheep	%		Use Table 2 (p 22) to calculate DSE Calculate % sheep as shown in Formula 1 box
Cattle			Use Table 2 to calculate DSE
Subtotal (domestic)			Sub-total – domestic grazing
Kangaroos	%		Calculate: – % kangaroo grazing pressure from formula 1 – Kangaroo DSE from formula 2
Goats	%		Use modified step-point transect or direct estimation
Rabbits	%		Use modified step-point transect or direct estimation
Subtotal (non domestic)			Sub-total – non-domestic grazing
PADDOCK TOTAL	100%		
		FACTOR 4*	TOTAL PADDOCK DSE

* FACTOR 4 – FOR USE IN STOCKING RATE ESTIMATION – PART 3.

SECTION D
SOIL COVER

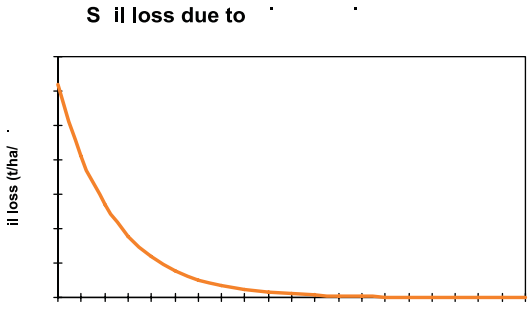
Soil cover maintenance is a key element of pasture management. It becomes particularly critical in times of drought.

Soil cover is important because it determines:

- how much water is able to soak into the soil rather than running off;
- degree of protection from both wind and water erosion;
- the efficiency of nutrient cycling (good soil cover means more soil water and nutrients available for pasture growth).

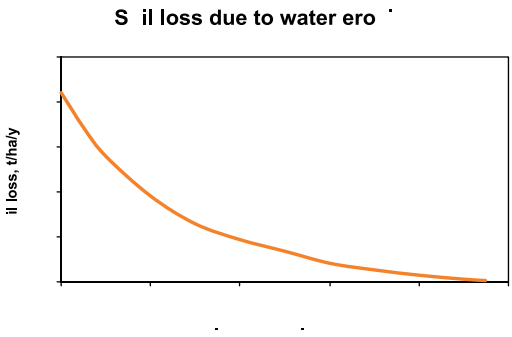
There are a number of different types of ground cover: stones, living plant material (e.g. grass butts), dead plant material (litter, leaves, branches), cryptogams (lichens, fungi and algae) and dung, some of these being very important but easily overlooked.

Figure 5a.



(Source: Leys, 1992)

Figure 5b.



(Source: Rosewell, 1993)

Maintaining a cover of 40% or greater will ensure no significant erosion (See Figure 5a and 5b).

To assess soil cover use one of the following procedures:

Step Point Method

Copy and use the Soil Cover, Step Point Method Recording Sheet at the end of this section.

- Mark a point on the toe of one boot, e.g. you could mark it with a pen, or a drawing pin.
- Walk in a straight line for 100 paces, do not look at the ground until you have put your marker boot down.
- Every time the marker boot comes down, record whether there is cover directly under the mark (include litter, grass butts, herbs, wood, cryptogams).
- When you have finished 100 paces (50 readings), step a few paces to the side, and repeat the process back towards the starting point.
- Tally the number of 'hits' to give the percentage soil cover for the site.
- Repeat the procedure for as many sites as possible in a paddock, or at fixed monitoring sites.

Note: Step pointing is a valuable technique to know. As well as assessing ground cover it can also be used to assess pasture composition. Simply record the name of the plant that is nearest your marker at each observation. Information on pasture composition can indicate pasture quality, to complement information on forage availability derived from the technique described in Part 1, Section B1 (page 21).

