Report prepared for the **Meat Research Corporation**

The pasture lands of northern Australia

J.C. Tothill and C. Gillies

Their condition,

productivity,

and sustainability.

Tropical Grassland Society of Australia
Occasional Publication No. 5

ISBN 0 9590948 4 9

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Published by Tropical Grassland Society of Australia Inc.
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306 Carmody Road
St Lucia
Queensland 4067
Australia

on behalf of Meat Research Corporation
PO Box A498
Sydney South
NSW 2000
Australia

Cover
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Printed by Cranbrook Press (Toowoomba) Pty Ltd, Queensland

Contents

A map entitled *The pasture lands of northern Australia* (Scale 1: 4 000 000) accompanies this report

Terms of Reference

The Terms of Reference for this report were to:

- collate and interpret all relevant published information, data sets and knowledge in relation to the soil and vegetation condition of lands covered by the North Australia Program–2 (NAP–2)
- define sustainability and degradation for each of the vegetation zones
- identify and quantify the status of the pastoral resources
- detail strategies for sustainability of condition states of pasture communities
- list priorities in the target areas for future research
- indicate to potential researchers and end-users the boundaries of Meat Research Corporation funding.

Definitions

Sustainability is defined in this report as the long-term maintenance of the livestock production resources and environment to enable viable livestock production. This is judged on:

- maintenance or improvement of ecologically desirable pasture composition and ground cover
- maintenance of desirable soil physical and chemical fertility, and water-use efficiency
- management's ability to utilise these resources efficiently and responsibly within the total production environment
- reasonable economic output.

Degradation represents a departure from a sustained condition, resulting from an undesirable change in one or more of the elements that govern sustainability. Degradation embraces the whole production environment, not only land.
Degradation is considered at two levels:
deteriorating—a state reversible with appropriate management and normal rainfall
degraded—probably irreversible within bounds of economic management.

Executive summary

Co-ordinated description of resources of northern Australia

Twenty-four pasture communities over Queensland, the northern part of the Northern Territory, and the northern region of Western Australia have been mapped using a scale of 1: 4,000,000. This information was derived from a wide range of reports and from local knowledge, using the Atlas of Australian Soils as a unifying basis for its interpretation. These pasture communities have been interpreted into 151 local pasture units. The map accompanies this report.

Assessment of condition and capability of the pasture resources

The current condition of the pasture resources of this northern Australian region was assessed. Land degradation was classed as either *deteriorating*—a state able to be reversed—or *degraded*—a state probably not reversible by property management. A *condition assessment matrix* based on vegetation condition, soil condition and land management capability was used to rank the resource into three condition levels (A, B, C) which equated to 'desirably sustainable', 'deteriorating' or 'degraded' states respectively.

This procedure was considered unusable for the Central Australia region of the Northern Territory because of great spatial and temporal variation in its vegetation and climate. There is no adequate methodology for monitoring and assessing condition of these pastoral resources or for interpreting the large body of information that exists for this region.

The condition assessments and production capabilities are presented in Table 3; they are linked with the mapped communities and local pasture units through the unit code numbers.

Information from the more productive pasture communities or local pasture units has been aggregated and presented in Figures 3 of Appendix 2, where condition classes and productivity (in terms of beef equivalents of output) are compared across the three states.

Conclusions

Degradation and deterioration

We conclude that there is widespread deterioration in most pasture communities in Queensland; this is indicated by undesirable changes in pasture composition and soil surface characteristics such as cover and organic matter content.

Deterioration is related to increased grazing pressures resulting from rainfall deficiencies in the past decade and the substantial build-up of livestock numbers in the beef crisis of the 1970s. It may also be associated with recent husbandry practices that allow stock to survive periods of stress, but appropriate property management should be able to reverse this level of degradation.

In north Queensland, several exotic weeds provide a more serious risk of degradation which is near to or beyond the capability of managers alone to address.

In the northern part of the Northern Territory and in northern Western Australia, degradation in areas such as the Victoria River District and the Ord River catchment relates to a previous period of mismanagement and lack of understanding of resource maintenance. Now, as a result of the Brucellosis and Tuberculosis Eradication Campaign, with its associated control of livestock numbers, reduction of feral animals, and better management of stock watering (particularly on frontage country), a new awareness of resource management is emerging.

For Central Australia, the management of diverse vegetation and of high climatic risk is a key issue in resource maintenance; management of stock water is being used increasingly to control livestock movements and grazing times. Rabbits remain as destructive feral animal pests in the southern part of this region.

Resource capabilities

Information on resource capability has been assembled. The high capability areas are more heavily used, and therefore stressed, particularly where they are fragmented topographically within larger areas of lower capability, or associated with water access. How-

ever this localised information can be easily lost when condition data is generalised at the broad community level.

Resource improvement through species introduction and fertiliser inputs is generally most successful in areas of moderate natural capability, but these improved areas are modest in size and are used strategically rather than on a broad scale.

