10-2002

Pasture condition guides for the Pilbara

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Miscellaneous Publication 19/2002
ISSN 1326-4168

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Department of Agriculture
Government of Western Australia

Cover picture: Pump well pool, Mount Florance Station, looking south to the Hamersley Ranges

Miscellaneous Publication 19/2002
Agdex 320/11
ISSN 1326-4168

PASTURE CONDITION GUIDES FOR THE PILBARA

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October 2002

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Introduction

These Pasture Condition Guides are relevant to about 192,000 square kilometres of the Pilbara of Western Australia (see Figure 1). The area has been the subject of two inventory and condition surveys (Payne and Tille 1992, Van Vreeswyk *et al.* in preparation) undertaken jointly by the Department of Agriculture and the Department of Land Administration. Information collected during these surveys has been used to prepare these guides.

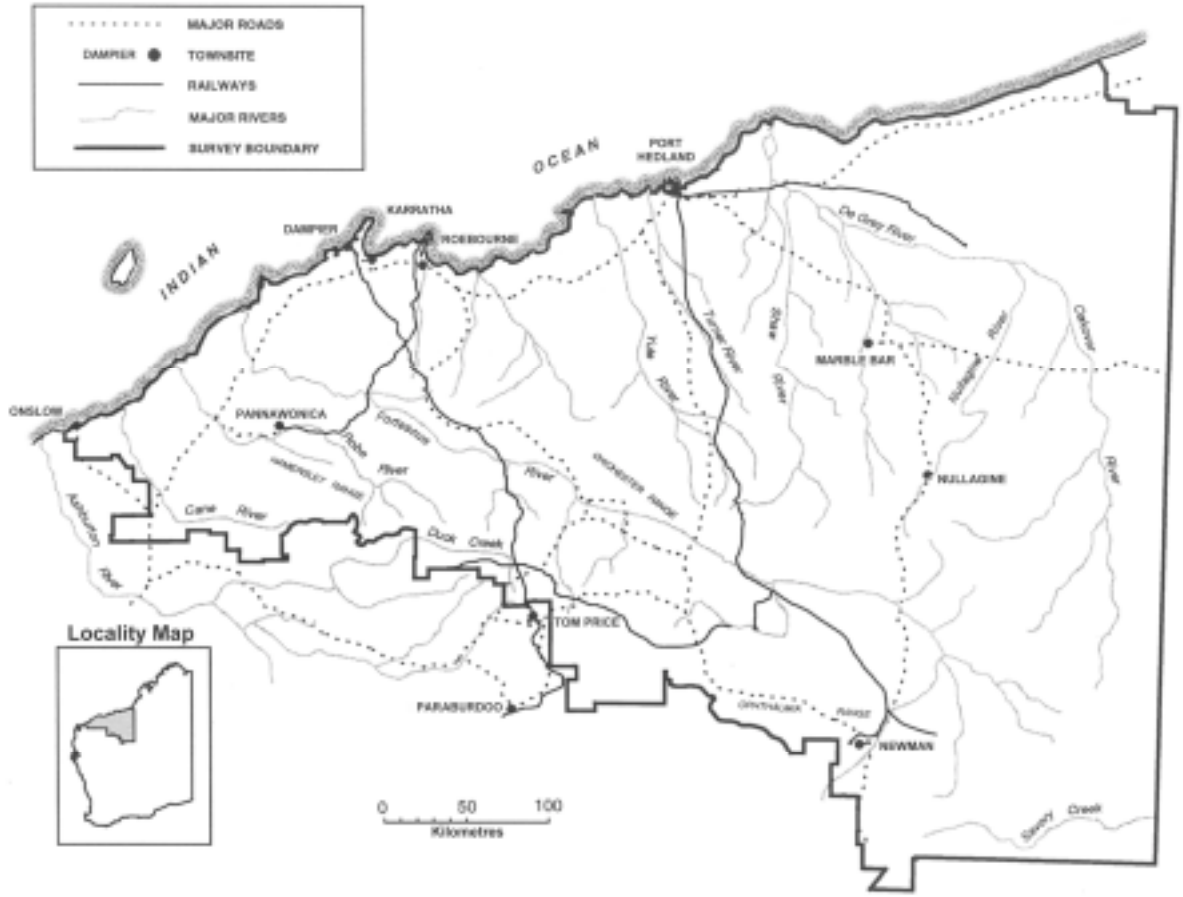

Figure 1. Pilbara locality map

The rangeland of the Pilbara can be separated into 12 very broad pasture types. The 'pasture type' is not strictly a botanical classification because, in determining such a class of pastoral lands, the perennial plant species that contribute to stock production have an over-riding importance. Even so, each pasture type represents a broad group of similar vegetation associations or 'site types' (as described by Van Vreeswyk *et al.* in preparation) which will have similar management requirements for pastoralism.

The aim of this publication is to provide pastoralists with descriptions and condition statements for individual pasture types as a guide, based on land capability assessment, for management and sustainable use.

A number of pasture types in the area are minor in a regional context but are important locally in the management of individual stations. For the sake of simplicity and brevity these have not been given separate descriptions. For example, Kangaroo Grass Pasture of the Hamersley Plateau is only found in two areas. The Mitchell Grass Alluvial Plain Pasture type in this guide has the greatest similarities in productivity, sensitivity and management requirements to Kangaroo Grass Pasture and should be consulted.

Appendix 1 summarises the pasture types in terms of extent, characteristics and present condition. More detailed descriptions of each pasture type, compiled from information

collected during the Pilbara RANGES (Resource and Geographic Survey) project 1995-97 (Van Vreeswyk *et al.* in preparation) and a survey of the Roebourne Plains (Payne and Tille 1992) are presented in the body of this report.

Suggested levels for sustainable grazing use as carrying capacities (per annum) in hectares per cattle unit (ha/cu), for three levels of range condition are presented.

It is stressed that these carrying capacities are only a guide to land capability and productive potential and are not intended to be rigidly applied by managers or used as a basis for legislative controls.

The actual grazing value and appropriate stocking of a particular pasture at any time vary enormously with seasonal conditions, fire history, perennial pasture condition and degree of recent use. Browse and herbage accruing from periods of growth will, in practice, be taken by stock and many other herbivores including feral donkeys, kangaroos, small mammals, termites and other insects. Such factors dictate that an inflexible adherence to suggested stocking rates is not to be recommended. Rather, the aim is to match stocking with the variation in pasture production as closely as possible. Fixed year-round stocking rates result in either under-use or over-use at most times and are largely inappropriate for arid zone pastures.

Pasture types in the Pilbara can be classified into three major groups: those dominated by spinifex (hummock grasslands); tussock grasses (tussock grasslands); or shrubs (shrublands).

Spinifex pastures

Soft Spinifex Plain Pasture

Hard Spinifex Plain Pasture

Spinifex Hill Pasture

Tussock grass pastures

Roebourne Plains Grass Pasture

Ribbon Grass Pasture

Mitchell Grass Alluvial Plain Pasture

Mitchell Grass Tableland Pasture

Buffel Grass Pasture

Shrub pastures

Bluebush/Saltbush Pasture

Snakewood Chenopod Pasture

Hardpan Mulga Shrub Pasture

Acacia Mixed Shrub Pasture

In the Pilbara there is a gradual change from dominantly shrub understoreys in southern parts to tussock grass or hummock grass (spinifex) understoreys in the north. For convenience, snakewood and mulga tall shrublands with understorey dominated by grasses have been described within their relevant grass pasture types whilst those with low shrub understoreys have been described in their relevant shrub pasture type. In assessing whether an area was once a shrubland or grassland we have assumed that soils with crabholes (gilgai microrelief) were once dominated by tussock grasses.

In the pasture type descriptions, the following terminology is used to describe the extent of perennial shrub vegetation and hummock grass (spinifex) cover, as a percentage of ground cover:

Term	Projected foliar cover (PFC) (%)
Isolated	<2.5
Very scattered	2.5-10
Scattered	10-20
Moderately close	20-30
Close	30-50
Closed	>50

For the purpose of this report, the following six categories of pastoral value or potential, based on estimated carrying capacity, have been adopted:

Pastoral value	Carrying capacity (ha/cu)
Very high	5-15
High	16-30
Moderately high	31-50
Moderate	51-80
Low	81-120
Very low	>120

Each pasture type has characteristic plants known as 'indicator species' that indicate the condition of the vegetation for the purpose of pastoral use. Plants in the species list for each pasture type have been divided into four categories of indicator value (see Table 1) - **decreasers**, **increasers**, **intermediates** and **no indicator value**. Some species are more sensitive to grazing than others in the same category. For example, ruby saltbush (*Enchylaena tomentosa*) is much more easily removed from the Bluebush/Saltbush Pasture type than tall saltbush (*Rhagodia eremaea*) but both are classified as decreasers.

More detailed information on many of the common species found in the Pilbara, including their indicator values, is contained in '*Arid shrubland plants of Western Australia*' (Mitchell and Wilcox 1994) and '*Plants of the Kimberley region of Western Australia'* (Petheram and Kok 1983). By being able to distinguish plant species, land managers can determine the impact of their management practices, and set goals in terms of the numbers and species of plants they want on the property.

Table 1. Species indicator values

Broad group	**Characteristics**
Decreasers (desirables)	Species which decrease in numbers as grazing pressure increases (e.g. barley Mitchell grass - *Astrebla pectinata*, silver saltbush - *Atriplex bunburyana*). These are highly palatable preferred species and are also known as 'desirables'.
Increasers (undesirables)	Species that increase in number with grazing pressure (e.g. crinkled cassia - *Senna artemisioides* subsp. *helmsii*, feathertop three awn - *Aristida latifolia*). These are unpalatable species known as 'woody weeds' (in the case of shrubs) or 'undesirables'. They can also include palatable species that are poisonous to livestock (e.g. black soil poison - *Stemodia kingii*).
Intermediates	Species which may initially increase under grazing, but being moderately or slightly palatable, later decrease under continued increasing grazing pressure (e.g. three winged bluebush – *Maireana triptera*).
No indicator value (stability desirables)	Species which are largely unaffected by grazing and which usually only decrease in number after natural disturbance such as hail damage or fire (e.g. mulga - *Acacia aneura*, hard spinifex - *Triodia* spp., eucalypt trees). These species are not palatable or only slightly palatable (or out of reach of browsing animals) and are known as 'stability desirables'. They confer stability on the landscape and contribute to important landscape functioning processes such as water retention and nutrient cycling.

SPINIFEX PASTURES

Soft Spinifex Plain Pasture

Approximate area 44,150 km^2 (23.0% of total)

Distribution and soil type

Soft Spinifex Plain Pasture is common throughout the survey area. It is found on areas that receive extra water such as alluvial fans, alluvial plains and drainage floors and on some stony plains, sandplains and coastal dunes. It is the major pasture of the Bonney, Dune, Mallina, Nita, Paradise and Urandy land systems and an important component on many other systems.

Extensive areas occur near the coast on calcareous sandy soils of the Cheerawarra and Dune systems and on the red duplex and gradational soils of the Mallina system. Soft spinifex is often dominant or co-dominant with buffel grass on the alluvial soils of the River system.

The pasture type is also common on sandy-surfaced plains, interfluves and drainage floors of such land systems as Macroy and Uaroo. They are common on narrow drainage floor of numerous other systems. Soils are stony duplexes, red sands or red gradational types.

Vegetation structure and composition

Structure and composition are variable and a function of past fire regimes, soil types and prevailing climatic conditions. Pastures may be hummock grasslands, tall or low shrublands and occasionally, low woodlands. In each case the ground storey is dominated by soft spinifex (*Triodia pungens* or *T. epactia*) which can have a PFC of up to 50%.

Shrubs and trees are usually very scattered (PFC <10%), but occasionally scattered (PFC 10-20%). On some sandy plains of the Uaroo land system shrubs such as poverty bush (*Acacia translucens*) and wax wattle (*Acacia ancistrocarpa*) can become close or closed (PFC 30->50%) and there are few associated species.

Hummock grasslands with high PFC are prone to fire. Evidence of past burns is obvious in many areas where the vegetation has been completely removed or where sub-climax stages exist. Early stages after fire on such systems as Mallina, Macroy, Uaroo, and Urandy often take the form of shrublands, where pioneering perennial shrubs are co-dominant with spinifex seedlings. Prominent shrubs after fire include fire wattle (*Acacia pyrifolia*), kanji (*A. inaequilatera*), poverty bush (*A. translucens*), wax wattle (*A. ancistrocarpa*) and pindan wattle (*A. tumida*). Other species include the relatively short-lived cockroach bush (*Senna notabilis),* woolly corchorus *(Corchorus walcottii*) and *Cullen* and *Indigofera* spp. A wide range of small annuals, biennials and herbaceous perennials also occur after fire. About five years after burning, soft spinifex may regain dominance in the stand as the shrubs either senesce or are crowded out by expanding spinifex hummocks (Suijdendorp 1967). Pastures will resume the form of hummock grassland with scattered or very scattered shrubs. Isolated trees such as corkwood (*Hakea suberea*), wild walnut (*Owenia reticulata)* and eucalypts are occasionally present.

A few other perennial grasses occur as isolated clumps or patches within Soft Spinifex Plain Pasture. The most important of these are hop-along grass (*Paraneurachne muelleri*), ribbon grass (*Chrysopogon fallax*) and buffel grass (*Cenchrus ciliaris*) on sandy-surfaced soils and Roebourne Plains grass (*Eragrostis xerophila*) and curly windmill grass (*Enteropogon acicularis*) on more clayey soils.

Pastoral value

The pastoral value and carrying capacity of Soft Spinifex Plain Pastures varies from moderate to low depending on the stage in the burning cycle. After fire, this pasture produces a wide range of palatable short-lived perennial herbs, annuals and young soft spinifex and has a moderate carrying capacity (about 60 ha/cattle unit).

Forage value is high with crude protein levels as high as 9% in soft spinifex seedlings being reported by Suijdendorp (1981). By the third or fourth year after fire the productivity and forage value declines as the spinifex becomes older and less palatable and commences to reassert dominance in the stand.

The durability and usefulness to stock of young Soft Spinifex Plain Pastures in dry times is high. When maintained in a young productive state they are suitable for carrying stock, including breeders, on a year-long basis.

Common perennial species

Decreasers (desirables)
Aerva javanica (kapok bush)
Abutilon spp.
Abutilon trudgenii
Bonamia alatissima
Bonamia erecta
Bonamia rosea
Cenchrus ciliaris (buffel grass)
Chrysopogon fallax (ribbon grass)
Cullen pogonocarpum
Eragrostis eriopoda (woolly butt)
Eragrostis xerophila (Roebourne Plains grass)
Goodenia microptera
Hybanthus aurantiacus
Paraneurachne muelleri (hop-along grass)
Ptilotus astrolasius
Ptilotus axillaris (mat mulla mulla)
Ptilotus obovatus (cotton bush)
Rhyncosia minima (Mardie clover)
Senna artemisioides subsp. *oligophylla* (bloodbush)
Sida fibulifera (creeping sida)
Solanum diversifolium (bush tomato)
Tephrosia uniovulata
Triodia epactia (grey soft spinifex)
Triodia pungens (soft spinifex)

Increasers (undesirables)
Acacia ancistrocarpa (wax wattle)
Acacia translucens (poverty bush)
Corchorus sidoides (flannel weed)
Corchorus walcottii (woolly corchorus)
Crotalaria crispata (Kimberley horse poison)
Cullen leucochaites
Ipomoea muelleri (poison morning glory)
Pluchea tetranthera
Senna notabilis (cockroach bush)
Tephrosia rosea (Flinders River poison)

Intermediates
Aristida holathera var. *holathera* (erect kerosene grass)
Eriachne obtusa (wire grass)
Evolvulus alsinoides
Solanum lasiophyllum (flannel bush)

No indicator value (stability desirables)
Acacia atkinsiana
Acacia aneura (mulga)
Acacia bivenosa (two vein wattle)
Acacia coriacea (river jam, coastal jam)
Acacia eriopoda (Broome wattle)
Acacia holosericea (candelabra wattle)
Acacia inaequilatera (kanji)
Acacia pruinocarpa (gidgee)
Acacia pyrifolia (fire wattle)
Acacia sclerosperma (limestone wattle)
Acacia trachycarpa (miniritchie)
Acacia tumida (pindan wattle)
Acacia victoriae (prickly wattle)
Carissa lanceolata (conkerberry)
Corchorus spp.
Indigofera monophylla (one leaf indigofera)
Corymbia hamersleyana (Hamersley bloodwood)
Grevillea pyramidata (caustic bush)
Grevillea wickhamii (Wickham's grevillea)
Goodenia stobbsiana
Gossypium australe (wild cotton)
Hibiscus burtonii
Hibiscus sturtii
Hakea suberea (corkwood)
Mollugo molluginis
Pterocaulon sphacelatum
Senna artemisioides subsp. *helmsii* (crinkled cassia)
Senna glutinosa (sticky cassia)
Senna glutinosa subsp. *luerssenii* (white cassia)
Sida echinocarpa
Sida spp.
Triodia wiseana (limestone spinifex)
Triodia longiceps (knitting needle spinifex)

Condition statement

As with Hard Spinifex Plain Pasture, condition status and the effects of grazing are often difficult to assess on Soft Spinifex Plain Pasture. The high frequency of fires means that the presence or absence of particular species or suites of species may be more closely linked to season of firing and post-fire stages than to grazing pressure. Condition assessment is based on the composition of the short-lived perennial herbs and the density and vigour of spinifex seedlings that appear in the post-burning phase.

Long unburnt dense stands of mature spinifex can be regarded as being in good condition although it will not be known if the general absence of palatable species is due to direct competition from the spinifex alone or in combination with grazing. Palatability and pastoral value will be low. Marked shrub increases after fire can be regarded as indicating a decline in condition. Suijdendorp (1981) suggests that 'shrub invasions' can occur after a winter burn.

The unpalatable low shrub poverty bush (*Acacia translucens*) may thrive and establish in thick stands, at the expense of the spinifex. Winter burning appears to promote the vigorous growth of other undesirable and unpalatable plants such as cockroach bush (*Senna notabilis*).

Traverse data (3,581 observations) during the Pilbara rangeland survey 1995-97 (Van Vreeswyk *et al.* in preparation) indicated the following condition:

- Vegetation condition: very good 69%, good 20%, fair 8.5%, poor 2.5%
- Soil erosion: nil 95.5%, slight 1.5%, minor 1.9%, moderate 0.9%, severe 0.2%, extreme 0.1%.

These data show that the condition of Soft Spinifex Pasture in Pilbara is predominantly in very good or good condition but occasionally some areas are in poor condition.

Poor condition can result from long-term overuse especially on small areas of burnt spinifex among large areas of mature spinifex. Overuse results in the elimination of the edible herbs and grasses, including the spinifex seedlings and results in large areas of bare soil with a few isolated shrubs or large spinifex hummocks. Poor condition is also indicated by dense stands of undesirables such as poverty bush, wax wattle or cockroach bush. Although shrub invasion is not a widespread problem on this pasture type it is significant in localised areas on some coastal stations.