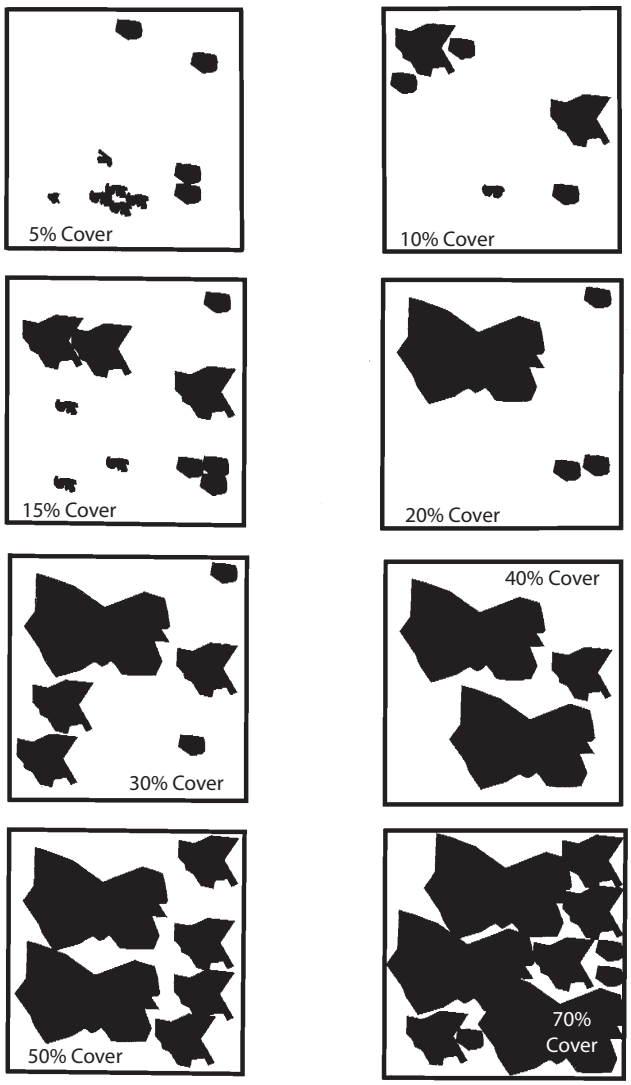
Quadrat Method

Copy and use the Soil Cover, Quadrat Method Recording Sheet at the end of this section.

Make a simple quadrat out of pieces of wood, wire or pipe. A 50 x 50 cm square will suffice.

- Walking in a straight line, place the quadrat directly at your feet every five steps.
- Use the examples in figure 6 to estimate the soil cover within each quadrat.
- Do this 10 times, step a few paces to the side and repeat the process back towards the starting point.
- Calculate the average soil cover for the site.
- Repeat the procedure for as many sites as possible in a paddock, or at fixed monitoring sites.

Figure 6 – % soil cover (shown as the dark areas).



SOIL COVER RECORDING SHEET
STEP POINT METHOD

PADDOCK	DATE

Place 4 in box if cover present, – if not	TOTAL
Site 1	
Site 2	
Site 3	
Site 4	
Site 5	

SOIL COVER RECORDING SHEET
QUADRAT METHOD

PADDOCK										DATE	
	Percentage cover										Average (total/20)
Site 1											
Site 2											
Site 3											
Site 4											
Site 5											

Graziers often use stock condition and behaviour to help make decisions about stocking rates for pastures. However it is important to keep in mind that the condition of your stock does not directly relate to pasture condition. The animals may be in reasonable condition while the pasture is being overgrazed. Stock will choose the best diet from the available pasture, eating out the desirable species first. By the time stock show a loss of condition from an inadequate diet, pastures could already be severely degraded.

The guidelines given below can be used to assess condition of animals but this information should not replace direct observation of pasture and soil in making decisions about grazing management.

Sheep

There is a strong relationship between live weight and fat content of sheep. Being aware of the condition of stock is also important for effective breeding. For instance maiden ewes will only join if they reach an optimum body weight of around 40–45kg. The extent of loss of condition/weight affects the chance of attaining a reasonable fat score by their next joining.

Assessing sheep by simply looking at them in the paddock or the yard is usually not very accurate. You will need to feel the amount of fat over the long ribs of standing, relaxed animals. Put your fingers through the wool and feel the 'boniness' of the ribs. You should place your hands about 10–11 cm from the midline on the second last long rib. There are 5 categories for fat score, 5 being the fattest score (Table 4a and photo standards).

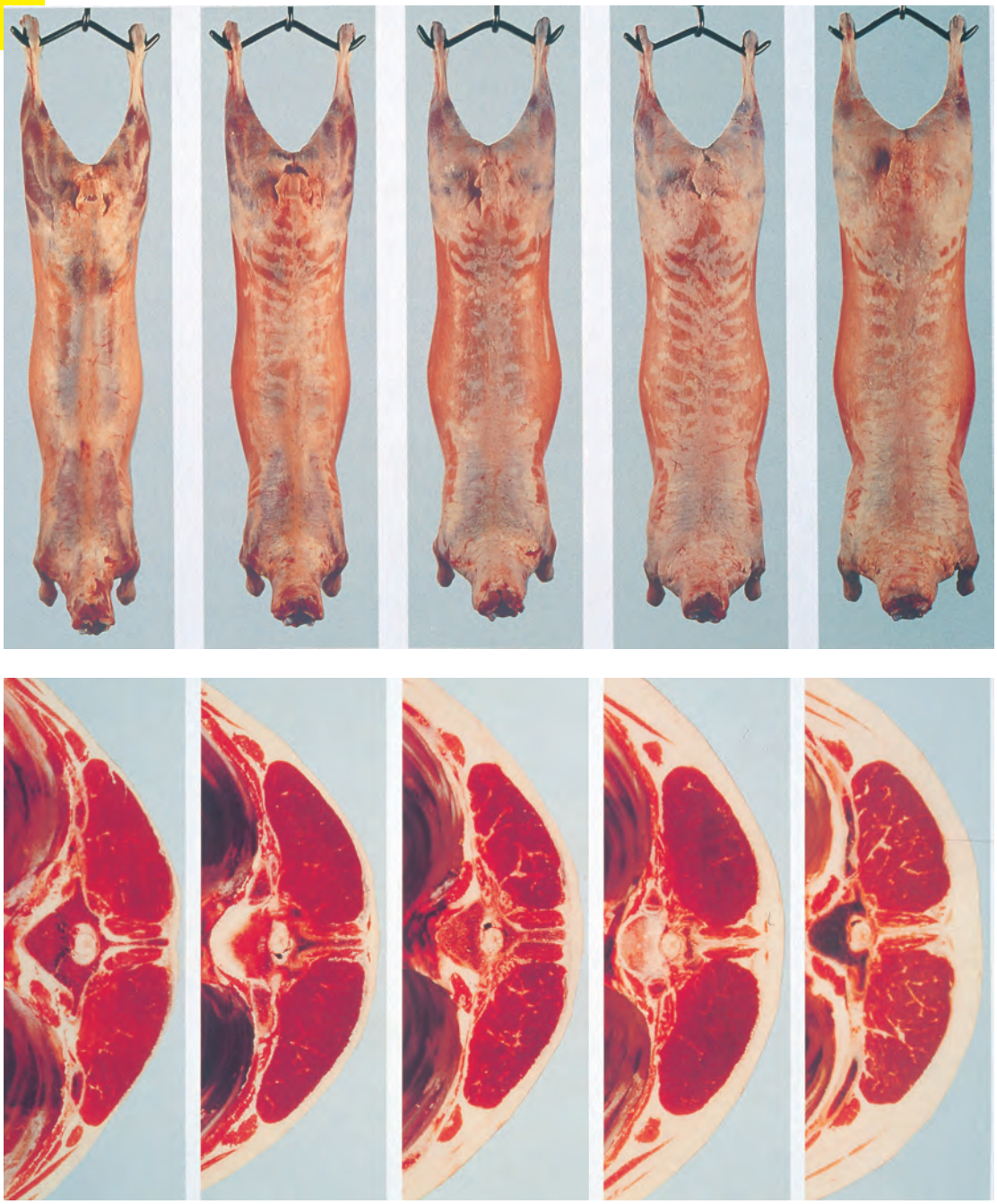
Table 4 (a) – Fat Scoring Sheep (Source: Prograze Manual 1996: Segment 4 – Sheep breeding package)

Score	Description
1	Individual ribs felt and no tissue can be felt sliding over ribs. Depressions between the ribs are obvious and easily felt.
2	Individual ribs are felt with some tissue able to be felt over the ribs. Depressions between ribs are obvious.
3	You should still feel each rib, but they are more rounded, with tissue movement being felt over the ribs. The depressions between the ribs are less obvious.
4	It is harder to feel each rib, with only some depression between them. It is easy to feel the tissue moving over the ribs.
5	It is hard to feel the ribs or any depressions between them. It is easy to slide your fingers over the ribs.

Fat score photo standards – sheep

FAT SCORE

1 2 3 4 5



Cattle

Cattle can be assessed visually, and while manual assessment is more accurate, visual assessment in the paddock or in the yard can give you useful information on the condition of your stock.

There are two main things to consider when you are looking at the condition of cattle: muscle and fat. These are assessed visually at three main sites – the rear, brisket and flank.