Soil erosion is not usually associated with a decline in condition on this pasture. However, there are some notable exceptions especially where the pasture occurs on sandy-surfaced duplex soils which are inherently susceptible if vegetative cover is depleted, e.g. on alluvial plains of the Paradise land system where minor and moderate erosion, in the form of scalding, sheeting and wind piling is common and severe erosion occurs locally. About 43.5 km^2 of the Paradise system (nearly 3%) is severely degraded and eroded (sde).

Suggested levels of use (per annum):

Good condition	60 hectares per cattle unit
Fair condition	84 ha/cu
Poor condition	120 ha/cu

Good condition

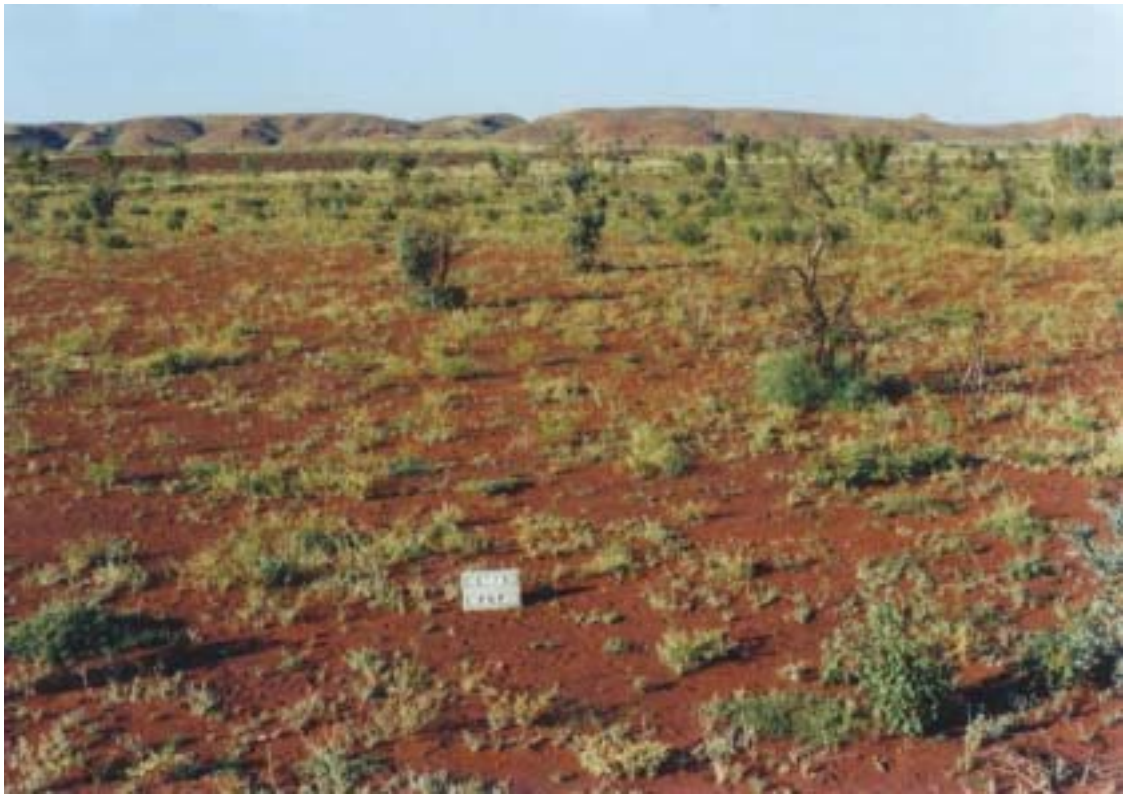

Photo 1 shows a soft spinifex community in good condition that was burnt a year previously. There is a diverse assemblage of short-lived perennial herbs and grasses, including spinifex seedlings, many of which are palatable to livestock. The site is a sandy-surfaced plain on the Urandy land system.

Photo 2 shows an old, dense community of soft spinifex that has not been burnt for several years. Competition from the spinifex means that there are only a few associated herbaceous perennials. It can still be regarded as being in good condition but pastoral value and carrying capacity are low compared to photo 1.

Fair condition

Photo 3 shows a soft spinifex community in fair condition. There is a much reduced population of palatable short-lived perennial herbs compared to good condition but generally no reduction in soft spinifex. There has been no increase of undesirable herbs or shrubs.

Poor condition

Photo 4 shows a soft spinifex community in poor condition. Regrowth from a burn about a year ago consists mostly of the short-lived perennial increasers cockroach bush (*Senna notabilis*) and *Cullen leucochaites*.

Poor condition

Photo 5 shows a dense stand of poverty bush (*Acacia translucens*) which has taken over in Soft Spinifex Plain Pasture on a sandy plain. Condition is poor. Poverty bush is a common minor component in these pastures but can sometimes become a woody weed problem to the exclusion of most other species. It can be removed by hot fire.

Management

Soft Spinifex Plain Pasture is of most use to stock when spinifex plants are young and a range of other grasses, herbs and forbs are present. Areas of useful pasture can be maintained by a system involving periodic burning on a paddock or sub-paddock scale (using natural firebreaks and cleared lines wherever possible) and rotational use.

There is evidence that in the Pilbara environment season of burning influences the resulting species composition of the pasture (Suijdendorp 1967). Summer burning, to encourage grass species rather than shrubs is recommended. Burning should be accompanied by deferment of grazing for six to eight weeks following effective rainfall to ensure that spinifex seedlings and other desirable species have time to establish and develop. For a more detailed coverage of fire management on soft spinifex see Stretch (1996) and Williams and Tauss (1990).

Soft spinifex plants usually regain dominance in a stand within about five years. By that time its palatability will be relatively low and there are few other useful species left in the stand. Rotational burning of these pastures will ensure that, at any give time, some areas are in the most acceptable stages of growth with a wide range of plant species available for grazing.

Exceptions exist to the general recommendation of regular burning. It is not recommended on the Cheerawarra land system which is inherently highly susceptible to wind erosion. Grazing pressure needs to be carefully manipulated to ensure that ground cover of desirable perennials such as soft spinifex and buffel grass is sufficient to maintain soil stability.

Where possible, extensive areas of soft spinifex should be fenced separately from other more productive pastures. This will allow use of spinifex pastures on an opportunistic basis by using the palatable ephemeral growth in good seasons after fire and spelling more valuable pastures at a time when their rejuvenation will be at a maximum.

Hard Spinifex Plain Pasture

Approximate area 55,280 km^2 (28.8% of total)

Distribution and soil type

This pasture type is one of the largest in the Pilbara and is widely distributed. It is an amalgam of a great variety of spinifex communities in which the main spinifex species are generally unpalatable to stock. It is found on saline plains, coastal plains, plains formed on granite, basalt, shale and other rocks, calcrete plains and sandplains. Soils may be very shallow to full depth (>1 m) and are often stony. They include red duplex and gradational types, red clays, red sands and shallow calcareous loams.

Hard Spinifex Plain Pasture is widespread on land systems such as Boolgeeda, Calcrete, Divide, Giralia, Little Sandy, Macroy, Paterson, Peedamulla, Pyramid, Satirist, Sherlock, Stuart and Taylor where it is frequently associated with lesser areas of Soft Spinifex Plain Pasture.

Vegetation structure and composition

Hard Spinifex Plain Pasture is predominantly hummock grassland - that is, the spinifex ground strata is dominant. Occasionally, the upper strata may dominate and the pasture type takes the form of a low (<2 m) or tall (>2 m) shrubland but still with a prominent spinifex ground layer.

The upper strata within Hard Spinifex Plain Pasture is generally isolated to very scattered (PFC <2.5-10%). Occasional trees include bloodwoods (*Corymbia* spp.), corkwood (*Hakea suberea*), desert walnut (*Owenia reticulata*) and desert oak (*Allocasuarina decaisneana*). Shrubs are dominated by *Acacia* spp. particularly the ubiquitous kanji (*Acacia inaequilatera*), fire wattle (*A. pyrifolia*), two vein wattle (*A. bivenosa*), wax wattle (*A. ancistrocarpa*), poverty bush (*A. translucens*), *A. atkinsiana* and *A. acradenia*. Widely distributed low shrubs include *Corchorus*, *Cullen* and *Indigofera* spp. and cassias (*Senna* spp.).

Perennial grasses other than hard spinifex occur occasionally, but are never significant in the stand. Buck wanderrie (*Eriachne helmsii*), ribbon grass (*Chrysopogon fallax*), and soft spinifex (*Triodia pungens*) on sandy sites and *Cymbopogon* sp. on stony sites are the most common.

Projected foliar cover (PFC) of the whole vegetation stand may range from 0-50% depending mainly on the fire history of the area. Old stands, unburnt for a long time, have a high PFC. Fires kill senescent stands and, for a short time, totally remove the ground cover.

On recently burnt country, spinifex seedlings establish readily after one reasonable season, but the cover remains low for one or two seasons. In some situations (particularly on plain land systems such as Boolgeeda, Macroy and Uaroo) numerous shrubs and a few herbaceous perennials emerge as pioneers together with spinifex. As such a stand matures the shrub layer may dominate briefly and the stand would be classified as a shrubland. These fire-responsive shrubs include fire wattle (*Acacia pyrifolia*), kanji (*A. inaequilatera*), poverty wattle (*A. translucens*), cockroach bush (*Senna notabilis*) and *Corchorus* and *Cullen* spp. As the stand approaches its climax state (commonly five years after fire) it normally resumes the form of hummock grassland with the shrub component diminishing through senescence or through competition and crowding by spinifex (Suijdendorp 1967).

Pastoral value

Hard Spinifex Plain Pasture has very low pastoral value and carrying capacity. It supports a smaller range and less dense stands of palatable short-lived perennial herbs and grasses after fire than Soft Spinifex Pasture. In addition the hard spinifex seedlings are unpalatable to stock, unlike soft spinifex.

Hard Spinifex Plain Pasture is incapable of supporting reproducing livestock in most situations. However, for a year or two after fire and with good seasonal conditions, it can support dry stock at low rates. Old, mature stands of hard spinifex are virtually useless for pastoralism.

Common perennial species

The spinifex communities in this pasture type are so diverse that a meaningful species list cannot be compiled. Instead it is more useful to briefly describe the various hard spinifex communities in the region.

Porcupine spinifex (*Triodia secunda*)

This is found growing on saline soils on some level plains of the Yamerina and other land systems near the coast and in small patches marginal to creeks in granite landscapes north of the Chichester Range. It is very slow to regenerate after fire and this community should not be burnt if at all possible as the ground is left bare for long periods, allowing erosion to start. Unlikely as it would appear, this spinifex is eaten by stock in times of forage shortage. Their method of eating is unusual, it being reported that stock trample the brittle leaves from the hummocks and then eat the leaves off the ground.

Desert hard spinifex (*Triodia basedowii*)

Extensive areas of this community are found on the sandplains of the Divide, Buckshot and Little Sandy land systems east of Newman and Nullagine. The authors have no knowledge of it being eaten by stock but the community does support a variety of short-lived perennial herbs and grasses after fire when it provides moderate grazing. However, because it is associated with the desert where rainfall is low and erratic, return to burning time is likely to be more than five years and possibly up to 10 years or more.

Common hard spinifex (*Triodia lanigera*)

This spinifex is found throughout the Pilbara except for the desert. It is not known to be eaten by stock but after fire the community supports numerous edible short-lived perennial herbs and grasses which provide fair grazing. Return to burning time would be about five years.

Weeping spinifex (*Triodia* sp. 'Indee')

This spinifex occurs on some sandplains of the Uaroo system developed on old alluvium and granite between the Chichester Range and Port Hedland. It is usually unpalatable but is eaten during periods of extreme forage shortage. It is generally not killed by fire and early storms can bring up regrowth that is palatable to stock when there is no other forage available. The pasture includes a variety of short-lived perennial herbs and grasses after fire when it provides good grazing. It has a return to burning frequency of about five years.

Knitting needle spinifex (*Triodia longiceps*)

This community is associated with partly saline clay soils on numerous land systems in the eastern Pilbara. It can grow into hummocks to 2 m tall, has extremely sharp leaf points and, to our knowledge, is never eaten by stock. It is associated with salt-tolerant plants like golden bluebush (*Maireana georgei*) and bindiis (*Sclerolaena* spp.) and may have taken over significant areas of saltbush/bluebush/Roebourne Plains grass on some land systems. After burning it supports a limited array of salt loving, short-lived perennial herbs and grasses which provide small quantities of good forage.

Pincushion spinifex (*Triodia plurinervata*)

This spinifex is largely restricted to the upland plains of the Hamersley Range and desert areas. It usually grows on shallow infertile soil and grows very slowly. Return to burning frequency would be in the order of 10 to 15 years. After burning it supports a sparse community of short-lived perennials and is of little pastoral value.

Limestone spinifex (*Triodia wiseana*)

This common spinifex is widespread in Pilbara. It is the dominant vegetation on the Calcrete and Oakover land systems and a minor component on many other stony plain systems. It is found on alkaline soils such as those developed on basalt, limestone and calcrete. It is not known to be eaten by stock. It has a return to burning frequency of about five years and supports a variety of short-lived perennial herbs and grasses after fire which provide small quantities of fair grazing for about two years after fire.

Giant oat-eared spinifex (*Triodia bynoei*)

This spinifex is mainly restricted to shallow valleys within the Hamersley Plateau associated with a sparse overstorey of mulga (*Acacia aneura*). It grows rapidly and its return to burning frequency may be less than five years. It too supports a variety of short-lived perennial herbs and grasses after fire when it has some grazing value.

Condition statement

Condition levels and effects of grazing are difficult to determine on Hard Spinifex Plain Pasture. The relatively frequent occurrence of fire strongly influences the situation. The presence or absence of desirable or undesirable species may be more closely linked to particular fire events than to grazing pressure.

Occasionally, shrub invasion can be a problem on some plain areas. After a winter fire, conditions seem to favour the establishment of shrubs. Thick stands of unpalatable species, such as poverty bush (*Acacia translucens*) and cockroach bush (*Senna notabilis*) can develop at the expense of other species and a stable, non-productive shrubby association develops.

On sandy sites wind erosion in the form of piling and hummocking can occur on burnt areas which have not yet stabilised with seasonal growth. Such areas may appear degraded until after good rain when they are rapidly recolonised and stabilised by spinifex and other species.

In general, Hard Spinifex Plain Pasture is little affected by grazing, when in good condition and shows no erosion. Traverse data (4,115 observations) during the Pilbara rangeland survey 1995-97 (Van Vreeswyk *et al.* in preparation) indicated the following condition:

- Vegetation condition: very good 87%, good 9.5%, fair 3%, poor 0.5%
- Soil erosion: nil 98%, slight 1%, minor 1%.

Good condition

In good condition Hard Spinifex Plain Pasture supports small quantities of a variety of short-lived perennials after fire and these gradually disappear as the spinifex reasserts dominance.

Photo 6 shows a hard spinifex grassland of limestone spinifex (*Triodia wiseana*) on a stony plain of the Taylor land system. It was burnt a few years ago and is in good condition.

Photo 7 shows a hummock grassland of pincushion spinifex (*Triodia plurinervata*) that is probably at least five years old. It is growing on a stony rise in the White Springs land system. This community only burns occasionally and is among the least productive in the Pilbara. It can be regarded as being in good condition but has no carrying capacity.

Fair condition

This condition is rarely seen and no photograph is available.

Poor condition

This condition is rare but occasionally found where small patches of hard spinifex have been burnt and animals selectively overgraze these small areas.

Photo 8 shows a weeping spinifex (*Triodia* sp. 'Indee') community in poor condition because a small area has been burnt and then heavily grazed resulting in large but sparse hummocks and the disappearance of perennial herbs and grasses. Note that this spinifex is not normally grazed but has been in this case due to forage shortage. Most hard spinifexes are rarely grazed.

Management

Hard Spinifex Plain Pasture is generally of very limited use to stock. However, controlled fires can be used as a management tool to marginally improve carrying capacity. Burning old stands allows the establishment of more nutritious and palatable shrubs, herbs and grass species. A hot summer burn will carry well and spinifex hummocks will be killed outright. It is considered less beneficial to burn in winter as all of the old spinifex stands may not be killed and conditions may favour the establishment of unpalatable species, and shrub invasion may become a problem.

Following burning, paddocks should be spelled for six to eight weeks over the growing season to allow palatable seedlings to develop and set seed. If grazed immediately after burning, palatable seedlings are likely to be selectively removed and unpalatable species favoured.

Hard spinifex can be expected to resume dominance and become a mature closed community by about five to ten years after a burn. The actual time taken will depend on the species of spinifex involved and site and climate factors. Sites with deeper sandy soils are likely to have shorter return to burning times than sites with shallow stony soils.

Paddocks with hard spinifex should be burnt on a rotational basis with successive seasonal deferments. Such a practice, once established, will maintain most pastures in the more productive stages for a longer time. As such they are suitable for use by dry stock at very low rates.

Suggested levels of use (per annum):

Good condition	140 hectares per cattle unit
Fair or poor condition	170 ha/cu

Spinifex Hill Pasture

Approximate area 56,730 km^2 (29.5% of total)

Distribution and soil type

Spinifex Hill Pasture is extensive and widespread in the Pilbara. It dominates all of the hills with the notable exception of the basalt hills around Marandoo (Marandoo land system) which support tussock grasses below shrubs. Most hills support various species of hard spinifex (*Triodia* spp.) but there are also some appreciable hill areas that support soft spinifex (*Triodia pungens*) e.g. on some parts of the Granitic, Rocklea and Ruth land systems. Soils are skeletal clays and sands with dense stony surface mantles and rock outcrop.

Vegetation structure and composition

This pasture type is usually a hummock grassland of various spinifexes with isolated to very scattered (PFC <2.5-10%) trees and shrubs. Occasionally the upper strata may become scattered with PFC up to 20%. Eucalypt trees such as snappy gum (*Eucalyptus leucophloia*) and Hamersley bloodwood (*Corymbia hamersleyana*) are common on some hills and ranges of the Newman and McKay land systems. Other trees include terminalia (*Terminalia canescens*) and rock fig (*Ficus* spp.) on some basalt and granitic hills. Kanji (*Acacia inaequilatera*) occurs extensively as isolated low trees or tall shrubs over many hill systems. Common low or mid height (<2 m tall) shrubs include sticky cassia (*Senna glutinosa*), white cassia (*S. glutinosa* subsp. *luerssenii)*, one-leaved indigofera (*Indigofera monophylla*), tall mulla mulla *(Ptilotus calostachyus*) and *Acacia* spp.

The ground layer in this pasture type is spinifex with a PFC usually in the range of 5-30% depending on such factors as fire history, slope and degree of stoniness. Common but isolated or very patchy companion perennial grasses are lemon scented grass (*Cymbopogon ambiguus*) and stony wanderrie grass (*Eriachne mucronata*).