The ribs become less visible on an animal as it becomes fatter. The tailhead softens with rounds of fat increasing behind the tail, with the muscle seams of the hindquarters becoming less evident. The brisket, flank, cod and twist all fill out making the animal look squarer.

Manual assessment gives a much more accurate indication of fat condition for cattle. The best areas for assessment are the rib area of the short loin, over the long ribs and around the tailhead (Table 4b and photo standards).

Table 4 (b) – Fat Scoring Cattle (Source: Prograze Manual 1996: Segment 5 – Cattle breeding package)

Score	Description
1	The animal is emaciated. Individual spines are sharp. There is no fat around the tail, and hip bones, tailhead and ribs are prominent.
2	There is no fat beside the tailhead. Short and long ribs are easily felt, but the spines feel rounded. The hip bones and ribs are hard. The ribs are not visually obvious.
3	The short ribs are prominent and rounded, but can still be felt easily. The ribs are easily felt, but you need to apply firm pressure to distinguish between them. There is fat cover that is easily felt on either side of the tailhead.
4	The short ribs cannot be felt. There is some cover around the hip bone. There are small, soft mounds of fat around the tailhead. The ribs are hard to feel.
5	The short ribs can no longer be felt. The tailhead and hip bones are almost buried in fat. The ribs are 'wavy' from fat folds. There is fat in the brisket and udder. The flank area appears to be squared off.
6	The short ribs cannot be seen. The tailhead and hips are completely buried by large mounds of fat. The ribs are 'wavy' from fat folds. The brisket and udder are heavy. The flank is squared off. The animal's mobility is reduced to a walk.

Fat score photo standards - cattle

FAT SCORE

1

2

3

4

5

6

PART 2.
LONG-TERM MONITORING

How to set up a monitoring system for your property

Tactical management is about trying to achieve specific objectives in each paddock of the property. Monitoring will help you appreciate the progress you are making towards these objectives. To assess any long-term changes in your pastures you may need to set up some permanent sites to come back to year after year to provide comparative data.

As well as using these permanent monitoring sites for photo points they can also be the areas on which the techniques outlined in Part 1 are applied.

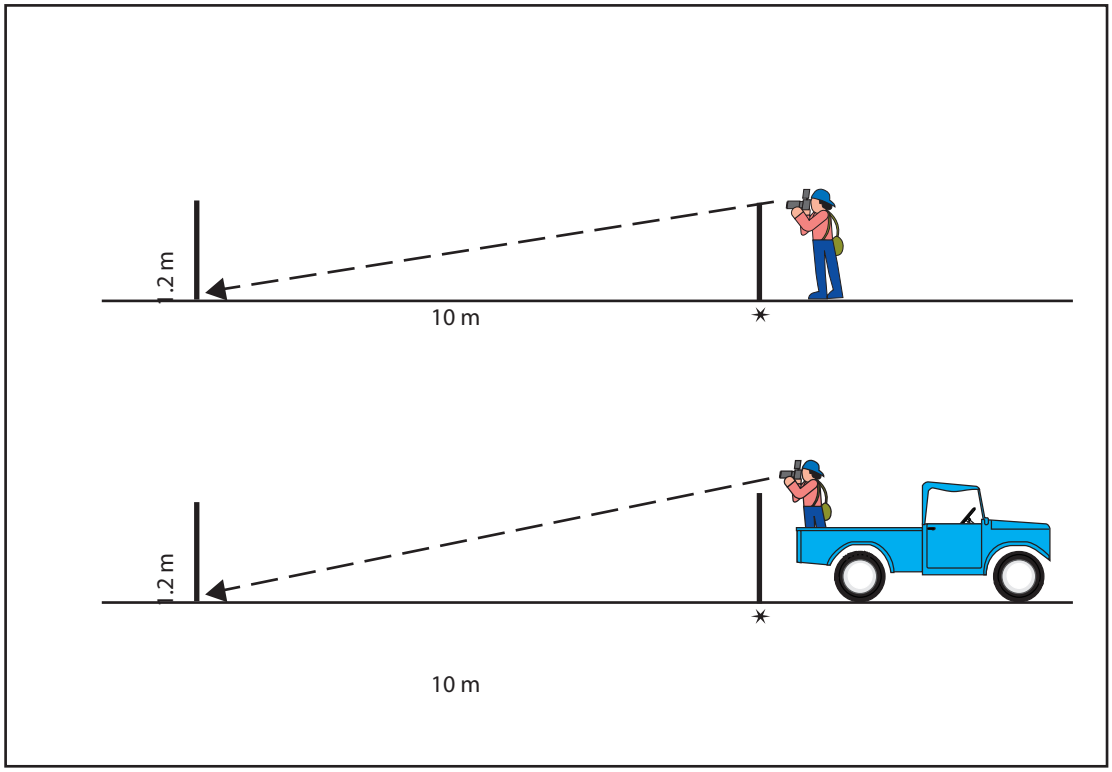
With a little planning, it's not difficult or time consuming to set up and use a network of sites on your property. Repeated observations at these sites will allow you to assess the extent to which management objectives are being achieved.