Pastoral value

The bulk of Spinifex Hill Pasture is based on hard spinifex and as such has no value for pastoralism. The type supports very few palatable perennial plants at low density and, in many cases, access to livestock is severely restricted by rugged topography.

Those relatively limited areas of Spinifex Hill Pasture based on soft spinifex and where accessibility is not a problem have low or very low pastoral value and carrying capacity. Hills and ranges are not favoured by livestock which appear to only graze accessible lower slopes in times of forage shortage on more favoured pastures or for short periods after burning. Given that this pasture supports very few palatable species and is largely unaltered by grazing it is not possible to prepare meaningful species lists based on plant responses to grazing.

The following are the main spinifex communities found on hills in the Pilbara:

Common hard spinifex (*Triodia lanigera*)

This unpalatable hard spinifex is common on hills and plains. The short-lived herbaceous perennial component after fire within the hill communities is unknown but is most likely less productive than in plain communities.

Limestone spinifex (*Triodia wiseana*)

Like common hard spinifex, this species occurs widely on both hill and plain land systems. It favours alkaline soils.

Echidna spinifex (*Triodia brizoides*)

This unpalatable spinifex is found on hills and hill slopes with shallow skeletal soils over parent material such as sandstone and quartzite. After fire it probably supports very low populations of short-lived perennial herbs and grasses but is of little grazing value.

Soft spinifex (*Triodia pungens*)

Some hills of basalt, other volcanic rocks, pisolite and shale support both soft and hard spinifex, not usually as mixed stands but as one or other spinifex being locally dominant. As it is not possible to map the distribution of soft spinifex on hills by aerial photo interpretation, this community has been included in with the hard spinifexes in the Spinifex Hill Pasture type. It has a greater production capacity than hills with hard spinifex but is not as good as Soft Spinifex Plain Pasture.

Scree soft spinifex (*Triodia biflora*)

This rare spinifex is found on some scree slopes of the Hamersley Ranges where there are generally no grazing animals. Very little is known about this spinifex as it has only recently been recognised as a species. It is of academic interest rather than of pastoral value.

Condition statement

Spinifex Hill Pasture is largely unaffected by grazing and is all in good condition. There is no erosion.

Good condition

Photo 9 shows a hill slope on the Newman land system supporting a hummock grassland of echidna spinifex (*Triodia brizoides*) with an overstorey of snappy gum (*Eucalyptus leucophloia*). Condition is good but it has negligible grazing value.

Good condition

Photo 10 shows a low basalt hill crest of the Rocklea land system supporting a hummock grassland of limestone spinifex (*Triodia wiseana*) with a few shrubs of kanji (*Acacia inaequilatera*). Condition is good but there is negligible grazing potential.

Photo 11 shows the Newman land system in the vicinity of Camp Anderson in the Hamersley Ranges with a hummock grassland of scree soft spinifex (*Triodia biflora*) and a few eucalypt trees in the foreground. There is no value for pastoralism.

Management

These pastures are of very little or no use for grazing by stock and there are no management methods that can markedly improve their value for pastoralism. They are subject to fires from lightning strike, accident and from fires spreading from deliberate burning on adjacent plain systems.

Suggested levels of use (per annum)

Hills with soft spinifex	120 hectares per cattle unit
Hills with hard spinifex	280 ha/cu

TUSSOCK GRASS PASTURES

Roebourne Plains Grass Pasture

Approximate area 5,280 km^2 (2.8% of total)

Distribution and soil type

Extensive areas of this pasture are found on the Roebourne Plains as the name implies and along the valleys of major rivers, such as the Fortescue, De Grey and Oakover. It is common on land systems such as Brockman, Horseflat, Pullgarah and Yamerina and is a minor component of many other systems. It grows on old alluvial plains (and some plains developed *in situ* on basalt) with alkaline, cracking clay soils, often with weak crabhole (gilgai) microrelief, and which are generally saline at depth. Soil colour is red or reddish brown and depth >1 m. Surface mantles are absent or common to abundant as pebbles and cobbles of ironstone, basalt and other rocks. The plains are not generally subject to inundation.

Vegetation structure and composition

The pasture type occurs as tussock grasslands on open, treeless plains that may extend for 5 or 6 km or more. A feature of the pasture is its occurrence as a natural mosaic of dense and less dense patches of Roebourne Plains grass (*Eragrostis xerophila*) over the plains. Variations in micro-topography and soil properties are probably responsible for the patterning.

Roebourne Plains grass occurs with a basal density of up to 10% (but most commonly 5% or less) and is often associated with patches of swamp grass (*Eriachne benthamii*) or neverfail (*Eragrostis setifolia*) on the larger gilgai depressions. Other perennial grasses which may occasionally occur as sparse patches or isolated tussocks within the stand are barley Mitchell grass (*Astrebla pectinata*), ribbon grass (*Chrysopogon fallax*) and native panic (*Panicum decompositum*). Shrubs are generally absent or isolated although there are sometimes patches of snakewood (*Acacia xiphophylla*). Occasionally, on weakly gilgaied saline plains of the Horseflat and Cheerawarra systems Roebourne Plains grass is associated with giant bindii shrubs (*Sclerolaena hostilis*) up to 1 m tall with PFC up to 15%.

Beard (1975) suggests that parts of the Roebourne Plains may originally have carried silver saltbush (*Atriplex bunburyana*) in addition to perennial grasses. Isolated plants of silver saltbush were seen on the Horseflat land system. Larger relic patches are present near the Roebourne airport. Here they take the form of low shrublands of saltbush and giant bindii (PFC 5-10%) with prominent patches of Roebourne Plains grass and scattered ribbon grass and buffel grass. Such areas are a saltbush pasture type rather than Roebourne Plains grass pastures. They are of very limited extent and are best described under the Saltbush/Bluebush Pasture type in this publication.

Pastoral value

Pastoral value is high with numerous ephemerals and perennial grasses and herbs providing nutritious grazing after rain. Roebourne Plains grass is not particularly palatable to livestock but is usually grazed after the short-lived perennial herbs and annuals have been consumed. It provides reasonable quality forage for several months into the dry season. However, when mature its palatability and quality deteriorates considerably and, in prolonged dry periods, the pasture provides only a sub-maintenance ration for stock.

Common perennial species

Decreasers (desirables)
Abutilon malvifolium
Astrebla pectinata (barley Mitchell grass)
Cenchrus ciliaris (buffel grass)
Chrysopogon fallax (ribbon grass)
Cyperus bulbosus
Desmodium campylocaulon
Enchylaena tomentosa (ruby saltbush)
Enteropogon acicularis (curly windmill grass)
Eragrostis setifolia (neverfail)
Eragrostis xerophila (Roebourne Plains grass)
Fimbristylis dichotoma
Goodenia pascua
Indigofera trita
Neptunia dimorphantha (sensitive plant)
Panicum decompositum (native panic)
Rhagodia eremaea (tall saltbush)
Rhyncosia minima (Mardie clover)
Sclerolaena hostilis (giant bindii)
Senna hamersleyensis (creeping cassia)
Sida fibulifera (creeping sida)
Tephrosia clementii
Increasers (undesirables)
Acacia farnesiana (mimosa bush)
Acacia victoriae (prickly acacia)
Aristida latifolia (feathertop three awn)
Ipomoea muelleri (poison morning glory)
Senna artemisioides spp. *helmsii* (crinkled cassia)
Senna sp. 'Meekatharra' (straight leaf cassia)
Stemodia kingii (black soil poison)
Streptoglossa spp. (stinkweed)
Intermediates
Eriachne benthamii (swamp grass)
Senna artemisioides subsp. *oligophylla* (bloodbush)
Sclerolaena bicornis (goathead burr)
Triodia pungens (soft spinifex)
No indicator value (stability desirables)
Acacia xiphophylla (snakewood)

Condition statement

The condition of this pasture type is assessed by observing such characteristics as the degree of ground cover (% basal cover) afforded by grass tussocks, the vigour of the tussocks and the age structure of the stand and the presence or absence of soil erosion.

Traverse data (362 observations) during the Pilbara rangeland survey 1995-97 (Van Vreeswyk *et al.* in preparation) indicated the following condition:

- Vegetation condition: very good 8%, good 24%, fair 23%, poor 28%, very poor 17%
- Soil erosion: nil 70%, slight 5%, minor 7%, moderate 8%, severe 5%, extreme 4%.

These data show that the condition of Roebourne Plains Grass Pasture varies considerably from very good to very poor and that soil erosion is common.

Heavy grazing pressure on plains of the Cane, Horseflat, Onslow, Paradise, Pullgarah and Yamerina land systems has resulted in areas where Roebourne Plains grass has been lost and soil surfaces eroded. The action of water and wind has resulted in sheeting, scouring, scalding and hummocking. Some areas, notably in the Cane, Horseflat, Paradise and Yamerina land systems, are severely degraded and eroded.

On the Horseflat and other land systems, the natural mosaic of dense Roebourne Plains grass (gilgaied areas) and less dense grass (non-gilgaied areas) can be exacerbated by over use. The less dense areas can become devoid of perennial grass resulting in patchy scalds that may be actively eroding or protected by dense stony mantles.

Good condition

In good condition there is a dense population of Roebourne Plains grass tussocks, the bases of which cover 3 to 5% or more of the soil surface and there is no soil erosion. Basal area of tussocks (rather than foliar cover % which varies with seasonal and grazing effects) is a consistent way of measuring the health of a tussock grassland from year to year. Tussock bases persist in both drought and good seasons and can be measured (basal cover %) despite being hidden by stems and leaves in good seasons.

Fair condition

In fair condition this pasture consists of common but scattered tussocks of Roebourne Plains grass that have a basal cover of between 1 and 3%. There is usually no soil erosion. Increasers such as feathertop three awn (*Aristida latifolia*) and black soil poison (*Stemodia kingii*) may be present but not in excessive numbers.

Poor condition

In poor condition this pasture type supports isolated or very patchy tussocks of Roebourne Plains grass with a basal cover of less than 0.5% and soil erosion is common. In extreme situations tussocks are absent or occur only as rare dead butts. Occasionally there may be large numbers of undesirable increasers such as cassias (*Senna* spp.) or black soil poison (*Stemodia kingii*) but, more typically, the stand of grass becomes much thinner and patchier and is not replaced by other perennial plants.

The soil surface commonly seals over and large scalded areas may develop, sometimes with wind piling and hummocking at the margins.

Good condition

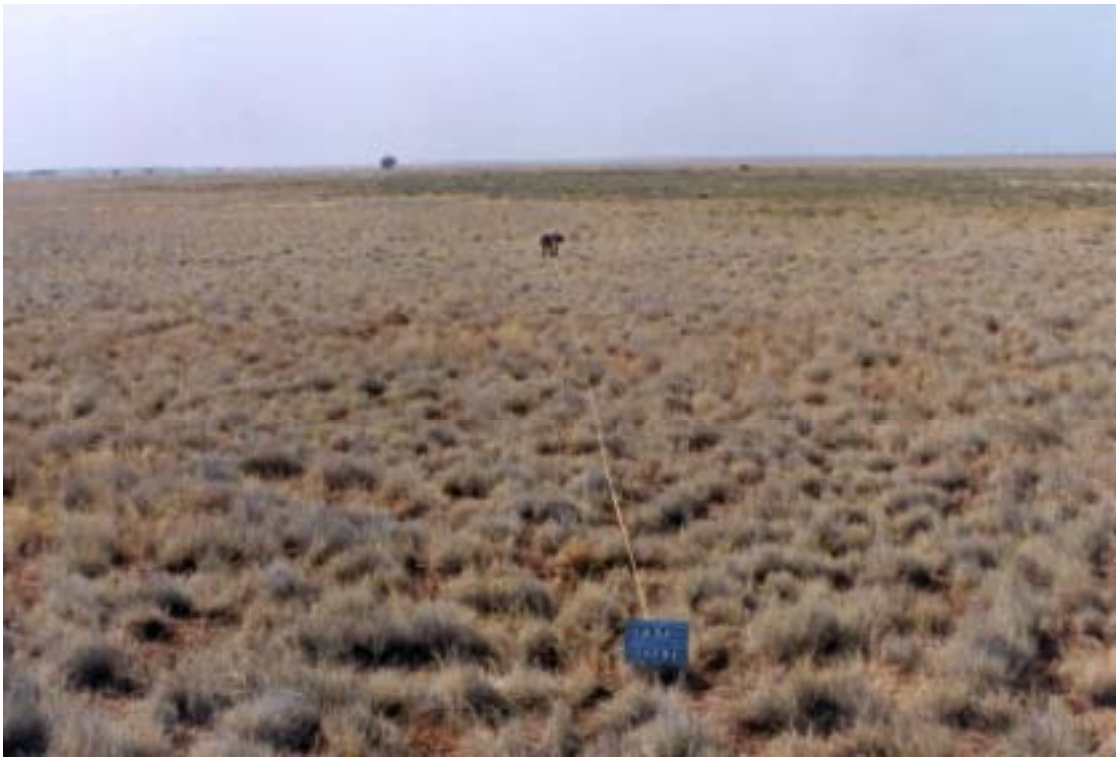

Photo 12 shows Roebourne Plains Grass Pasture in good condition on a weakly gilgaied plain of the Pullgarah land system. Basal cover is about 5%. There are no shrubs or trees.

Fair condition

Photo 13 shows a patchy stand of Roebourne Plains Grass Pasture (with basal cover of about 2%) in fair condition. The inter-tussock spaces support annual grasses and herbs in season.

Poor condition

Photo 14 shows Roebourne Plains Grass Pasture in poor condition on an alluvial plain of the Horseflat land system. Basal cover of the grass tussocks is considerably less than 0.2%. After the seasonal growth of annual herbs and grasses has gone, the soil is exposed to wind and water erosion.

Photo 15 shows a Roebourne Plains Grass Pasture at the extreme end of poor condition. The site is severely degraded and eroded with a few remnant dead tussocks. There is little doubt that the area once supported a good population of Roebourne Plains grass but excessive grazing has eliminated the cover and subsequent erosion of the topsoil has produced a bare, rocky surface.

Management

Roebourne Plains Grass Pasture can be used for year-long grazing but palatability and feed quality are poor when dry and mature. For good productivity the best use appears to be moderately heavy shorter term (six to nine months) stocking when feed is green and actively growing.

Patch grazing whereby animals graze particular patches repeatedly while virtually ignoring other areas is particularly noticeable on this pasture. Once a tussock has been grazed it produces new leaves which are lower in fibre and higher in protein than the older material on ungrazed tussocks. The new growth is preferred by animals that return to the grazed tussocks again and again. Patch grazing over a number of years can result in the death of tussocks and the development of bare patches.

Burning grasslands to eliminate patch memory has been successful in the tropics (Andrew 1986) but whether this is practical and effective in the Pilbara is unknown. Likely problems are, first, that once burnt, the tussocks may die if the next season fails. Second, in most seasons, Roebourne Plains Grass Pasture does not generate sufficient fuel to carry a fire. Third, special measures may be required to keep kangaroos off the pasture after a burn to stop overgrazing and killing tussocks.

An alternative to burning may be to crash graze these pastures to eliminate patch memory. This could entail grazing with very large numbers of animals for short periods on some type of cell grazing system. This approach has not been tested in the Pilbara but deserves further consideration.

Whatever grazing system is used it is desirable that these pastures are occasionally spelled for a few months after a good season to enable tussocks to recover and seedlings to establish. Roebourne Plains grass recruits very easily from seed in some years but it is unlikely that favourable conditions occur every year. Careful management involving deferred stocking is necessary to take advantage of recruitment events.

Roebourne Plains Grass Pasture in fair or poor condition will require spelling over a number of consecutive wet seasons and conservative grazing levels at other times in order to improve condition. Severely degraded and scalded areas can be regenerated by protection from grazing and mechanical works such as water ponding that will increase water infiltration and provide niches for grass to re-colonise. However, it is far more desirable to keep this pasture in good or fair condition by manipulating grazing pressure and season of use rather than going to the expense of mechanical regeneration.

Suggested levels of use (per annum)

Good condition	20 hectares per cattle unit
Fair condition	40 ha/cu
Poor condition	50 ha/cu

Ribbon Grass Pasture

Approximate area 1,765 km^2 (0.9% of total)

Distribution and soil type

This pasture is found throughout the Pilbara on numerous land units and different soil types. It does not usually occur over areas more than a few kilometres in extent and frequently as much smaller inclusion (e.g. groves) within other pastures. It is mostly found in run-on positions in the landscape where it receives additional water shed by overland flow or channelled flow from adjacent surfaces or overbank flooding from rivers and creeks.

Land units which support Ribbon Grass Pasture are:

(1) Crab-holed (gilgaied) groves and drainage tracts in south-central parts of the Pilbara on land systems such as Jurrawarrina, Marillana and Wannamunna. Soils are cracking clays and red loamy earths.

(2) Some alluvial plains, gilgai plains and levees associated with major rivers on land systems such as Brockman, Cane, Fortescue and Paradise. Soils are cracking clays, deep red-brown clays and red sandy earths.

(3) Some drainage floors and shallow valleys in granitic landscapes on the Macroy, Stuart and Sylvania land systems. Soils are red sandy earths, red loamy earths and sandy duplex types.

Vegetation structure and composition

The one common feature of this pasture is that the grass layer is dominated or co-dominated by ribbon grass (*Chrysopogon fallax*). In other respects the vegetation structure and composition is highly variable with different suites of species associated with different habitats and soil types. Structure can be tall shrublands or woodlands (PFC 10-30%) on drainage floors or grasslands with isolated to very scattered trees and shrubs (PFC <2.5%) on alluvial plains.

In gilgaied groves and drainage floors the tree and tall shrub layer is dominated by mulga (*Acacia aneura*) with occasional eucalypt trees and corkwood (*Hakea suberea*). Total foliar cover is 25->50%. Common mid height and low shrubs include Wilcox bush (*Eremophila forrestii*), warty fuchsia bush (*Eremophila latrobei*), 12-mile poverty bush (*Eremophila lanceolata*), flannel bush (*Solanum lasiophyllum*) and creeping sida (*Sida fibulifera*). The perennial grass layer with up to 5% basal cover is predominantly ribbon grass but others such as kangaroo grass (*Themeda triandra*), Roebourne Plains grass (*Eragrostis xerophila*), neverfail (*Eragrostis setifolia*) and *Digitaria* spp. may also occur.

On alluvial plain sites with clay soils this pasture type is a tussock grassland of ribbon grass commonly with others such as Roebourne Plains grass, neverfail and swamp grass (*Eriachne benthamii*). Total basal cover can be up to about 10% but is usually much less. A few isolated to very scattered (PFC <2.5-10%) shrubs such as mimosa bush (*Acacia farnesiana*), prickly acacia (*Acacia victoriae*) and cassias (*Senna* spp.) may be present. Occasionally the total shrub cover may reach 15 or 20%.

On drainage tracts with sandy soils (such as on granitic terrain of the Macroy land system) this pasture type often has soft spinifex (*Triodia pungens*) as a companion (sometimes co-dominant). The shrub layers are well developed and much more diverse than on clay sites. They include *Acacia*, *Senna*, *Cullen*, *Bonamia* and *Ptilotus* species. The PFC of the shrub layers is variable and dependent on fire history.

Pastoral value

In good condition the pastoral value of Ribbon Grass Pasture is very high. Ribbon grass is palatable and preferred by stock when green but is unattractive when dry. Many of the other grasses, low shrubs, herbaceous perennials and annuals in season which are associated with ribbon grass are also palatable and supply good quality forage for much of the year. Ribbon Grass Pasture in good condition can support all classes of livestock.

Common perennial species - (1) gilgaied groves, drainage foci and drainage tracts (clayey soils)

Decreasers (desirables)
Chrysopogon fallax (ribbon grass)
Eragrotis setifolia (neverfail)
Eragrostis xerophila (Roebourne Plains grass)
Eremophila forrestii (Wilcox bush)
Eremophila latrobei (warty fuchsia bush)
Maireana planifolia (flat-leaved bluebush)
Maireana planifolia x *villosa*
Ptilotus obovatus (cotton bush)
Rhagodia eremaea (tall saltbush)
Rhyncosia minima (Mardie clover)
Sida fibulifera (creeping sida)
Themeda triandra (kangaroo grass)
Increasers (undesirables)
Dodonaea petiolaris (hop bush)
Eremophila lanceolata (12-mile poverty bush)
Malvastrum americanum (spiked malvastrum)
Solanum sturtianum
Intermediates
Eriachne benthamii (swamp grass)
Eriachne obtusa (wire grass)
Solanum lasiophyllum (flannel bush)
No indicator value (stability desirables)
Acacia aneura (mulga)
Acacia tetragonophylla (curara)
Canthium latifolium (wild lemon)
Corymbia aspera
Eucalyptus victrix (coolibah)
Hakea suberea (corkwood)

Common perennial species - (2) alluvial plains (clay soils)

Decreasers (desirables)
Cenchrus ciliaris (buffel grass)
Chrysopogon fallax (ribbon grass)
Dichanthium fecundum (bundle bundle)
Eragrostis setifolia (neverfail)
Eragrostis xerophila (Roebourne Plains grass)
Rhagodia eremaea (tall saltbush)
Rhyncosia minima (Mardie clover)
Sida fibulifera (creeping sida)
Senna artemisioides subsp. *oligophylla* (bloodbush)

Increasers (undesirables)
Acacia glaucocaesia
Acacia victoriae (prickly acacia)
Aristida latifolia (feathertop tree awn)
Ipomoea muelleri (poison ivy glory)
Malvastrum americanum (spiked malvastrum)
Senna artemisioides subsp. *helmsii* (crinkled cassia)
Senna sp. 'Meekatharra' (straight leaf cassia)
Intermediates
Eriachne benthamii (swamp grass)
No indicator value (stability desirables)
Acacia farnesiana (mimosa bush)
Acacia xiphophylla (snakewood)
Carissa lanceolata (conkerberry)
Eucalyptus victrix (coolibah)

Common perennial species - (3) drainage floors in granitic terrain (sandy soils)

Decreasers (desirables)
Cenchrus ciliaris (buffel grass)
Chrysopogon fallax (ribbon grass)
Cullen pogonocarpum
Enneapogon spp. (bottle washers)
Fimbristylis dichotoma
Goodenia microptera
Paraneurachne muelleri (hop-along grass)
Rhyncosia minima (Mardie clover)
Solanum diversiflorum (bush tomato)
Increasers (undesirables)
Acacia translucens (poverty bush)
Ipomoea muelleri (poison morning glory)
Pluchea tetranthera
Intermediates
Aristida holathera var. *holathera* (erect kerosene grass)
Cullen martinii
Eriachne obtusa (wire grass)
Triodia pungens (soft spinifex)
No indicator value (stability desirables)
Acacia inaequilatera (kanji)
Acacia holosericea (pindan wattle)
Acacia victoriae (prickly acacia)
Corchorus spp.
Eucalyptus spp.
Gossypium australe (wild cotton)
Hakea suberea (corkwood)
Indigofera monophylla (one leaved indigofera)
Indigofera spp.
Tephrosia spp.

Condition statement

Traverse data (224 observations) during the Pilbara rangeland survey 1995-97 (Van Vreeswyk *et al.* in preparation) indicated the following condition:

- Vegetation condition: very good 11%, good 24%, fair 30%, poor 25.5%, very poor 9.5%
- Soil erosion: nil 85%, slight 3% minor 4%, moderate 7% severe 1%.

Ribbon Grass Pasture is in highly variable condition with some significant areas in poor or very poor condition. Soil erosion is not widespread but is serious in localised areas on parts of the Cane and Paradise land systems.

Good condition

Good condition is indicated by a moderately dense to dense population of ribbon grass (*Chrysopogon fallax*) and associated grasses with basal cover of between 3 and 10%. The lower values are associated with gilgaied groves and flow tracts that also support dense woodlands or shrublands of mulga (*Acacia aneura*) or other acacias. These mulga communities also support populations of other shrubs such as cotton bush (*Ptilotus obovatus*) and Wilcox bush (*Eremophila forrestii*). Ribbon grass on gilgai plains and alluvial plains can form dense tussock grasslands, without trees or shrubs, where basal cover can reach 10%.

Fair condition

In fair condition there is a population of ribbon grass with basal cover of between about 1 and 3%. Plants may be patchy in distribution and some may show poor vigour. Populations of associated palatable low shrubs and herbaceous perennials are usually reduced from potential.

Poor condition

Ribbon Grass Pasture with less than 1% basal cover of ribbon grass is regarded as in poor condition. Tussocks may show poor vigour or be moribund. Unpalatable plants such as 12-mile poverty bush (*Eremophila lanceolata*) and spiked malvastrum (*Malvastrum americanum*) may increase. In extreme situations ribbon grass is present only as occasional dead relics and there may be soil erosion as surface sheeting and pedestalling of grass butts.

Groves in poor condition will have only a few moribund butts of ribbon grass. Other decreaser grasses and shrubs will be rare or absent beneath the taller mulgas. There is usually no erosion except in extreme situations where nearly all plants, including the mulgas, die and the grove structure collapses.

Good condition

Photo 16 shows Ribbon Grass Pasture in good condition in a drainage tract with large mulgas on the Jurrawarrina land system. Basal cover of ribbon grass is about 3% and a few other decreaser plants are also present.

Photo 17 shows a dense Ribbon Grass Pasture in good condition with about 6% basal cover on an open gilgaied alluvial plain.

Good condition

Photo 18 shows Ribbon Grass Pasture in good condition on a sandy, unchannelled drainage tract in the Macroy land system. There is some soft spinifex (*Triodia pungens*) as a companion grass and very scattered eucalypts and acacia shrubs.

Fair condition

Photo 19 shows Ribbon Grass Pasture in fair condition. The total basal cover of grasses is less than 3%. The population of ribbon grass (left foreground and centre) has been reduced and replaced in part by Roebourne Plains grass (*Eragrostis xerophila*). There are a few small bare patches.

Poor condition

Photo 20 shows Ribbon Grass Pasture in poor condition on an alluvial plain. The grass tussocks are nearly all dead. There has been some loss of soil in the inter-tussock spaces but the site is still able to support annuals in season.

Photo 21 shows a grove with weakly gilgaied soil where the ribbon grass ground layer has been removed by grazing. There are very few other palatable plants. Undesirables such as hop bush (*Dodonaea petiolaris*) and spiked malvastrum (*Malvastrum americanum*) have increased. Condition is poor.

Management

Ribbon grass is palatable to stock when green but when dry, like many grasses, it is not preferred. From the animal productivity aspect the best use of Ribbon Grass Pasture on open grassland sites where there are few other useful plants (other than annuals in season) is probably six to nine months grazing rather than year-long. However, in groves and drainage tracts where the pasture includes a wide range of palatable low shrubs and perennial herbs which hold their forage value, it can support livestock (at appropriate stocking rates) on a year-long basis.

Repeated grazing and/or a series of dry years will kill ribbon grass. Its seeds appear to last a long time in the ground as germination events can occur without mature plants being present. Seedlings do not persist if grazed heavily. Occasional spelling over a growing season is necessary to maintain good condition.

Ribbon Grass Pasture can be adversely affected by changes to the distribution of water in the landscape. For example, sheet wash and overland flows can be disrupted by inappropriate positioning or construction of roads and tracks resulting in water starvation effects on groves and drainage tracts downslope. Other causes may be erosion gullies draining water from drainage foci or low lying alluvial plains.

Fire is a management tool on those pastures which have a high proportion of soft spinifex (*Triodia pungens*) in the stand (e.g. sandy sites in granitic country) but its usefulness in tussock grasslands on broad alluvial plains is unknown. Generally it would be regarded as undesirable in this situation and certainly on groved sites which support fire-sensitive plants such as mulga (*Acacia aneura*).

Within the spinifex hummock grasslands, ribbon grass probably once dominated areas receiving flood water such as sandy drainage floors and minor alluvial plains. Reduction in ribbon grass on these sites can be attributed to heavy grazing by sheep and kangaroos. Appropriate burning and grazing management can return these areas to ribbon grass and other grasses (Suijdendorp 1967). An area at the old Woodstock Research Station that was 100% soft spinifex in the 1950s but was burnt every five years and spelled for the growing season yearly until seed set, has returned to ribbon grass.

Suggested levels of use (per annum)

Good condition	15 hectares per cattle unit
Fair condition	30 ha/cu
Poor condition	45 ha/cu

Mitchell Grass Alluvial Plain Pasture

Approximate area 505 km^2 (0.3% of total)

Distribution and soil type

This pasture is occasionally found in the alluvial valleys of the Fortescue River and its tributaries on such land systems as Brockman, Coolibah, Elimunna, Fortescue, Hooley and Kanjenjie. It occurs on level plains with gilgai microrelief and deep cracking clay soils with crumbly self-mulching surfaces. Surface mantles are absent or few to common (2-20%) as pebbles of ironstone and other rocks.

Vegetation structure and composition

This pasture type occurs as tussock grasslands on open treeless plains that may extend for 2 or 3 km, or as considerably smaller patches within stony plains and associated with Roebourne Plains Grass Pasture. The tussock grasses consist mostly of barley Mitchell grass (*Astrebla pectinata*) and weeping Mitchell grass (*Astrebla elymoides*) with a few other perennial grasses such as Roebourne Plains (*Eragrostis xerophila*), ribbon grass (*Chrysopogon fallax*) and neverfail (*Eragrostis setifolia*), and numerous herbs and forbs in season. Curly Mitchell grass (*Astrebla lappacea*) is found on the Hamersley Plain, the only location where it is known in Western Australia. Shrubs are usually absent or isolated but occasionally there is a scattered to moderately close (PFC 10-25%) layer of snakewood (*Acacia xiphophylla*).

Pastoral value

In good condition these pastures are of very high pastoral value. Mitchell grasses are the most palatable and are generally heavily grazed. Other grasses, herbaceous perennials and annuals associated with the Mitchell grasses also provide good quality forage for much of the year. Mitchell Grass Alluvial Plain Pasture in good condition can be grazed year-long (at appropriate stocking rates) by all classes of stock.

Common perennial species

Decreasers (desirables)
Abutilon malvifolium
Astrebla elymoides (weeping Mitchell grass)
Astrebla lappacea (curly Mitchell grass)
Astrebla pectinata (barley Mitchell grass)
Commelina ensifolia
Chrysopogon fallax (ribbon grass)
Desmodium campylocaulon
Dichanthium fecundum (bundle bundle)
Eragrostis setifolia (neverfail)
Eragrostis xerophila (Roebourne Plains grass)
Glycine falcata
Goodenia pascua
Neptunia dimorphantha (sensitive plant)
Rhyncosia minima (Mardie clover)
Senna hamersleyensis (creeping cassia)
Sida fibulifera (creeping sida)
Themeda triandra (kangaroo grass)
Vigna sp. 'Pilbara black soil'

Increasers (undesirables)
Aristida latifolia (feathertop three awn)
Ipomoea muelleri (poison morning glory)
Senna artemisioides subsp. *helmsii* (crinkled cassia)
Stemodia kingii (black soil poison)
Streptoglossa bubakii (stinkweed)
Streptoglossa odora (stinkweed)
Intermediates
Crotalaria dissitiflora subsp. *benthamiana*
Polymeria lanata (black soil bindweed)
Sida rohlenae
No indicator value (stability desirables)
Acacia farnesiana (mimosa bush)
Acacia victoriae (prickly acacia)
Acacia xiphophylla (snakewood)

Condition statement

The condition of this pasture is assessed by observing the degree of ground cover (% basal cover) afforded by the grass tussocks, the vigour of the tussocks, age structure of the stand, the proportion of undesirables in the stand and the condition of the soil surface.

Traverse data (47 observations) during the Pilbara rangeland survey 1995-97 (Van Vreeswyk et al. in preparation) indicated the following condition:

- Vegetation condition: very good 13%, good 21%, fair 19%, poor 17%, very poor 30%
- Soil erosion: nil 92%, slight 0%, minor 2%, moderate 2%, severe 2%, extreme 2%.

These data indicate that the condition of Mitchell Grass Alluvial Plain Pasture is highly variable and that substantial parts are seriously degraded. Where there has been a long grazing history and Mitchell grass occurs in small areas as part of a mosaic with other less palatable pasture types, it has been removed by preferential grazing. However, where it occurs over larger areas distant from water, this pasture type can still be found in good condition. Soil erosion is uncommon due to flat topography and heavy textured soils, but is a problem in some localised areas.

Good condition

In good condition the basal cover of Mitchell grass tussocks will be in the range of about 3-6% and there should also be some young age classes in the stand. There should also be a range of useful perennial herbs such as Mardie clover (*Rhyncosia minima*) and sensitive plant (*Neptunia dimorphantha*).

Fair condition

In fair condition this pasture type has a reduced population of Mitchell grasses and basal cover of the tussocks varies from about 1-3%. The populations of other palatable perennials also decrease while those of intermediate or undesirable plants may increase marginally.

Poor condition

In poor condition the population of Mitchell grass has largely disappeared with only isolated plants remaining. The population of herbaceous perennials has largely disappeared and there can be an increase in unpalatable perennials and annuals.

Management

Mitchell grasses seed readily and the seedlings appear regularly but most do not survive. Grazing animals often trample or pull seedlings out of the crumbly-surfaced soil. The adult tussocks suffer the same fate but to a lesser degree. If this continues year after year without spelling, a population will eventually disappear especially if grazing effects are exacerbated by poor seasons. Mitchell grass pastures in fair or poor condition require resting from grazing for at least a year, if not two. Degraded Mitchell grass pastures that are protected from grazing generally recover fairly rapidly provided sufficient plants remain to supply a seed source.

Mitchell grass pastures have traditionally been protected from fire. However, burning could be considered for reasons such as encouraging more even utilisation in large paddocks, the rejuvenation of rank pasture and to encourage a temporary increase in the legume and annual component, which may improve nutritional quality. A minimum of five years between fires is generally recommended. For pasture management burning should be late in the year when the fire danger index has moderated, for example immediately after the first storms.

Suggested levels of use (per annum)

Good condition	15 hectares per cattle unit
Fair condition	30 ha/cu
Poor condition	45 ha/cu

Good condition

Photo 22 shows an open gilgaied plain on the Brockman land system supporting a fairly dense tussock grassland of barley Mitchell grass (*Astrebla pectinata*). Basal cover is about 5% and condition is good. Note that there are no shrub layers.

Fair condition

Photo 23 shows a moderate stand of barley Mitchell grass with basal cover of about 2% and the development of a bare patch in the middle distance. Condition is fair.

Poor condition

Photo 24 shows a gilgaied plain with a very sparse stand (foreground) of barley Mitchell grass (basal cover of less than 0.5%). Note the mimosa bush (*Acacia farnesiana*) in the middle distance that is increasing due to lack of competition from perennial grass and fire. The site condition is poor.

Photo 25 shows Mitchell Grass Alluvial Plain Pasture in poor condition on the Brockman land system. The soil is not eroded and shows the typical crumbly gilgaied surface of a Mitchell grass site, but the grass is present only as isolated dead butts. The site will still produce abundant annual herbage in season but has no durability in dry times.

Mitchell Grass Tableland Pasture

Approximate area 1,480 km^2 (0.8% of total)

Distribution and soil type

This pasture is found on basaltic uplands and tablelands of the Wona land system and residual stony gilgai plains of the White Springs system. The main area of tablelands as they are known locally, is along the top of the Chichester Ranges that separates the Fortescue River catchment from the granitic Yule and Turner River catchments to the north. The soils are formed *in situ* and consist of deep, self-mulching cracking clays with gilgai microrelief and many basalt cobbles and stones on the surface.

Vegetation structure and composition

The pasture consists of open tussock grasslands without tree or shrub cover or, occasionally, grasslands with very scattered to scattered (PFC 2.5-20%) shrubs of snakewood (*Acacia xiphophylla*). The tussock grasses are mainly barley Mitchell grass (*Astrebla pectinata*) but commonly include other perennial grasses such as Roebourne Plains grass (*Eragrostis xerophila*), ribbon grass (*Chrysopogon fallax*) and feathertop three awn (*Aristida latifolia*). Common herbaceous perennials include creeping sida (*Sida fibulifera*), sensitive plant (*Neptunia dimorphantha*) and creepers such as Mardie clover (*Rhyncosia minima*), *Cajanus marmoratus*, *Desmodium campylocaulon* and *Vigna* sp. 'Pilbara black soil'. Numerous small annuals occur in season. The rare tableland white grass (*Ischaemum albovillosum*) occurs only in this pasture type.

Pastoral value

In good condition these pastures have high pastoral value but are somewhat less productive than the Mitchell Grass Alluvial Plains Pasture. Mitchell grass tussocks are not usually as dense or as large as those found on the alluvial plains possibly because of slightly different soil, more rocks and the lack of floods across the tablelands.

Productivity is not solely dependent on the Mitchell and other grasses but also on the annual and perennial herbs that grow with them, many of which provide high quality forage.

Mitchell Grass Tableland Pasture in good condition can support all classes of stock on a year-long basis provided stocking rates are appropriate. However, pastures in fair or poor condition with much reduced perennial grasses cannot generally be grazed on a year-long basis. They still have the ability to produce valuable annual forage in season but this falls away quickly in moderate or poor years and the pastures lack durability.