Set up one site to start with in each paddock. For extra information you can at a later date set up sites on separate land types in each paddock.

Select a site that is typical of the most important pasture type in the paddock with an area about 300 m x 300 m.

The area should also be:

- easy to find in the future
- accessible by a motor vehicle
- at least 100 m from fence lines, major tracks and waterways and between 1 and 2 km from a watering point. Establish and photograph the site as shown below.



Taking photographs

- Photos can be taken either by standing on the ground or from the back of a vehicle.
- Once you decide which method you prefer, stick to it.
- If you are standing on the ground, stand directly behind the first peg, and line the second peg up in the centre of your viewfinder; there should be only a thin strip of sky visible at the top of the view finder.

A few hints and tips:

- You could lean a small chalkboard up against the second post every time you take a photograph, to indicate the date, site number and paddock.
- It is fine to use a 'point and shoot' camera, all you need is something that takes good quality photos.
- Try to use the same camera settings, and film every time you take a photo.
- Decide on a particular time of the year (or a couple of definite times) to take photos (e.g. May 1st and November 1st), you could also take extra photos when there has been a major change, such as a change of season (e.g. severe drought, heavy rain) or a change in grazing conditions (e.g. stocking rate).
- Note in a diary the details of each photo (date, site number, location and exposure number).
- Build up a series of photos of each site in an album.

There are a few simple details about each site that you need to record when you first mark it out.

Copy and use the Site Details Recording Sheet at the end of this section.

Another sheet has been provided for you to record vegetation and soil observations.

Copy and use the Vegetation and Soil Observations Record Sheet at the end of this section.

Use a new one of these sheets every time you take measurements.

- In addition to forage availability; utilisation, shrub cover, and soil cover this sheet allows you to record the management objective that you have established for the paddock and the strategy you will implement to achieve it. It also allows you to record observations on seasonal conditions, non-domestic grazing and any other factors which may affect management decisions.
- Another sheet has been provided to record the stocking history of the paddock.

Copy and use the Paddock Stocking History sheet at the end of this section.

Use one of these sheets per year.

An example of a completed Paddock Stocking History Recording Sheet is shown at the end of this section. On the opening date you record the stock already present and the total DSE by reference to Table 2 (page 22). With each successive entry record the stock numbers in or out, the resulting balance of each type and the total DSE. Also count up the number of days since the last entry, multiply this figure by the total DSE figure of the previous entry to fill out the column on the far right of the sheet. This calculates the grazing from the previous entry to the present date.

The start of the year is a matter of choice but is probably better related to the seasonal pattern or animal husbandry schedules than to the calendar.

SITE DETAILS RECORDING SHEET

Site name/number	
Date of establishment Established by	Area ha ac
Range type/Land system	
Site location map and description	Diagram of site design (mark direction in which photographs and measurements are to be taken

VEGETATION AND SOIL OBSERVATIONS RECORD SHEET

Site					
Date			Recorder		
Management objective for paddock: Strategy:					
Paddock condition compared to management objective					
Standing dry matter (kg/ha)			Available forage (kg/ha)		
Shrub cover (%)			Soil cover (%)		
Utilisation of key species					
Rate seasonal conditions for previous 6 months (from 1 = very poor to 5 = very good)					
Woody weed seedlings			None	Some present	Prolific
Site Grazed by	Light	Moderate	Heavy	Notes/causes	
Goats					
Kangaroos					
Rabbits					

PADDOCK STOCKING HISTORY

Paddock name					Area		
Date	Stock type and number		Balance of each stock type	DSE of Type	TOTAL DSE	Number of days since last entry	Previous total DSE × number of days
	IN	OUT					
Opening date							
Closing date							
						TOTAL:	
						TOTAL / 365 = AV. DSEs for year	
						Area / AV. DSEs = area per DSE for year	

PADDOCK STOCKING HISTORY

Paddock name	Shanty				Area	1500 ha	
Date	Stock type and number		Balance of each stock type	DSE of Type	TOTAL DSE	Number of days since last entry	Previous total DSE × number of days
	IN	OUT					
Opening date 16.1.99			300 EWES 8 RAMS	300 x 1.5 = 450 8 x 2 = 16	466		
1.2.99	7 HORSES		300 P. EWES 8 RAMS 7 HORSES	450 16 7x15 = 105	571	17	466 x 17 = 7922
2.3.99		8 RAMS	300 P. EWES 7 HORSES	450 105	555	29	571 x 29 = 16559
10.5.99		300 P. EWES	7 HORSES	105	105	38	555 x 38 = 21090
1.6.99	350 WETHERS		7 HORSES 350 WETHERS	60 350	455	22	105 x 22 = 2310
7.8.99		3 HORSES	4 HORSES 350 WETHERS	60 350	410	66	455 x 66 = 30030
2.9.99	10 Y. STEERS		4 HORSES 350 WETHERS 10 Y. STEERS	60 350 70	480	25	410 x 25 = 10250
30.9.99		350 WETHERS	4 HORSES 10 Y. STEERS	60 70	130	28	480 x 28 = 13440
10.11.99	250 MERINO WEANERS		4 HORSES 10 Y. STEERS 250 WEANERS	60 70 375	505	41	130 x 41 = 5330
Closing date 16.1.00			4 HORSES 10 Y. STEERS 250 WEANERS	60 70 375	505	66	505 x 66 = 33330

TOTAL:	140261
TOTAL / 365 = AV. DSEs for year	384
Area / AV. DSEs = area per DSE for year	1500 / 384 = 3.9 ha

PART 3. DETERMINING STOCKING RATE

ESTIMATING SHORT-TERM STOCKING RATES

In the semi-arid woodlands rain can occur at any time of the year and forage can be produced from either summer or winter growing species. It is therefore desirable to check or adjust stocking rate at least twice a year – at the end of the summer growing season and at the end of winter-spring growing season.

The method given below is particularly suitable for use at these times. However, it can be used to adjust stocking rate, or monitor forage availability and grazing impact, more frequently if desired.

The process involves four steps. The factors determined in each step will be combined to calculate an appropriate stocking rate for the following 12 months.

Copy and use the Stocking Rate Work Sheet at the end of this section.

STEP 1 – Determine the available forage on hand (Factor 1) relative to this time last year.

- For each type of forage listed in the work sheet table rate the amount present now relative to this time last year, bearing in mind the abundance of the various plant types, their palatability, feed quality, and current level of utilisation. (Be sure to rate the actual amount relative to last year not the proportional change e.g. a relatively large increase in a minor pasture component may still mean that the amount of forage available is only about the same as last year).
- Rate the availability as 1 = much less than this time last year; 2 = less than last year; 3 = about the same as last year; 4 = more than last year; 5 = much more than last year.
- Comparison with a photograph will be most helpful if monitoring sites have been established..
- Factor 1 = 1 if the amount of forage available now is about the same as this time last year.

STEP 2 – Determine the Seasonal Factor (Factor 2) to describe the expected growing conditions (particularly rainfall and temperature) over the coming year relative to those which produced the available forage on hand.

- Rate the seasons in the work sheet table as: 1 = very poor; 2 = poor; 3 = average; 4 = good; 5 = very good
- Ratings for next year of 1 and 2 are conservative, 4 and 5 are a high risk approach. Unless long range weather forecasts are suggesting otherwise you would most likely rate expected seasons as '3'.
- Note: This step is best applied at the end of summer (November–April) or the end of winter (May–October). However, a rating can be applied at any time.

STEP 3 – Determine the paddock condition factor (Factor 3) to estimate how stocking needs to vary to meet pasture management targets.

- To determine this factor you need to have established a management objective for the paddock and worked out your management targets to achieve it. These targets will be part of the overall strategy you have developed to maintain or improve the productivity of the paddock.