Common perennial species

Decreasers (desirables)
Astrebla elymoides (weeping Mitchell grass)
Astrebla pectinata (barley Mitchell grass)
Cajanus marmoratus
Chrysopogon fallax (ribbon grass)
Desmodium campylocaulon
Eragrostis xerophila (Roebourne Plains grass)
Ischaemum albovillosum (tableland white grass)
Glycine falcata
Goodenia pascua
Neptunia dimorphantha (sensitive plant)
Phyllanthus maderaspatensis
Rhyncosia minima (Mardie clover)
Senna hamersleyensis (creeping cassia)
Sida fibulifera (creeping sida)
Themeda triandra (kangaroo grass)
Vigna sp. 'Pilbara black soil'

Increasers (undesirables)
Aristida latifolia (feathertop three awn)
Senna sp. 'Meekatharra' (straight leaf cassia)
Stemodia kingii (black soil poison)
Streptoglossa bubakii (stinkweed)
Streptoglossa odora (stinkweed)
Intermediates
Eriachne obtusa (wire grass)
Minuria integerrima
No indicator value (stability desirables)
Acacia xiphophylla (snakewood)

Condition statement

Traverse data (116 observations) during the Pilbara rangeland survey 1995-97 (Van Vreeswyk et al. in preparation) indicated the following condition:

- Vegetation condition: very good 3%, good 21%, fair 33%, poor 36%, very poor 7%
- Soil erosion: Nil 100%.

Condition of these pastures is highly variable. Large areas are devoid of Mitchell grasses due to preferential overgrazing. Areas close to stock water are usually in much poorer condition than distant areas. Degraded sites still support abundant annuals in season or may be dominated by the undesirable perennial grass feathertop three awn (*Aristida latifolia*). The pasture is not susceptible to erosion except if the stony surface mantle is removed such as along tracks on sloping plains.

Good condition

This pasture consists of Mitchell grass (*Astrebla* spp.) tussocks with a basal cover of about 2-5%. There should be some young plants in the stand and a scattering of other desirable grasses and herbaceous perennials.

Fair condition

In fair condition the pasture has a reduced population of Mitchell grasses and basal cover of the tussocks varies from about 0.5-2%. Other desirable plants are still present but populations are below potential. Undesirable unpalatable species may increase in the stand.

Poor condition

In poor condition the population of Mitchell grass and other grasses and herbaceous perennials has largely disappeared with only isolated plants remaining. There may be a marked increase in unpalatable perennials and herbs such as feathertop three awn (*Aristida latifolia*) and stinkweed (*Streptoglossa* spp.) but not always.

Good condition

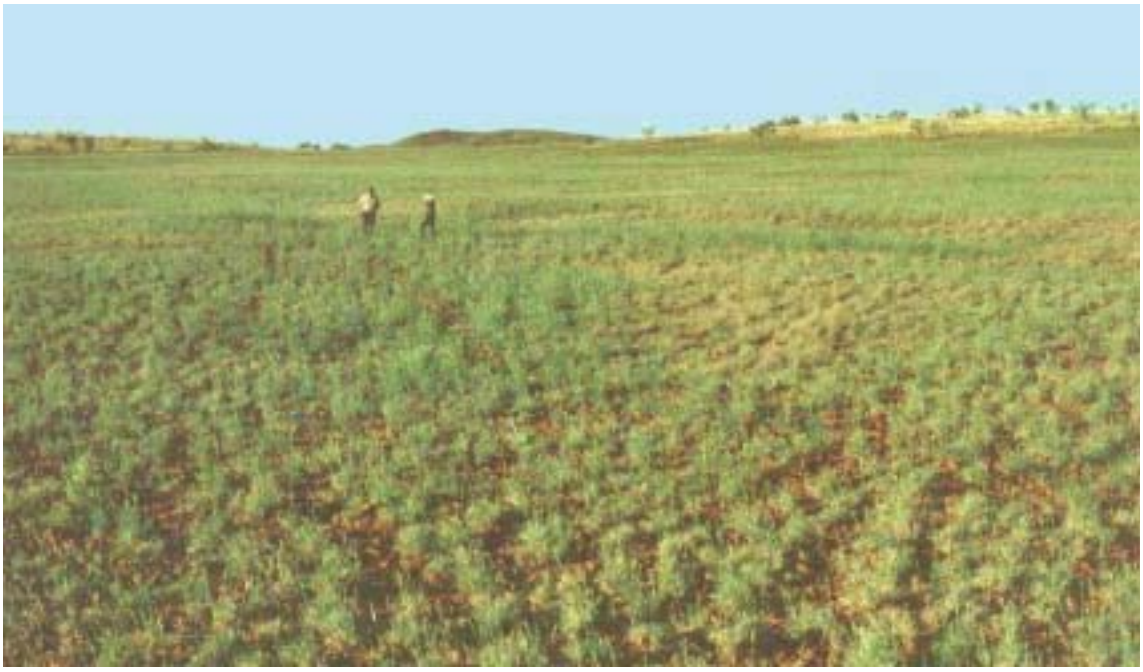

Photo 26 shows a dense stand of barley Mitchell grass (*Astrebla pectinata*) on a gilgaied upland plain of the Wona land system. Basal cover is about 4% and condition is good.

Fair condition

Photo 27 shows a scattered population of Mitchell grasses (with a basal cover of about 1.5%) with creeping sida (*Sida fibulifera*) and sensitive plant (*Neptunia dimorphantha*) on a gilgai plain of the Wona land system. Condition is fair.

Poor condition

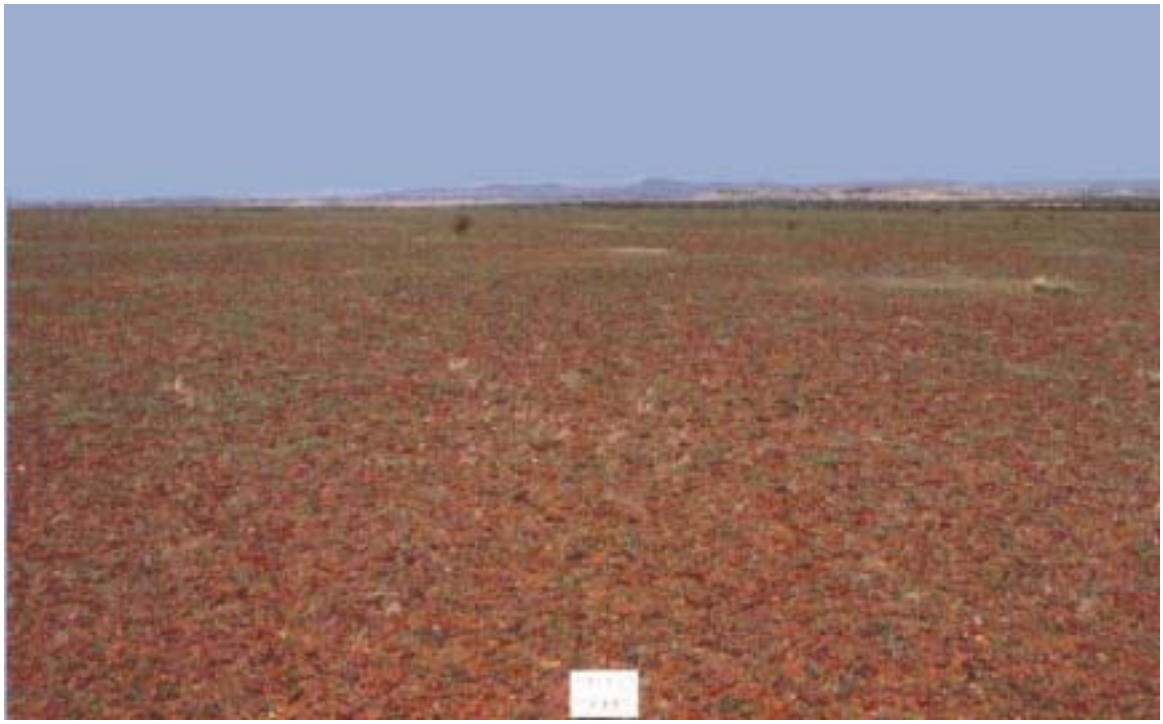

Photo 28 shows a Mitchell Grass Tableland Pasture in poor condition on the Wona land system. Virtually no perennial plants remain. The pasture consists of an annual herbfield in season that provides good grazing when green, but negligible forage in dry times.

Management

Mitchell grasses in these upland sites react to grazing similarly to alluvial plain sites but they are likely to be more fragile and not quite as productive. For management requirements see Mitchell Grass Alluvial Plain Pasture description.

Suggested levels of use (per annum)

Good condition	30 hectares per cattle unit
Fair condition	60 ha/cu
Poor condition	75 ha/cu

Buffel Grass Pasture

Approximate area 3,435 km^2 (1.8% of total)

Distribution and soil type

Buffel grass (*Cenchrus ciliaris*) and its close relative Birdwood grass (*Cenchrus setigerus*) were introduced from arid parts of India and Africa. Local legend has it that camel saddles were imported from Afghanistan to Port Hedland in the early 1900s, abandoned in the town and subsequently split. The stuffing consisted of buffel grass seed which germinated and spread around Port Hedland. A local pastoralist from Mundabullangana station observed this and as severe dust storms were emanating from bare eroded country, planted the grass in the Yule River delta. Today the Yule delta supports a prime example of Buffel Grass Pasture.

Buffel grass is naturalised in many Pilbara habitats. It thrives in well-watered areas such as drainage floors, levees and creek banks and sandy alluvial plains. It has colonised many disturbed and previously eroded sites and some soft spinifex (*Triodia pungens*) sand dunes on the coast where it forms dense stands that exclude most other plants. It is thought to be allelopathic, that is to produce chemicals from its roots that inhibit the establishment of other plants (Cheam 1984).

Buffel grass grows mainly on sandy or loamy soils although clay-tolerant races may be developing. It is a major pasture type on the Yamerina land system in the deltas of the De Grey, Yule and Turner Rivers and on the River land system along the major rivers and creeks in the Pilbara. It is common on drainage floors and smaller creeklines of many other land systems. In coastal areas it is a major pasture component on the Anna and Eighty-Mile land systems and also occurs on the Cheerawarra, Dune and Onslow systems.

Buffel grass may have displaced ribbon grass (*Chrysopogon fallax*) and/or silver saltbush (*Atriplex bunburyana*) on some alluvial plains. The original vegetation probably disappeared before the introduction of buffel grass that has now stabilised erosion-prone soils and added substantially to the production base of the country.

The buffel grass invasion, its replacement of native species and perceived adverse effects on biodiversity, especially in National Parks and wilderness areas, concerns some rangeland stakeholders. A balanced review of the benefits and disbenefits would be interesting but the reality is that, in the Pilbara and other parts of Western Australia, it is here to stay.

Vegetation structure and composition

Buffel Grass Pasture occurs mainly as tussock grasslands without shrubs or isolated to very scattered (PFC <2.5-10%) shrubs. Common tall shrubs include mimosa bush (*Acacia farnesiana*), prickly acacia (*Acacia victoriae*), limestone wattle (*Acacia sclerosperma*) and kanji (*Acacia inaequilatera*). Occasional low shrubs include *Senna*, *Pluchea* and *Rhagodia* species.

Along river banks, sandy levees and occasionally spreading further out onto floodplains the tree layer may be dominant (PFC 10-20%) and vegetation takes the form of a grassy woodland. The ground layer of buffel grass is always prominent and well developed. The most common trees are coolibah (*Eucalyptus victrix*), river red gum (*Eucalyptus camaldulensis*), river jam (*Acacia coriacea*), white wood (*Atalaya hemiglauca*) and corkwood (*Hakea suberea*). Buffel grass may completely dominate the grass layer but other grasses which may be present include ribbon grass (*Chrysopogon fallax*), Roebourne Plains grass (*Eragrostis xerophila*), Birdwood grass (*Cenchrus setigerus*), silky browntop (*Eulalia aurea*) and soft spinifex (*Triodia pungens* and *T. epactia*).

On coastal dunes and plains the pasture is tussock grassland with isolated to very scattered shrubs which are distinctive to the coastal habitat. These include coastal jam (*Acacia coriacea*), kapok bush (*Aerva javanica*), green bird flower (*Crotalaria cunninghamii*) and *Trianthema turgidifolia*.

Pastoral value

Buffel grass pastures are of very high pastoral value. They respond rapidly to small falls of rain, provide large quantities of good quality feed when green and, compared to native pastures, can be heavily stocked without deteriorating. Like other grass pastures feed value falls in dry times and they are not as nutritious or durable as some shrub pastures or young soft spinifex. When very dry and rank they provide only a sub-maintenance ration for livestock. Nevertheless Buffel Grass Pastures are suitable for grazing by all classes of stock on a year-long basis especially if animals are supplemented with phosphorus and nitrogen.

A significant attribute of buffel grass of value to the pastoral industry is its ability to colonise and stabilise some badly degraded and eroded sites.

Common perennial species

Decreasers (desirables)
Aerva javanica (kapok bush)
Cenchrus ciliaris (buffel grass)
Cenchrus setigerus (Birdwood grass)
Chrysopogon fallax (ribbon grass)
Eragrostis eriopoda (woolly butt)
Eragrostis xerophila (Roebourne Plains grass)
Eulalia aurea (silky browntop)
Panicum decompositum (native panic)
Rhagodia eremaea (tall saltbush)
Rhyncosia minima (Mardie clover)
Sida fibulifera (creeping sida)
Sporobolus mitchellii
Triodia epactia (grey soft spinifex)
Triodia pungens (soft spinifex)
Increasers (undesirables)
Acacia translucens (poverty bush)
Acacia victoriae (prickly acacia)
Prosopis spp. (mesquite)
**Solanum esuriale*
Intermediates
Eriachne obtusa (wire grass)
Solanum lasiophyllum (flannel bush)
No indicator value (stability desirables)
**Acacia ampliceps* (black wattle)
Acacia aneura (mulga)
Acacia coriacea (coastal jam, river jam)
Acacia citrinoviridis (black mulga)
Acacia farnesiana (mimosa bush)
Acacia inaequilatera (kanji)
Acacia pyrifolia (fire wattle)
Acacia sclerosperma (limestone wattle)
Acacia tetragonophylla (curara)
Acacia trachycarpa (miniritchie)
Acacia tumida (pindan wattle)
Atalaya hemiglauca (white wood)
Carissa lanceolata (conkerberry)
Corymbia hamersleyana (Hamersley bloodwood)
**Crotalaria cunninghamii* (green bird flower)
Eucalyptus camaldulensis (river red gum)
Eucalyptus victrix (coolibah)
Hakea suberea (corkwood)
Lysiphyllum cunninghamii (bauhinia)
Pluchea tetranthera
Senna artemisioides subsp. *oligophylla* (bloodbush)

**Trianthema turgidifolia*
Triodia longiceps (knitting needle spinifex)
**Whiteochloa airoides*

* Mostly restricted to coastal dunes and coastal plains.

Condition statement

Buffel Grass Pasture often provides dense ground cover (basal cover 5-10%) and is usually in good condition. However, where buffel is acting as a primary coloniser on eroded country and basal cover is less than 2% (such as on some degraded hummocky plains of the Paradise land system) the overall condition may be fair or poor.

Traverse data (509 observations) during the Pilbara rangeland survey 1995-97 (Van Vreeswyk *et al.* in preparation) indicated the following condition:

- Vegetation condition: very good 47%, good 36%, fair 15%, poor 2%, very poor 1%
- Soil erosion: nil 93%, slight 2%, minor 2.5%, moderate 1%, severe 1%, extreme 0.5%.

There are generally no sensitive shrub indicator species in Buffel Grass Pasture, but other desirable perennial grasses may be present. Their absence though does not necessarily indicate poorer condition, but rather the aggressive competition of buffel grass. The condition of buffel pasture is best assessed by observing characteristics such as the degree of ground cover (basal cover %) afforded by tussocks, their vigour and the age structure of the stand.

Good condition

Buffel Grass Pasture in good condition supports a grass population with basal cover of between 4 and 10%. Trees and shrubs may be absent or isolated or the community may be a scattered tall shrubland or woodland with a prominent ground layer of buffel grass.

Fair condition

Buffel Grass Pasture in fair condition will have a basal cover of between 1 and 3%. Tussock distribution may be patchy and there may be some small bare scalded areas. There may be a few shrubs such as prickly acacia (*Acacia victoriae*), limestone wattle (*Acacia sclerosperma*) or mimosa bush (*Acacia farnesiana*) and occasional eucalypts.

Poor condition

In poor condition this pasture consists of a sparse, patchy population of buffel grass with basal cover of less than 1%. There may be frequent bare patches and some soil erosion. This condition is not frequent but is seen where buffel is colonising degraded areas.

Management

Buffel Grass Pasture in good or fair condition is stable and very resistant to grazing. It should be stocked fairly heavily to maintain the stand in a short condition as this will encourage and prolong the production of green shoot and leaf. Green material is available for at least six months of the year given reasonable seasons. Animal productivity over this time will be good. When pastures are completely dry or become tall and rank they are less palatable to stock and animal performance will be poorer.

Buffel grass is capable of setting some seed even with heavy grazing, however, occasional spelling for four to eight weeks over a growing season will ensure that the stand sets plentiful seed and remains vigorous. It is not necessary or desirable to spell for longer than eight weeks as the pastures quickly become rank if left ungrazed.

Fire could be a management tool to rejuvenate long ungrazed or rank buffel grass stands but its application has not been researched. Appropriate grazing management may generally preclude the need to use fire. Buffel Grass Pasture may well lend itself to cell grazing systems coupled with strategic supplementation with phosphorus and nitrogen. This approach is being tested on one pastoral property in the Ashburton area.

Suggested levels of use (per annum)

Good condition	6 hectares per cattle unit
Fair condition	12 ha/cu
Poor condition	18 ha/cu

Good condition

Photo 29 shows an alluvial plain supporting a moderately dense stand of buffel grass (*Cenchrus ciliaris*). Basal cover is about 4% and condition is good.

Photo 30 shows a riverine woodland with Buffel Grass Pasture in good condition. Basal cover of the grass is about 7% and the other vegetation is Hamersley bloodwood (*Corymbia hamersleyana)*, coolibah (*Eucalyptus victrix*) and *Acacia trachycarpa*.

Fair condition

Photo 31 shows Buffel Grass Pasture in fair condition on an alluvial plain. There are a few small bare patches and basal cover is below potential. Shrubs are prickly acacia (*Acacia victoriae*).

Poor condition

Photo 32 shows Buffel Grass Pasture in poor to fair condition. The buffel is colonising a scalded alluvial plain and has the potential to cover the area completely.

SHRUB PASTURES

Bluebush/Saltbush Pasture

Approximate area 1,570 km^2 (0.8% of total)

Distribution and soil type

This pasture type is found in isolated pockets in the Pilbara and rarely over areas more than a few kilometres in extent. It usually occurs on saline clays or duplex soils associated with salt lakes or semi-saline coastal areas and flood plains such as those of the De Grey River delta. It is an important component of the Yamerina land system near the coast and the minor saline land systems Tallawana, Cundlebar and Weelarrana inland. It is a minor component in numerous other systems including Balfour, Cowra, Narbung, Marsh and Sylvania.