- The following calculations are only applicable if grazing can continue in the paddock. If the strategy calls for complete destocking e.g. for seed set or burning, this response will have to be determined independently of this procedure.
- In the box on the work sheet list the management target that you have established for the paddock.
- In column 1 of the work sheet table rate the current status of the paddock against the target. Rate the current status as: 1 = much worse than target; 1.5 = worse than the target; 2 = about on target; 2.5 = better than target; 3 = much better than target.
- In Column 2 enter the rating that will balance the rating in Column 1 to give an average of 2. For example if the paddock condition this year is worse than target (say 1.5) then to get an average of two (2) we will need to rate next year as better than the target (2.5).
  You may feel that the coming year is an opportune time to make large gains in the condition of the paddock in which case you should give Column 2 a higher rating than is necessary to achieve an average of two.
- Note that in determining the current status score it will be necessary to consider the growth stage of the pasture and the stage of the season.
  For example if paddock management targets involve utilisation levels, high utilisation early in the growing season may justify a low score even if the target has not been exceeded.

STEP 4 – Determine the total grazing pressure factor (Factor 4) as a measure of the grazing the paddock has received over the last year

- This factor is the average number of dry sheep equivalents, including non-domestic animals, which the paddock has carried over the last 12 months
- The total number of dry sheep equivalents carried in a two month period is given in the Composition of Total Grazing Pressure Work Sheet (page 45).
- Enter the various total dry sheep equivalent values recorded over the past 12 months in the work sheet table and average to produce FACTOR 4
- At the same time enter the non-domestic dry sheep equivalents recorded over the last 12 months and average. This will be required for the calculations below.

Now estimate the appropriate number of stock to be carried for the next 12 months.

CALCULATION 1: Calculate carrying capacity for the next 12 months as Total Dry Sheep Equivalents

- Combine Factors 1, 2, 3 and 4 to calculate the Total Dry Sheep Equivalents this paddock should carry over the next 12 months.
- Remember this carrying capacity has to be shared between stock and non-domestic animals.

CALCULATION 2: Determine how much of the carrying capacity is available for domestic livestock

- Adjust the figure for average Non-Domestic Dry Sheep Equivalents over the last 12 months (from step 4) up or down if this is likely to change much over the coming year (e.g. due to control measures).
- Subtract this figure from the Total Dry Sheep Equivalents (Calculation 1) to determine the carrying capacity available for domestic stock.

CALCULATION 3: Determine the number of stock to place in the paddock

- If more than one type of stock (sheep/goats or cattle) will be placed in the paddock split the number of domestic DSEs (calculation 2) into the desired proportions.
- Divide the number of DSEs available for each stock type by the DSE conversion factor for that class from Table 2, page 22.

STOCKING RATE WORK SHEET

PADDOCK	AREA (ha)
	DATE

STEP 1 – FORAGE AVAILABILITY FACTOR

FORAGE TYPE	RATING
Palatable perennial grasses	
Winter annuals	
Summer annuals	
Palatable shrubs	
Copper burrs	
TOTAL (Divide total by 15)	____ 15*

FACTOR 1

* If some of these forage types never grow in the paddock, or are never present at this time of year, reduce 15 by 3 for every missing type e.g. if palatable shrubs are never present divide the total by 12 (i.e. 4 x 3).

STEP 2 – SEASONAL FACTOR

	Column 1		Column 2
Previous Season (12–6 months ago)		Expected next season (now–6 months hence)	
Season just gone (6 months ago–now)		Expected following season (6–12 months hence)	
Total over last 12 months–now		Total for coming year	
Seasonal Factor = $\frac{\text{Total coming year (now–12mths) Col 2}}{\text{Total for last 12mths Col 1}}$			

FACTOR 2

STOCKING RATE WORK SHEET (cont)

STEP 3 – PADDOCK CONDITION FACTOR

Paddock Management Target e.g. level of utilisation of perennial grasses not to exceed 30% or soil cover not to drop below 40 %	

COLUMN 1	COLUMN 2	COLUMN 3
Current status	Required status next year	paddock condition factor = column 1 / column 2

FACTOR 3

STEP 4 – TOTAL GRAZING PRESSURE FACTOR

Observation	1	2	3	4	5	6	AVERAGE
Total DSE							
							FACTOR 4
Non-domestic DSE							

CALCULATIONS

1. TOTAL DRY SHEEP EQUIVALENTS

Forage Availability	×	Seasonal	×	Paddock Condition	×	Total Grazing Pressure	=	Total Dry Sheep Equivalents
Factor 1		Factor 2		Factor 3		Factor 4		

2. DOMESTIC CARRYING CAPACITY

	–		=	
Total Dry Sheep Equivalents (Calculation 1)		Non domestic Dry Sheep Equivalents		Number of Domestic Dry Sheep Equivalents

3. NUMBER OF STOCK

SHEEP/ GOATS	÷		=	
CATTLE	÷		=	
Dry Sheep Equivalents available for domestic stock		Conversion factor for stock class (see Table 2 page 22)		Number of stock to run

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APPENDIX 1

THE BITTERLICH GAUGE

A Bitterlich gauge is an easy to make instrument used to estimate canopy cover. As this method does not involve measuring areas, it is relatively fast.

A Bitterlich gauge is simply a rod with a perpendicular cross arm mounted evenly on one end (see diagram). The gauge should be of light material that is easy to hold and will not alter or become hot in the sun.

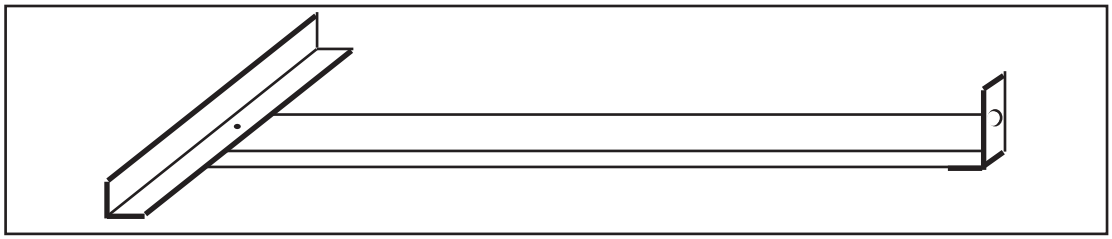
This method of estimating cover is based on the ratio of the cross arm length to the distance of the cross arm from the eye piece. For example, if a Bitterlich gauge is 80 cm long and has a cross arm of 8 cm, the ratio is 1:10. The distance from the observer to any shrub that appears to have a diameter equal to the length of the cross arm will therefore be ten times its actual diameter, just like the cross arm.

Knowing the ratio of a shrub's diameter to its distance, one can calculate the percentage of the area covered by the shrub canopy. If the distance from the observer to the shrub is 10 times the shrub diameter then, assuming the shrub canopy is circular, the area of the canopy is 1/400 or 0.25% of the area of the circle centered on the observer and passing through the base of the shrub.

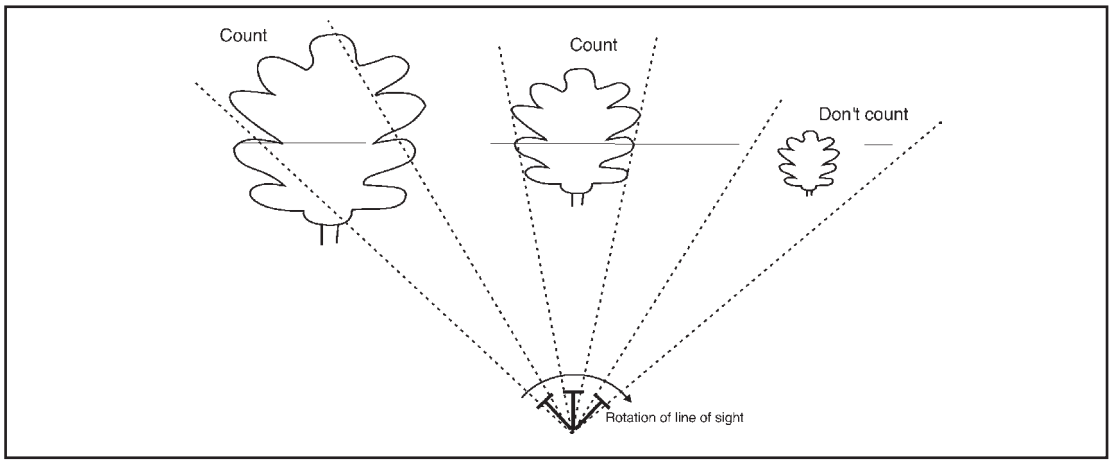
METHOD

The operator sights along the gauge and counts every bush that is as wide or wider than the cross arm that they can see whilst rotating on the spot.

Dividing the total count by the appropriate factor for the gauge (4 for a 1:10 gauge) provides an estimate of % cover. Estimates from several spots (the more the better) are required to obtain an average for the paddock.



Bitterlich gauge. Cross arm is at the left, eyepiece is at the right.



Method of counting.

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