Vegetation structure and composition

A number of easily recognised communities fall into the broad Bluebush/Saltbush Pasture type. These communities are all based on drought-resisting chenopod low shrubs of the genera *Maireana*, *Atriplex* and *Rhagodia* with various admixtures of other shrubs including *Senna*, *Eremophila*, and *Frankenia* spp. and mulga (*Acacia aneura*) and other acacias. Typically the pasture type is a very scattered to moderately close (PFC 2.5-30% - depending largely on condition status) low shrubland. Occasionally the tall or mid shrub layer of mulga or prickly acacia (*Acacia victoriae*) is dominant but low shrubs are still prominent. Sparse perennial grasses such as Roebourne Plains grass (*Eragrostis xerophila*) and curly windmill grass (*Enteropogon acicularis*) are fairly common.

Pastoral value

Bluebush/Saltbush Pasture is of moderate pastoral value. It produces high quality forage that persists throughout all but the worst droughts, but carrying capacity is not as high as tussock grass pastures. The pasture's productivity is not solely dependent on the perennial shrubs but also on the associated annuals and semi-perennial species. Most plants in this pasture are palatable with some notable exceptions that act as undesirable increasers.

Common perennial species

Decreasers (desirables)
Cenchrus ciliaris (buffel grass)
Cenchrus setigerus (Birdwood grass)
Chenopodium auricomum (swamp bluebush)
Atriplex bunburyana (silver saltbush)
Enchylaena tomentosa (ruby saltbush)
Enteropogon acicularis (curly windmill grass)
Eragrostis xerophila (Roebourne Plains grass)
Maireana aphylla (spiny bluebush)
Maireana georgei (golden bluebush)
Maireana glomerifolia (ball leaf bluebush)
Maireana tomentosa (felty bluebush)
Maireana pyramidata (sago bush)
Neptunia dimorphantha (sensitive plant)
Rhagodia eremaea (tall saltbush)
Scaevola spinescens (currant bush)
Tripogon loliiformis (one minute grass)
Increasers (undesirables)
Prosopis spp. (mesquite)
Sclerolaena cuneata (yellow bindi)
Senna artemisioides subsp. *helmsii* (crinkled cassia)
Senna sp. 'Meekatharra' (straight leaf cassia)

Intermediates
Frankenia spp. (frankenia)
Maireana carnosa (cottony bluebush)
Maireana triptera (three winged bluebush)
Ptilotus obovatus (cotton bush)
Sclerolaena hostilis (giant bindii)
Sclerolaena bicornis (goathead burr)
Senna artemisioides spp. *oligophylla* (bloodbush)
Solanum lasiophyllum (flannel bush)
No indicator value (stability desirables)
Acacia aneura (mulga)
Acacia tetragonophylla (curara)
Acacia victoriae (prickly acacia)
Eremophila cuneifolia (royal poverty bush)
Eremophila lanceolata (12-mile poverty bush)

Condition statement

Bluebush/Saltbush Pasture in the Pilbara is often considerably degraded and eroded.

Traverse data (202 observations) during the Pilbara rangeland survey 1995-97 (Van Vreeswyk *et al.* in preparation) indicated the following condition:

- Vegetation condition: very good 17%, good 12%, fair 20%, poor 38%, very poor 13%
- Soil erosion: nil 73%, slight 5%, minor 9%, moderate 9%, severe 4%.

Many shrubs in this pasture are preferentially grazed by livestock and are prone to decline under continuous heavy grazing. Soils are often duplexes with surface layers of sand or loam abruptly overlying saline clays. Once shrub cover is lost the topsoil is easily eroded to expose clays with scalded surfaces on which little will grow.

Condition is assessed by observing characteristics such as plant composition in terms of key decreasers compared to intermediates and increasers, total projected foliar cover, age structure of the stand and condition of the soil surface.

Good condition

When in good condition this pasture type consists of a low shrubland with foliar cover values between 10 and 25% of various shrubs, including numerous decreaser species, with annual herbs and grasses growing between the shrubs in good seasons. Some of these pastures have an overstorey of mulga or other acacias whilst others do not. There should be no soil erosion.

Fair condition

Fair condition is indicated by a reduced population of desirable shrubs. Projected foliar cover will be less than 10%. Soils may be un-eroded or small scalds up to 10 or 20 m in extent, or shallow gutters, may be present.

Poor condition

Bluebush/Saltbush Pasture in poor condition has none or very few desirable shrubs remaining and reduced to supporting annuals in season. Occasionally undesirable shrubs such as cassias (*Senna* spp.) or mesquite (*Prosopis* spp.) may increase. Active soil erosion is frequent.

Good condition

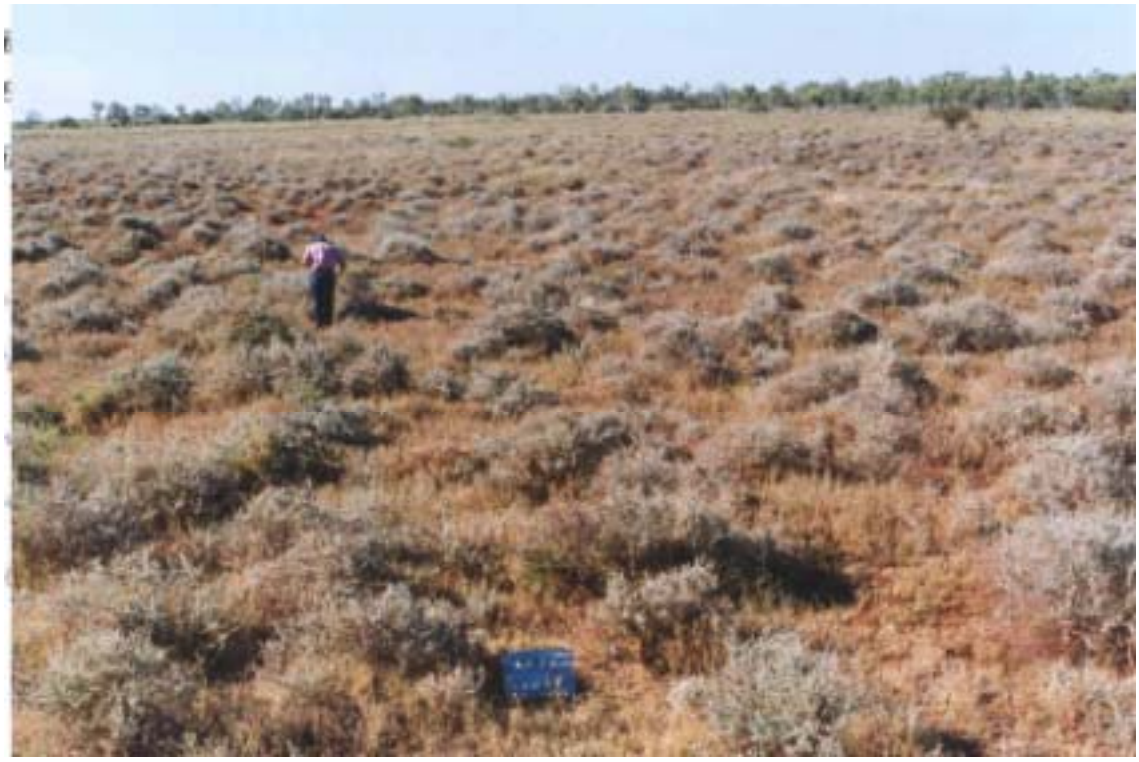

Photo 33 shows Bluebush/Saltbush Pasture in good condition with silver saltbush (*Atriplex bunburyana*) and perennial grasses on an alluvial plain of the Marsh land system. Shrub PFC is 20-25% and condition is good.

Fair condition

Photo 34 shows Bluebush/Saltbush Pasture in fair condition on a broad drainage floor of the Tallawana land system. The cover of spiny bluebush (*Maireana aphylla*) is below potential and there is minor water erosion in the form of shallow scours and redistribution of soil material.

Poor condition

Photo 35 shows Bluebush/Saltbush Pasture in extremely degraded condition on an alluvial plain of the Yamerina land system. A few moribund remnants of silver saltbush (*Atriplex bunburyana*) still exist and there is accelerated soil erosion in the form of wind piling and surface scalding. Buffel grass (*Cenchrus ciliaris*) is colonising the site that could be improved quickly if grazing ceased.

Management

These high quality pastures need to be managed to maintain the desirable decreaser shrubs which provide the bulk of feed in normal seasons and valuable reserves in drought seasons. Most bluebushes and tall saltbush (*Rhagodia eremaea*) are moderately resistant to grazing; silver saltbush is rather less resilient. Long-term preferential overgrazing will deplete shrub populations and cause severe degradation. However, provided stocking rates are appropriate, these pastures are suitable for year-long use by all classes of livestock.

Closely spaced good quality water supplies must be provided if maximum pasture use and animal performance are to be achieved. Bluebush/Saltbush Pasture is saline and if stock waters are also saline the high total salt intake will severely restrict feed intake, grazing radius and stock productivity.

Pastures in fair or poor condition will require periodic spelling if condition is to be improved. Spelling should be during and immediately after the growing season for as long as possible, preferably at least six months, to enable seedlings to establish and mature plants to build up food reserves and set heavy seed crops.

Suggested levels of use (per annum)

Good condition	55 hectares per cattle unit
Fair condition	77 ha/cu
Poor condition	110 ha/cu

Snakewood Chenopod Pasture

Approximate area 1,320 km^2 (0.7% of total)

Distribution and soil type

This pasture is found in southern and central parts of the Pilbara on alluvial and stony plains of land systems such as Christmas, Cowra, Hooley, Marillana, Narbung, Paraburdoo, Sherlock and Turee. Soils are deep red-brown clays, loamy earths and deep duplexes which often occur as a mosaic with cracking clay soils with gilgai microrelief surfaces. Stony surface mantles may or may not be present. The mosaic of soil types occurs in patches that may be 10 m to more than 100 m in extent, and the Snakewood Chenopod Pasture is mostly confined to the non-gilgaied parts. The gilgaied surfaces usually support tussock grasslands of Roebourne Plains Grass Pasture or Mitchell Grass Alluvial Plain Pasture. Alternatively Snakewood Chenopod Pasture can occur over more extensive alluvial plains (such as in the Cane land system) where there is no gilgai development. Soils are deep red-brown clays occasionally with a lighter surface of loam and the subsoil is usually semi-saline.

Vegetation structure and composition

Snakewood Chenopod Pasture is characteristically a mid height (1-2 m) or tall (>2 m) shrubland of snakewood (*Acacia xiphophylla*) with a patchy understorey of chenopod shrubs (saltbush and bluebush of the family Chenopodiaceae), other low shrubs and a few perennial grasses. The low shrubs tend to be clumped beneath the protection of the taller snakewoods and are somewhat sparser in the inter-snakewood spaces. The overall density of shrubs is usually scattered to moderately close with projected foliar cover 10-25%.

Common low shrubs include silver saltbush (*Atriplex bunburyana*), sago bush (*Maireana pyramidata*), ruby saltbush (*Enchylaena tomentosa*), tall saltbush (*Rhagodia eremaea*), cassias (*Senna* spp.) and bindiis (*Sclerolaena* spp.).

Pastoral value

Snakewood Chenopod Pasture is of moderate pastoral value. The low shrubs include palatable species which are preferred by livestock and provide high quality feed in dry seasons. These are augmented by scattered perennial grasses and a range of forbs and herbs in season. Snakewood itself is a poor feed and grazed only as a last resort. Snakewood Chenopod Pasture in good condition can support all classes of stock on a year-long basis provided stocking rates are appropriate.

Common perennial species

Decreasers (desirables)
Atriplex bunburyana (silver saltbush)
Cenchrus ciliaris (buffel grass)
Enchylaena tomentosa (ruby saltbush)
Enteropogon acicularis (curly windmill grass)
Eragrostis xerophila (Roebourne Plains grass)
Maireana georgei (golden bluebush)
Maireana pyramidata (sago bush)
Maireana tomentosa (felty bluebush)
Neptunia dimorphantha (sensitive plant)
Senna hamersleyensis (creeping cassia)
Sida fibulifera (creeping sida)
Increasers (undesirables)
Triodia lanigera (hard spinifex)
Triodia wiseana (hard spinifex)
Senna sp. 'Meekatharra' (straight leaf cassia)

Intermediates
Maireana triptera (three winged bluebush)
Senna artemisioides subsp. *oligophylla* (bloodbush)
Senna artemisioides subsp. *sturtii* (variable cassia)
Sclerolaena spp. (bindiis)
Triodia pungens (soft spinifex)

No indicator value (stability desirables)
Acacia tetragonophylla (curara)
Acacia victoriae (prickly acacia)
Acacia xiphophylla (snakewood)
Eremophila cuneifolia (royal poverty bush)
Senna glutinosa subsp. *luerssenii* (white cassia)

Condition statement

Traverse data (138 observations) during the Pilbara rangeland survey 1995-97 (Van Vreeswyk *et al.* in preparation) indicated the following condition:

- Vegetation condition: very good 7%, good 12%, fair 23%, poor 34%, very poor 24%
- Soil erosion: nil 74%, slight 9%, minor 7%, moderate 4%, severe 3%, extreme 3%.

The condition of Snakewood Chenopod Pasture is variable but mostly poor with moderate to substantial losses of decreaser species in many cases. Where the vegetation is severely degraded soil erosion is common.

Good condition

In good condition nearly all snakewood shrubs will have three or four species of decreaser palatable shrubs (e.g. silver saltbush, ruby saltbush, tall saltbush) growing around the trunks or under their canopies. Sparse tussocks of desirable grasses such as curly windmill grass (*Enteropogon acicularis*) also grow under the snakewoods. In addition the inter-snakewood spaces support very scattered stands (projected foliar cover 2.5-10%) of low shrubs some of which will be decreasers. There should be no soil erosion.

Fair condition

Snakewood Chenopod Pasture in fair condition still supports decreaser shrubs under the snakewoods but populations are reduced to perhaps two or three individuals under each tree. The density of decreasers in the inter-snakewood spaces is reduced and may be replaced by marginal increases in less desirable shrubs such as cassias (*Senna* spp.).

Poor condition

Palatable shrubs and grasses are absent or occur only as occasional heavily grazed remnants under the snakewoods or in open spaces. The hardy decreaser tall saltbush (*Rhagodia eremaea*) is among the last to disappear under excessive grazing pressure. Forage is reduced to annual herbs and grasses in season and the pasture has no durability in dry times. Soil erosion is common.

Good condition

Photo 36 shows a Snakewood Chenopod Pasture in good condition on a flood plain of the Cane land system. Desirable decreasers such as silver saltbush (*Atriplex bunburyana*), ruby saltbush (*Enchylaena tomentosa*) and curly windmill grass (*Enteropogon acicularis*) grow under the snakewoods (*Acacia xiphophylla*) and silver saltbush is also established in the inter-snakewood spaces.

Fair condition

Photo 37 shows Snakewood Chenopod Pasture in fair condition on the Cowra land system. A range of decreasers is still present under the snakewoods but much sparser in the inter-snakewood spaces which are supporting mainly bindiis (*Sclerolaena* spp.).

Poor condition

Photo 38 shows Snakewood Chenopod Pasture in poor condition on the Hooley land system. There are no decreaser low shrubs beneath the snakewood. Ground cover consists of very sparse annual herbs and grasses.

Management

This preferred pasture type is prone to degradation. Management should be aimed at maintaining the productivity and vigour of the decreaser low shrubs. Grazing can be continuous for a number of years but a program of occasional spelling for three to six months after good rains, on a paddock-by-paddock basis, will be needed for maintenance. Pasture in poor condition may require spelling over consecutive growing seasons to effect improvement.

It is important that Snakewood Chenopod Pasture often occurs as small productive inclusions within less attractive pastures and that it is preferentially grazed. In these circumstances it is impossible to fence the Snakewood Chenopod Pasture as a separate entity. The effects of grazing on the preferred plants need to be carefully monitored.

Suggested levels of use (per annum)

Good condition	80 hectares per cattle unit
Fair condition	112 ha/cu
Poor condition	160 ha/cu

Hardpan Mulga Shrub Pasture

Approximate area 6,860 km^2 (3.6% of total)

Distribution and soil type

This pasture type is found in southern and south-eastern parts of the Pilbara on level or very gently sloping plains underlain by red-brown hardpan or 'Murchison cement'. The mulga shrublands on these plains consist of groves or sandy banks with dense vegetation and broad intergrove and interbank plains on land systems such as Cadgie, Jamindie, Nooingnin, Spearhole, Three Rivers, Wannamunna, Washplain and Zebra. The groves and banks vary in size from about 10-100 m wide by 50-5000 m long and are arranged more or less on the contour. The largest groves and banks are found on the Nooingnin and Zebra systems and have deep loamy or loamy clay soils. The broad intergrove and interbank areas which support much sparser vegetation than the groves or banks have shallow, slightly acid loam soils over hardpan. Soil surface mantles vary from very few to abundant pebbles of ironstone or quartz. The plains are subject to broad sheetwash water flow after rainfall.

Vegetation structure and composition

Hardpan Mulga Shrub Pasture on hardpan intergrove and interbank plains is typically isolated to very scattered (PFC <2.5-10%) low or tall shrublands or, less frequently, scattered (PFC 10-20%) shrublands. The most common low shrubs are horse mulla mulla (*Ptilotus schwartzii*), cotton bush (*Ptilotus obovatus*) and *Eremophila* species. Tall and mid height shrubs include the ubiquitious mulga (*Acacia aneura*), gidgee (*Acacia pruinocarpa*) and curara (*Acacia tetragonophylla*). Annual grasses, mainly wind grass (*Aristida contorta*), and herbs occur as a ground layer in season.

Hardpan Mulga Shrub Pasture in groves consist of moderately close to closed (PFC 25->50%) tall shrublands or woodlands. Trees and tall shrubs are mulga (*Acacia aneura*), gidgee (*Acacia pruinocarpa*) and *Acacia catenulata*. Common mid height and low shrubs are Wilcox bush (*Eremophila forrestii*), cotton bush (*Ptilotus obovatus*), flannel bush (*Solanum lasiophyllum*), tall sida (*Sida calyxhymenia*), ruby saltbush (*Enchylaena tomentosa*), silky bluebush (*Maireana villosa*) and cassias (*Senna* spp.). A few perennial grasses may be present.

Pastoral value

Hardpan Mulga Shrub Pasture has low to moderate pastoral value. The large intergrove areas support only very sparse desirable low shrubs and sparse annual grasses and herbs in season. The relatively small areas of groves are more productive with a range of desirable shrubs (and a few grasses) which provide high quality feed. However, because of the overall sparsity of desirable plants, Hardpan Mulga Shrub Pasture has only limited durability in dry times.

Common perennial species

Decreasers (desirables)
Canthium lineare
**Chrysopogon fallax* (ribbon grass)
**Digitaria ammophila*
**Digitaria coenicola*
Enchylaena tomentosa (ruby saltbush)
Eremophila forrestii (Wilcox bush)
Eremophila latrobei (warty fuchsia bush)
Maireana planifolia (flat-leaved bluebush)
Maireana planifolia x *villosa*
Maireana villosa (silky bluebush)
Ptilotus obovatus (cotton bush)
Ptilotus roei (creeping mulla mulla)
Ptilotus schwartzii (horse mulla mulla)

Rhagodia eremaea (tall saltbush)
Senna artemisioides subsp. *sturtii* (variable cassia)
Sida calyxhymenia (tall sida)
Tribulus platypterus (corky bark)

Increasers (undesirables)

**Dodonaea petiolaris* (hop bush)
Senna artemisioides subsp. *helmsii* (crinkled cassia)
**Solanum sturtianum* (wild tomato)

Intermediates

Solanum lasiophyllum (flannel bush)

No indicator value (stability desirables)

Acacia aneura (mulga)
Acacia catenulata
Acacia pruinocarpa (gidgee)
Acacia tetragonophylla (curara)
Canthium latifolium (wild lemon)
Eremophila fraseri (turpentine bush)
Eremophila sp. 'Jigalong'
Eremophila lanceolata (12-mile poverty bush)
Eremophila spathulata
Hakea suberea (corkwood)
Hibiscus burtonii
Senna glutinosa subsp. *luerssenii* (white cassia)

* Only in groves.

Condition statement

Traverse data (620 observations) during the Pilbara rangeland survey 1995-97 (Van Vreeswyk et al. in preparation) indicated the following condition:

- Vegetation condition: very good 6%, good 26%, fair 29%, poor 30%, very poor 9%
- Soil erosion: nil 91%, slight 1.5%, minor 3%, moderate 2%, severe 2%, extreme 0.5%.

These data indicate that the condition of Hardpan Mulga Shrub Pasture is highly variable. Extensive parts are degraded with moderate to substantial losses of desirable understorey shrubs (30% of traverse records indicate poor condition and 9% indicate very poor condition). The overstorey is not usually adversely affected but some areas of collapsed groves with dead mulgas occur where overland flow processes have been disrupted.

This pasture type with its level topography and well developed cryptogamic soil crusts is relatively resistant to erosion. However, sheet erosion can occur on hardpan plains and tracts subject to more concentrated through flow if the soil crust is broken by excessive trampling or other disturbances. Some localised but significant areas are severely degraded and eroded.

Good condition

Hardpan Mulga Shrub Pasture in good condition support isolated to very scattered (PFC <2.5-5%) decreaser low shrubs such as horse mulla mulla (*Ptilotus schwartzii*) and cotton bush (*Ptilotus obovatus*) in the intergroves. A wider range of denser decreaser plants occur under the dense mulga shrubs in the groves. The groves receive and trap water being shed off adjacent hardpan intergrove plains and are areas of high biological activity with deep soils, dense vegetation and plentiful litter. They are areas preferred by livestock and other animals. There is no soil erosion.

Fair condition

In fair condition Hardpan Mulga Shrub Pasture has a reduced population of decreaser shrubs (PFC generally <2.5%) in the hardpan intergrove areas but desirable decreaser species are still relatively common in the groves. Increaser species such as crinkled cassia (*Senna artemisioides* subsp. *helmsii*) may increase marginally in the intergroves and stability desirables such as poverty bushes (*Eremophila* spp.) are common but nowhere form dense stands. There is no soil erosion.

Poor condition

In poor condition Hardpan Mulga Shrub Pasture is devoid of palatable decreaser shrubs. Hardpan intergrove plains support only isolated to very scattered (PFC < 2.5-5%) stability desirables such as *Acacia* and *Eremophila* species. Groves are still close (PFC 30-50%) tall shrublands or woodlands of mulga but palatable undershrubs are virtually absent. The shrubs beneath the mulgas consist of a few unpalatable stability desirables or increasers such as hop bush (*Dodonaea petiolaris*) or wild tomato (*Solanum sturtianum*). In extreme situations where groves have been starved of water by alterations to run-off and run-on processes, all plants may die and the grove structure collapses.

Management

Hardpan Mulga Shrub Pasture can be grazed continuously provided stocking rates are appropriate and, if in good or fair condition, they will supply feed of sufficient quality for breeding livestock. Alternative management could include relatively heavy, short-term opportunistic use of the ephemeral grasses and herbs in good seasons. Provided the period of grazing is controlled, no damage will occur to desirable shrubs.

Grazing policy should be flexible in order to take advantage of favourable seasons or to respond to other factors such as obvious decline in pasture condition. Occasional complete spelling over a growing season will be required to improve the cover and vigour of shrubs.

Hardpan Mulga Shrub Pasture should be protected from burning as mulga and many associated shrubs are fire-sensitive. In average years these pastures will not generally carry a fire but in heavy seasons wind grass (*Aristida contorta*) and other herbage will supply sufficient fuel.

Suggested levels of use (per annum)

Hardpan plains and intergrove plains

Good condition	120 hectares per cattle unit
Fair condition	145 ha/cu
Poor condition	170 ha/cu

Groves

Good condition	60 hectares per cattle unit
Fair condition	84 ha/cu
Poor condition	120 ha/cu

Good condition

Photo 39 shows a hardpan plain of the Cadgie land system supporting Mulga Shrub Hardpan Pasture in good condition. There is a scattering of desirables such as horse mulla mulla (*Ptilotus schwartzii*), creeping mulla mulla (*Ptilotus roei*), tall saltbush (*Rhagodia eremaea*) and tall sida (*Sida calyxhymenia*). The site has very shallow soil over hardpan and does not have the potential to carry many more shrubs.

Photo 40 shows Hardpan Mulga Shrub Pasture in a grove that is favoured by additional water running on from adjacent intergrove surfaces. The mulga (*Acacia aneura*) trees are close (PFC 30-50%) and there is a good range of desirable decreaser shrub species in the understorey. The site is on the Pindering land system and condition is good.

Fair condition

Photo 41 shows a hardpan plain on the Zebra land system with Hardpan Mulga Shrub Pasture in fair condition. The unpalatable stability desirable *Eremophila* sp. 'Jigalong' dominates the low shrub layer and only a few palatable decreaser shrubs are present. The background spinifex is on a different unit (low sandy banks) of the Zebra system and is Soft Spinifex Plain Pasture.

Poor condition

Photo 42 shows an intergrove hardpan plain on the Zebra land system with Hardpan Mulga Shrub Pasture in poor condition. There are virtually no perennial plants remaining and the pasture produces only sparse annual grasses and herbs in season.

Poor Condition

Photo 43 shows a collapsed grove in a Hardpan Mulga Shrub Pasture. The normal water recharge system to the grove has been disrupted and the mulga and associated shrubs have died. There is active soil erosion and condition is very poor.

Acacia Mixed Shrub Pasture

Approximate area 3,170 km^2 (1.6% of total)

Distribution and soil type

This pasture type is widespread in southern parts of the Pilbara as acacia-poverty bush-cassia (*Acacia-Eremophila-Senna*) shrublands on level to gently undulating stony plains, low rises and footslopes of land systems such Balfour, Charley, Laterite, Prairie, Robertson, Sylvania and Warri. Soils are stony, shallow loams and earths (sometimes calcareous) and red-brown clays with many to very abundant (20->90%) surface mantles of ironstone, basalt, quartz, shale or calcrete pebbles and cobbles. Less frequently soils are red shallow sands, such as on parts of the Sylvania land system, and surface mantles are absent or present as veneers of quartz grit.

Vegetation structure and composition

The pasture type is typically a very scattered to scattered low shrubland with sparse mid height and tall shrubs (total PFC 5-15%). Occasionally the mid or tall shrub layers may dominate but this is not usual. On some sites, notably those on calcrete such as in Warri land system, the total foliar cover of shrubs can reach 25%.

The dominant low shrubs are invariably poverty bushes (*Eremophila* spp.) and/or cassias (*Senna* spp.). Cotton bush (*Ptilotus obovatus*) and flannel bush (*Solanum lasiophyllum*) are also extremely common. The taller shrubs are most commonly mulga (*Acacias aneura*), curara (*Acacia tetragonophylla*), prickly acacia (*Acacia victoriae*) and miniritchie (*Acacia grasbyi*). A very few perennial grasses may be present and become rather more frequent on sandier sites. Numerous annual grasses such as wind grass (*Aristida contorta*) and limestone grass (*Enneapogon* spp.) and herbs occur in season.

Pastoral value

Acacia Mixed Shrub Pasture has low pastoral value in terms of carrying capacity but some of the shrubs and the annuals that they support provide high quality forage in season. In good condition they are capable of supporting all classes of stock on a year-long basis albeit at low stocking rates. However, they have only limited durability in dry years and desirable shrubs are susceptible to preferential overuse in such years.

Common perennial species

Decreasers (desirables)
Enchylaena tomentosa (ruby saltbush)
Eragrostis eriopoda (woolly butt)
Eremophila forrestii (Wilcox bush)
Eremophila latrobei (warty fuchsia bush)
Maireana villosa (silky bluebush)
Maireana georgei (golden bluebush)
Maireana thesioides (lax bluebush)
Maireana planifolia (flat leaved bluebush)
Maireana tomentosa (felty bluebush)
Monochather paradoxa (broad leaved wanderrie grass)
Ptilotus obovatus (cotton bush)
Ptilotus roei (creeping mulla mulla)
Rhagodia eremaea (tall saltbush)
Senna artemisioides subsp. *oligophylla* (bloodbush)
Senna artemisioides subsp. *sturtii* (variable cassia)
Sida calyxhymenia (tall sida)
Tephrosia supina

Increasers (undesirables)
Aristida holathera var. *holathera*
Senna artemisioides subsp. *helmisii* (crinkled cassia)
Senna artemisioides subsp. *filifolia* (desert cassia)
Senna sp. 'Meekatharra' (straight leaf cassia)
Intermediates
Maireana triptera (three winged bluebush)
Solanum lasiophyllum (flannel bush)
No indicator value (stability desirables)
Acacia aneura (mulga)
Acacia grasbyi (miniritchie)
Acacia pruinocarpa (gidgee)
Acacia rhodophloia (miniritchie)
Acacia sclerosperma (limestone wattle)
Acacia tetragonophylla (curara)
Acacia victoriae (prickly acacia)
Acacia wanyu
Eremophila cuneifolia (royal poverty bush)
Eremophila exilifolia (little turpentine poverty bush)
Eremophila fraseri (turpentine bush)
Eremophila sp. 'Jigalong'
Grevillea spp.
Hakea suberea (corkwood)
Hibiscus burtonii
Indigofera monophylla (one leaved indigofera)
Senna artemisioides subsp. *stricta*
Senna glutinosa subsp. *luerssenii* (white cassia)

Condition statement

Traverse data (319 observations) during the Pilbara rangeland survey 1995-97 (Van Vreeswyk et al. in preparation) indicated the following condition:

- Vegetation condition: very good 9%, good 27%, fair 41%, poor 21%, very poor 2%
- Soil erosion: nil 93%, slight 2%, minor 3%, moderate 2%.

These data show that Acacia Mixed Shrub Pasture in Pilbara are predominantly in fair or good condition with minimal loss of desirable shrubs. Some parts are degraded to poor condition (23% of traverse records) with considerable loss of desirable low shrubs. Soil erosion is generally not significant largely due to the protection afforded by stony surface mantles.

Good condition

In good condition these pastures support a range of decreaser low shrubs, but at relatively low densities, mixed with unpalatable species (stability desirables) which are a normal component of the vegetation. Key decreaser shrubs include bluebushes (*Maireana* spp.), warty fuchsia bush (*Eremophila latrobei*) and tall sida (*Sida calyxhymenia*). There is no erosion.

Fair condition

Acacia Mixed Shrub Pasture in fair condition still has some palatable decreaser species present but populations are below potential and individual plants such as warty fuchsia bush (*Eremophila latrobei*) and tall saltbush (*Rhagodia eremaea*) may be heavily utilised. Unpalatable shrubs increase their relative proportion in the stand but total foliar cover is little changed from good condition.

Poor condition

When this pasture type is in poor condition palatable decreaser plants are absent or occur only as occasional isolated remnants. On some sites, particularly those based on calcrete, increaser plants such as crinkled cassia and desert cassia (*Senna artemisioides* subsp. *helmsii* and *S. artemisioides* subsp. *filifolia*) may thicken but more commonly there is no increase or a decrease in total foliar cover. The stand then consists of very scattered unpalatable plants of no indicator value.

Good condition

Photo 44 shows an Acacia Mixed Shrub Pasture on a stony plain of the Charley land system. The low shrubs are mostly cassia (*Senna artemisioides* subsp. *helmsii*) with some decreasers such as Wilcox bush (*Eremophila forrestii*), warty fuchsia bush (*Eremophila latrobei*) and cotton bush (*Ptilotus obovatus*). Range condition of the site, based on the perennial vegetation, is good. The plentiful ground layer consists of annual wind grass (*Aristida contorta*) and small herbs and indicates that seasonal conditions have been good.

Fair condition

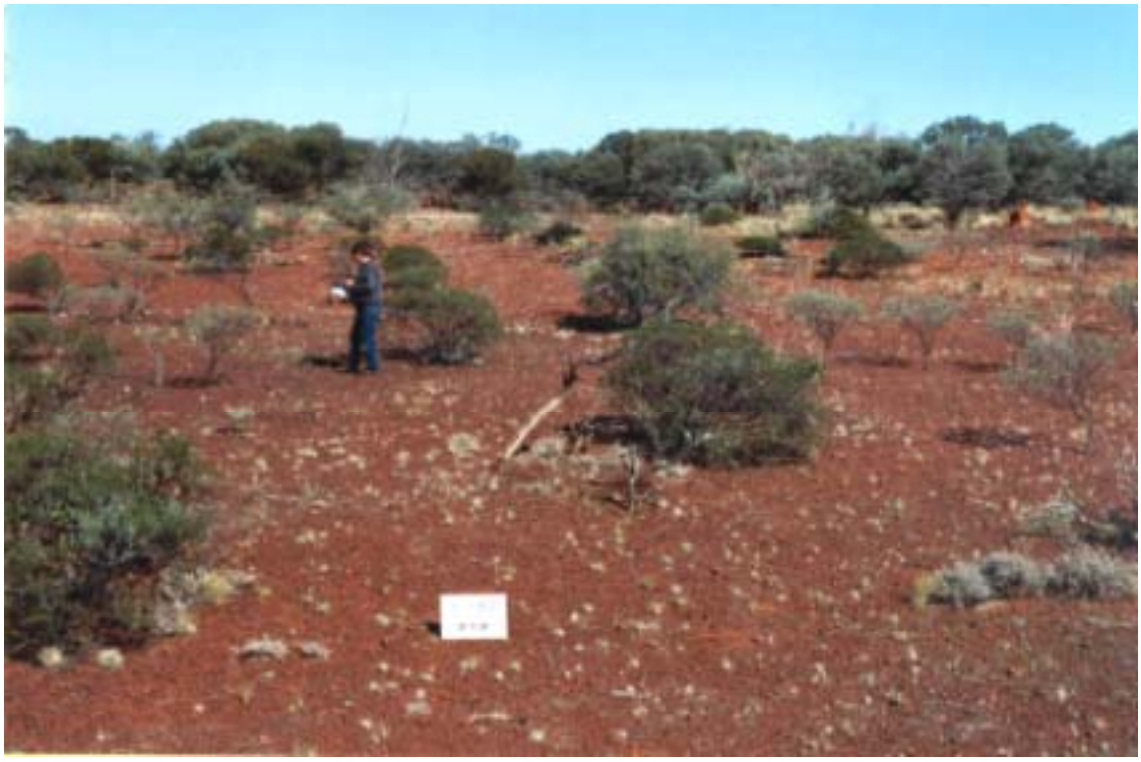

Photo 45 shows Acacia Mixed Shrub Pasture in fair condition on a gently sloping gravelly plain of the Laterite land system. There are three or four species of decreaser shrubs present but they are very sparse. The most prominent shrubs are unpalatable cassias (*Senna* spp.) and royal poverty bush (*Eremophila cuneifolia*) and mulga (*Acacia aneura*) (background).

Poor condition

Photo 46 shows Acacia Mixed Shrub Pasture in poor condition on a stony plain in the Sylvania land system. There are virtually no palatable decreaser plants on the site and many other shrubs such as mulga (*Acacia aneura*) are dead.

Management

Acacia Mixed Shrub Pasture in good or fair condition can be grazed continuously provided stocking rates are appropriate. Alternative management could include relatively heavy, short-term grazing of the annual grasses and herbs in good seasons and, provided the period of grazing is restricted, no damage will occur to desirable shrubs.

In dry years decreaser shrubs are prone to preferential overuse and numbers may decline. Grazing policy needs to be flexible enough to include removing animals when overuse on key indicator plants is observed or to take advantage of heavy seasons. Pastures in poor condition will require complete spelling over a growing season or number of growing seasons to improve the number and vigour of desirable shrubs. As a general principle, fires should be excluded.

Suggested levels of use (per annum)

Good condition	120 hectares per cattle unit
Fair condition	145 ha/cu
Poor condition	170 ha/cu

Acknowledgements

The authors greatly appreciate the help provided by colleagues Ken Leighton, Peter Hennig and Sandra Van Vreeswyk in the preparation of this publication.

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Appendix 1. Summary of pasture types in the Pilbara

Pasture type	Area km^2	Per cent	Landforms, soils and vegetation	Pastoral potential	Condition
Spinifex Hill	56,730	29.5	Rugged hills, ridges, plateaux and footslopes; stony soils and red shallow loams, mostly hard spinifex with sparse shrubs and occasional trees.	Very low to useless	Vegetation condition good, unattractive or poorly accessible to livestock; mostly of no use for pastoralism.
Hard Spinifex Plain	55,280	28.8	Extensive level to gently undulating stony plains, gritty surfaced plains and sandplains; deep and shallow sands, loams, sandy earths and duplex soils, occasionally clayey soils; hard spinifex grasslands with very scattered shrubs and occasional trees.	Very low	Vegetation condition mostly good; generally unattractive to livestock except for a few years following burning; generally not susceptible to erosion.
Soft Spinifex Plain	44,150	23.0	Alluvial plains, drainage floors, sandy-surfaced plains, sandplains and dunes; sandy earths, duplex soils and deep sands; soft spinifex grasslands with scattered shrubs and occasional trees.	Moderate	Vegetation condition mostly good (69% of records). Some degraded areas and localised erosion on some alluvial plains. Soft spinifex pastures are moderately preferred by livestock, good drought reserve; regular burning required to maintain pasture attractiveness and value for stock.
Hardpan Mulga Shrub	6,860	3.6	Level to gently inclined alluvial hardpan plains; hardpan shallow loams and loamy earths; mulga shrublands with groves (bands of dense mulga) arranged at right angles to direction of sheet water flow.	Low	Conditions is about equally distributed between good, fair and poor with palatable shrubs considerably reduced in some parts; soil erosion not widespread but some areas of moderate and severe sheeting.
Roebourne Plains Grass	5,280	2.8	Level alluvial plains often with gilgai microrelief; deep cracking clays and red-brown clays; tussock grasslands dominated by Roebourne Plains Grass occasionally with patches of snakewood shrubs.	High	Vegetation condition varies from very good to very poor with some extensive areas of pasture decline. Soil erosion fairly common, some severely degraded and eroded areas.

Appendix 1. continued ...

Pasture type	Area km^2	Per cent	Landforms, soils and vegetation	Pastoral potential	Condition
Buffel Grass	3,435	1.8	Alluvial plains, river terraces, levees, channel banks and drainage floors, also coastal dunes and sandplains; loamy and sandy earths, loamy duplex soils and deep calcareous sands; tussock grasslands with very scattered shrubs and trees.	Very high	Pasture condition is predominantly very good or good (83% of records); buffel grass has ability to colonise and eventually stabilise many degraded sites; recently colonised sites with poor total cover are still degraded and may show erosion.
Acacia Mixed Shrub	3,170	1.6	Level to gently undulating stony plains, low rises and hill footslopes; stony soils, shallow loams, red-brown clays and shallow sands; scattered low shrublands (less frequently mid height or tall shrublands).	Low	Pasture condition is predominantly fair (40% of records) with moderate losses of palatable shrubs but varies from very good to poor; soil erosion is rare.
Ribbon Grass	1,765	0.9	Alluvial plains, drainage tracts and groved plains. Also sandy plains and floors in granitic terrain. Deep clays and cracking clays, loamy and sandy earths and sandy duplex soils; tussock grasslands ± shrubs or tall shrublands with grass understorey.	Very high	Condition is highly variable ranging from very good to very poor. Soil erosion is not widespread but is locally significant on some drainage floors and alluvial plains.
Bluebush/Saltbush	1,570	0.8	Level alluvial plains and drainage floors with saline clay or duplex soils; low shrublands of bluebush, saltbush and other halophytes with sparse acacia overstorey.	Moderate	These pastures are prone to preferential overuse by livestock. Condition is predominantly poor (38% of records) with substantial losses of palatable shrubs but varies from very poor to very good. Pasture decline is frequently associated with soil erosion on duplex soils or other soils that are not protected by stony mantles.

Appendix 1. continued ...

Pasture type	Area km^2	Per cent	Landforms, soils and vegetation	Pastoral potential	Condition
Mitchell Grass Tableland	1,480	0.8	Gently sloping or gently undulating upland stony gilgai plains and other stony plains based on basalt; self-mulching cracking clay and other clay soils; tussock grasslands.	High	Pastures are mostly in poor or fair condition (69% of records), some areas more distant from water are in good condition. Pastures are attractive to herbivores and prone to degrade to annual herb fields but are generally not susceptible to erosion.
Snakewood Chenopod	1,320	0.7	Alluvial plains and stony plains mostly without gilgai microrelief; soils are deep clays, loamy earths and duplex types; mid height or tall snakewood shrublands with understorey of chenopod shrubs.	Moderate	These pastures are prone to preferential overuse by livestock. Condition is predominantly poor (34% of records) but varies from very poor to very good. Considerable loss of palatable shrubs is widespread and soil erosion is common.
Mitchell Grass Alluvial Plain	505	0.3	Alluvial plains with gilgai microrelief and deep, self-mulching, cracking clay soils; tussock grasslands of Mitchell grasses with very few shrubs.	Very high	Condition varies from very good to very poor. About 47% of records indicate degraded condition with substantial reductions in density of desirable grasses; soils mostly stable but some localised erosion.
Other	8,415	4.4			
Unvegetated	1,960	1.0	Saline tidal mud flats, lake beds, claypans, river beds.	Nil	
Total	191,920	100.0			

Appendix 2 Plant species listed by botanical name

Botanical name	Common name
Abutilon malvifolium	
Abutilon spp	
Abutilon trudgenii	
Acacia acradenia	
Acacia ampliceps	black wattle
Acacia ancistrocarpa	wax wattle
Acacia aneura	mulga
Acacia atkinsiana	
Acacia bivenosa	two vein wattle
Acacia catenulata	
Acacia citrinoviridis	black mulga
Acacia coriacea	river jam, coastal jam
Acacia eriopoda	Broome wattle
Acacia farnesiana	mimosa bush, false mesquite
Acacia glaucocaesia	
Acacia grasbyi	miniritchie
Acacia holosericea	candelabra wattle
Acacia inaequilatera	kanji
Acacia pruinocarpa	gidgee
Acacia pyrifolia	fire wattle
Acacia rhodophloia	miniritchie
Acacia sclerosperma	limestone wattle
Acacia tetragonophylla	curara
Acacia trachycarpa	miniritchie
Acacia translucens	poverty bush
Acacia tumida	pindan wattle
Acacia victoriae	prickly acacia, bardi bush
Acacia wanyu	bardi bush
Acacia xiphophylla	snakewood
Aerva javanica	kapok bush
Allocasuarina decaisneana	desert oak
Aristida contorta	wind grass
Aristida holathera var. *holathera*	erect kerosene grass
Aristida latifolia	feathertop three awn
Astrebla elymoides	weeping Mitchell grass
Astrebla lappacea	curly Mitchell grass
Astrebla pectinata	barley Mitchell grass
Atalaya hemiglauca	whitewood
Atriplex bunburyana	silver saltbush
Bonamia alatissima	
Bonamia erecta	
Bonamia rosea	
Cajanus marmoratus	tablelands creeper
Canthium latifolium	wild lemon
Canthium lineare	
Carissa lanceolata	conkerberry
Cenchrus ciliaris	buffel grass
Cenchrus setigerus	Birdwood grass
Chenopodium auricomum	swamp bluebush
Chrysopogon fallax	weeping grass, ribbon grass
Commelina ensifolia	
Corchorus sidoides	flannel weed
Corchorus spp.	
Corchorus walcottii	woolly corchorus
Corymbia aspera	rough leaf range gum
Corymbia hamersleyana	Hamersley bloodwood
Crotalaria crispata	Kimberley horse poison
Crotalaria cunninghamii	green bird flower
Crotalaria dissitiflora subsp. *benthamiana*	

Botanical name	Common name
Cullen leucochaites	
Cullen martinii	
Cullen pogonocarpum	
Cymbopogon ambiguus	lemon scented grass
Cymbopogon sp.	
Cyperus bulbosum	
Desmodium campylocaulon	
Dichanthium fecundum	bundle bundle, curly blue grass
Digitaria ammophila	
Digitaria coenicola	mulga grass
Dodonaea petiolaris	hop bush
Enchylaena tomentosa	ruby saltbush
Enneapogon spp.	limestone grass, bottle washers
Enteropogon acicularis	curly windmill grass
Eragrostis eriopoda	woolly butt
Eragrostis setifolia	neverfail
Eragrostis xerophila	Roebourne Plains grass
Eremophila cuneifolia	royal poverty bush
Eremophila exilifolia	little turpentine poverty bush
Eremophila forrestii	Wilcox bush
Eremophila fraseri	turpentine bush
Eremophila lanceolata	12-mile poverty bush
Eremophila latrobei	warty fuchsia bush, warty leaf eremophila
Eremophila sp. 'Jigalong'	
Eremophila spathulata	
Eriachne benthamii	swamp grass
Eriachne helmsii	buck wanderrie
Eriachne mucronata	stony wanderrie grass
Eriachne obtusa	wire grass
Eucalyptus camaldulensis	river red gum
Eucalyptus leucophloia	snappy gum
Eucalyptus spp.	
Eucalyptus victrix	coolibah, smooth bark coolibah
Eulalia aurea	silky brown top
Evolvulus alsinoides	
Fimbristylis dichotoma	
Frankenia spp.	frankenia
Glycine falcata	
Goodenia microptera	
Goodenia pascua	
Goodenia stobbsiana	
Gossypium australe	wild cotton
Grevillea pyramidata	caustic bush
Grevillea wickhamii	Wickham's grevillea
Grevillea spp.	
Hakea suberea	corkwood
Hibiscus burtonii	
Hibiscus sturtii	
Hybanthus aurantiacus	
Indigofera monophylla	one-leaved indigofera
Indigofera spp.	
Indigofera trita	
Ipomoea muelleri	poison morning glory
Ischaemum albovillosum	tableland white grass
Lysiphyllum cunninghamii	bauhinia
Maireana aphylla	spiny bluebush
Maireana carnosa	cottony bluebush
Maireana georgei	golden bluebush
Maireana glomerifolia	ball leaf bluebush
Maireana planifolia	flat-leaved bluebush

Botanical name	**Common name**
Maireana planifolia x *villosa*	
Maireana pyramidata	sago bush
Maireana thesioides	lax bluebush
Maireana tomentosa	felty bluebush
Maireana triptera	three winged bluebush
Maireana villosa	silky bluebush
Malvastrum americanum	spiked malvastrum
Minuria integerrima	
Mollugo molluginis	
Monochather paradoxa	broad leaved wanderrie grass
Neptunia dimorphantha	sensitive plant
Owenia reticulata	desert walnut
Panicum decompositum	native panic
Paraneurachne muelleri	hop-along grass
Phyllanthus maderaspatensis	
Pluchea tetranthera	
Polymeria lanata	black soil bindweed
Prosopis spp.	mesquite
Pterocaulon sphacelatum	
Ptilotus astrolasius	
Ptilotus axillaris	
Ptilotus calostachyus	tall mulla mulla
Ptilotus obovatus	cotton bush
Ptilotus roei	creeping mulla mulla
Ptilotus schwartzii	horse mulla mulla
Rhagodia eremaea	tall saltbush
Rhynchosia minima	Mardie clover
Scaevola spinescens	currant bush
Sclerolaena bicornis	goathead burr
Sclerolaena cuneata	yellow bindii
Sclerolaena hostilis	giant bindii
Sclerolaena spp.	bindii
Senna artemisioides subsp. *filifolia*	desert cassia
Senna artemisioides subsp. *helmsii*	crinkled cassia
Senna artemisioides subsp. *oligophylla*	bloodbush
Senna artemisioides subsp. *stricta*	
Senna artemisioides subsp. *sturtii*	variable cassia
Senna glutinosa	sticky cassia
Senna glutinosa subsp. *luerssenii*	white cassia
Senna hamersleyensis	creeping cassia
Senna notabilis	cockroach bush
Senna sp. 'Meekatharra'	straight leaf cassia
Sida calyxhymenia	tall sida
Sida echinocarpa	
Sida fibulifera	creeping sida
Sida rohlenae	
Sida spp.	
Solanum diversiflorum	bush tomato
Solanum esuriale	
Solanum lasiophyllum	flannel bush
Solanum sturtianum	
Sporobolus mitchellii	
Stemodia kingii	black soil poison
Streptoglossa bubakii	stinkweed
Streptoglossa odora	stinkweed
Tephrosia clementii	
Tephrosia rosea	Flinders River poison
Tephrosia supina	
Tephrosia uniovulata	
Terminalia canescens	native almond

Botanical name	Common name
Themeda triandra	kangaroo grass
Trianthema turgidifolia	
Tribulus platypterus	corky bark
Triodia sp. 'Indee'	weeping spinifex
Triodia plurinervata	pincushion spinifex
Triodia basedowii	desert hard spinifex
Triodia biflora	scree soft spinifex
Triodia brizoides	echidna spinifex
Triodia bynoei	giant oat-eared spinifex
Triodia epactia	grey soft spinifex
Triodia lanigera	common hard spinifex
Triodia longiceps	knitting needle spinifex
Triodia pungens	soft spinifex
Triodia secunda	porcupine spinifex
Triodia wiseana	limestone spinifex
Tripogon loliiformis	five minute grass
Vigna sp. 'Pilbara black soil'	
Whiteochloa airoides	

Appendix 3 Plant species listed by common name

Common name	Botanical name
ball leaf bluebush	*Maireana glomerifolia*
bardi bush	*Acacia victoriae*
bardi bush	*Acacia wanyu*
barley Mitchell grass	*Astrebla pectinata*
bauhinia	*Lysiphyllum cunninghamii*
Birdwood grass	*Cenchrus setigerus*
black mulga	*Acacia citrinoviridis*
black soil bindweed	*Polymeria lanata*
black soil poison	*Stemodia kingii*
black wattle	*Acacia ampliceps*
bloodbush	*Senna artemisioides* subsp. *oligophylla*
bottle washers	*Enneapogon* spp.
Broome wattle	*Acacia eriopoda*
buffel grass	*Cenchrus ciliaris*
bundle bundle	*Dichanthium fecundum*
bush tomato	*Solanum diversiflorum*
candelabra wattle	*Acacia holosericea*
caustic bush	*Grevillea pyramidata*
coastal jam	*Acacia coriacea*
cockroach bush	*Senna notabilis*
common hard spinifex	*Triodia lanigera*
conkerberry	*Carissa lanceolata*
corkwood	*Hakea suberea*
coolibah	*Eucalyptus victrix*
corky bark	*Tribulus platypterus*
cotton bush	*Ptilotus obovatus*
cottony bluebush	*Maireana carnosa*
creeping cassia	*Senna hamersleyensis*
creeping mulla mulla	*Ptilotus roei*
creeping sida	*Sida fibulifera*
crinkled cassia	*Senna artemisioides* subsp. *helmsii*
curara	*Acacia tetragonophylla*
curly blue grass	*Dichanthium fecundum*
curly Mitchell grass	*Astrebla lappacea*
curly windmill grass	*Enteropogon acicularis*
currant bush	*Scaevola spinescens*
desert cassia	*Senna artemisioides* subsp. *filifolia*
desert hard spinifex	*Triodia basedowii*
desert oak	*Allocasuarina decaisneana*
desert walnut	*Owenia reticulata*
echidna spinifex	*Triodia brizoides*
erect kerosene grass	*Aristida holathera* var. *holathera*
false mesquite	*Acacia farnesiana*
feathertop three awn	*Aristida latifolia*
felty bluebush	*Maireana tomentosa*
fire wattle	*Acacia pyrifolia*
five minute grass	*Tripogon loliiformis*
flannel bush	*Solanum lasiophyllum*
flannel weed	*Corchorus sidoides*
flat-leaved bluebush	*Maireana planifolia*
Flinders River poison	*Tephrosia rosea*
frankenia	*Frankenia* spp.
giant bindii	*Sclerolaena hostilis*
giant oat-eared spinifex	*Triodia bynoei*
gidgee	*Acacia pruinocarpa*
goathead burr	*Sclerolaena bicornis*
golden bluebush	*Maireana georgei*
green bird flower	*Crotalaria cunninghamii*
grey soft spinifex	*Triodia epactia*

Common name	Botanical name
Hamersley bloodwood	*Corymbia hamersleyana*
hop bush	*Dodonaea petiolaris*
hop-along grass	*Paraneurachne muelleri*
horse mulla mulla	*Ptilotus schwartzii*
kangaroo grass	*Themeda triandra*
kanji	*Acacia inaequilatera*
kapok bush	*Aerva javanica*
Kimberley horse poison	*Crotalaria crispata*
knitting needle spinifex	*Triodia longiceps*
lax bluebush	*Maireana thesioides*
lemon scented grass	*Cymbopogon ambiguus*
limestone grass	*Enneapogon* spp.
limestone spinifex	*Triodia wiseana*
limestone wattle	*Acacia sclerosperma*
little turpentine poverty bush	*Eremophila exilifolia*
Mardie clover	*Rhynchosia minima*
mesquite	*Prosopis* spp.
mimosa bush	*Acacia farnesiana*
miniritchie	*Acacia grasbyi*
miniritchie	*Acacia rhodophloia*
miniritchie	*Acacia trachycarpa*
mulga	*Acacia aneura*
mulga grass	*Digitaria coenicola*
native almond	*Terminalia canescens*
native panic	*Panicum decompositum*
neverfail	*Eragrostis setifolia*
one-leaved indigofera	*Indigofera monophylla*
pincushion spinifex	*Triodia* aff. *plurinervata*
pindan wattle	*Acacia tumida*
poison morning glory	*Ipomoea muelleri*
porcupine spinifex	*Triodia secunda*
poverty bush	*Acacia translucens*
prickly acacia	*Acacia victoriae*
ribbon grass	*Chrysopogon fallax*
river jam	*Acacia coriacea*
river red gum	*Eucalyptus camaldulensis*
Roebourne Plains grass	*Eragrostis xerophila*
rough leaf range gum	*Corymbia aspera*
royal poverty bush	*Eremophila cuneifolia*
ruby saltbush	*Enchylaena tomentosa*
sago bush	*Maireana pyramidata*
scree soft spinifex	*Triodia biflora*
sensitive plant	*Neptunia dimorphantha*
silky bluebush	*Maireana villosa*
silky brown top	*Eulalia aurea*
silver saltbush	*Atriplex bunburyana*
smooth barked coolibah	*Eucalyptus victrix*
snakewood	*Acacia xiphophylla*
snappy gum	*Eucalyptus leucophloia*
soft spinifex	*Triodia pungens*
spiked malvastrum	*Malvastrum americanum*
spiny bluebush	*Maireana aphylla*
sticky cassia	*Senna glutinosa*
stinkweed	*Streptoglossa bubakii*
stinkweed	*Streptoglossa odora*
stony wanderrie grass	*Eriachne mucronata*
straight leaf cassia	*Senna* sp. 'Meekatharra'
swamp bluebush	*Chenopodium auricomum*
swamp grass	*Eriachne benthamii*
tableland white grass	*Ischaemum albovillosum*

Common name	Botanical name
tablelands creeper	*Cajanus marmoratus*
tall mulla mulla	*Ptilotus calostachyus*
tall saltbush	*Rhagodia eremaea*
tall sida	*Sida calyxhymenia*
three winged bluebush	*Maireana triptera*
turpentine bush	*Eremophila fraseri*
12-mile poverty bush	*Eremophila lanceolata*
two vein wattle	*Acacia bivenosa*
variable cassia	*Senna artemisioides* subsp. *sturtii*
warty fuchsia bush	*Eremophila latrobei*
warty leaf eremophila	*Eremophila latrobei*
wax wattle	*Acacia ancistrocarpa*
weeping grass	*Chrysopogon fallax*
weeping Mitchell grass	*Astrebla elymoides*
weeping spinifex	*Triodia* sp. 'Indee'
white cassia	*Senna glutinosa* subsp. *luerssenii*
whitewood	*Atalaya hemiglauca*
Wickham's grevillea	*Grevillea wickhamii*
Wilcox bush	*Eremophila forrestii*
wild cotton	*Gossypium australe*
wild lemon	*Canthium latifolium*
wind grass	*Aristida contorta*
wire grass	*Eriachne obtusa*
woolly butt	*Eragrostis eriopoda*
woolly corchorus	*Corchorus walcottii*
yellow bindii	*Sclerolaena cuneata*