Strategies for maintaining sustainable condition

While problems relating to resource sustainability for Queensland, the northern part of the Northern Territory, Central Australia and northern Western Australia are similar, they are sometimes perceived as differing in priority for each region. General high priority is recognised for the following:

1. *Stocking strategies for*:
   - maintenance or improvement of the most productive pasture communities
   - managing resource diversity
   - managing drought and post-drought.
2. *Resource monitoring*:
   - to help understand the processes leading to sustainability or degradation
   - to aid in management
   - part of on-going leasehold monitoring.
3. *Research into fire as a tool*:
   - in pasture management
   - in weed control.
4. *Linking research and farm verification*:
   - to develop a closer relationship between researcher and property manager for improved feed-back
   - to access farm data to aid development of appropriate research.
5. *Weeds:*
   - for containment and control of exotic and native weeds.
6. *Education:*
   - to develop more participatory learning
   - to help develop appropriate decision support systems for managers.
7. *Management of trees*
   - as weeds and competitors with pastures
   - for control or prevention of salinisation
   - as an essential part of the ecosystem management.
8. *Management or control of feral animals and wildlife*
9. *Review of leasehold sizes and covenants*
10. *Market research.*

Pasture systems at risk

The following pasture systems are at risk:

At risk of overgrazing:
- black speargrass
- ribbongrass
- annual shortgrass on calcareous soils
- frontage country

At risk of weeds:

exotic woody weeds:
- mitchell grass (*Parkinsonia*, prickly acacia, mesquite)
- frontage country – Gulf and Peninsula (rubber vine, chinee apple)

native woody regrowth:
- southern black speargrass (eucalypts)
- *Aristida-Bothriochloa* (eucalypt, various shrub regrowth)
- mulga (seedling regeneration,turkey bush, hop bush)
- brigalow (sucker regrowth)
- gidgee (seedling regeneration and spread)

exotic herbaceous weeds:
- central Queensland bluegrass
- northern brigalow (parthenium)
- mitchell grass (threat of parthenium)
- southern Queensland alluvials (pimelea)

exotic grass weeds
- east coast of Queensland (giant rats tail)

At risk of soil salinisation resulting from tree clearing:
- duplex soils with high pH subsoils in the speargrass and *Aristida-Bothriochloa* regions
- brigalow clays with high subsoil salinity.

Role of the Meat Research Corporation

The Corporation's role in addressing the sustainability of the pastoral resources is to tailor the nature and degree of its sponsorship for research and development.

The Corporation should evaluate projects on an overall strategic basis, and should seek to integrate human, institutional, technical and regional resources. It must be aware of all potentially relevant research being done for a wider range of users and objectives, and know how its own sponsored research complements this. Linkages between research carried out on-farm and at local, regional and national levels should be strengthened.

Introduction

This report for the second North Australia Program (NAP-2) of the Meat Research Corporation describes the livestock production resources of northern Australia. It brings together the available information about these resources in terms of the pasture types, their condition, livestock production capability, productivity and problems; it attempts to co-ordinate this information over northern Australia to allow parallels to be drawn across the region and differences to be put into perspective.

Integrating the information for northern Australia in a coordinated manner should allow better definition of: regions or areas of potential for development; areas at risk of degradation if certain developments take place; resource and production issues; problem definition at region or local area levels; and priority setting for research and development.

It should also provide a basis for establishing strategies which will dove-tail with funding of research and development from other sources such as the National Soil Conservation Program and CSIRO's National Soil and Water Care Program, as well as with institutionally-funded research.

No such broad-scale review of the condition of northern Australia's grazing lands has been carried out since that of Woods (1983) entitled *Land Degradation in Australia.* The information contained in that document was originally compiled in 1975 from a wide range of contributors. Although a useful review, it suffers from considerable non-uniformity in the depth and manner of the subject treatments and some serious misplacement of information within it.

This report uses the following main themes to address the nature and condition of the livestock production resource:

- definition of sustainability and degradation
- description of the pasture resources in map and table form
- assessment of their present condition and capability
- strategies for maintaining the condition of the resource, and of livestock production
- the problems and research priorities.

1 Sustainability and degradation

The definitions of sustainability and degradation used in this report need to be understood; they are defined fully at the front of the report, and explained in this section. We define *sustainability* as the long-term maintenance of the livestock production resources and environment to enable viable livestock production. *Degradation* represents an undesirable change from sustainability, and is considered at two levels—*deteriorating* and *degraded.*

Sustainability simply means maintaining a prescribed level and direction of productive capability over time. In terms of sustainability of livestock production in northern Australia, an holistic approach must be taken because long-term maintenance of productive capability depends on the many parts of the total production environment—the ecosystem, physical, social, economic, cadastral, legal and personal constraints. Although the main objective should be the maintenance of the biological integrity of the ecosystem, these other constraints influence the environment in which this must be carried out.

Measurement of output of livestock products alone is not a sufficiently sensitive indicator of the sustainability of the production system because, being the final product of a complex and dynamic set of governing factors, livestock production is well buffered. It may often be some time after one or more of the elements within the system has significantly deteriorated that animal production begins to fall.

On the other hand, placing the emphasis on sustainability of the livestock production resources and their environment should lead to sustainable livestock production. This shifts the emphasis from productivity improvement as the main objective to efficiency of production at a sustainable level.

Degradation results from an undesirable change in one or more of the elements which govern a desirable sustained system. The issue is not only land degradation (though this is perhaps the most vulnerable and visible element) but whole system degradation.

Degradation is considered here under two states: the first is referred to as '*deteriorating*', and is considered to be readily reversible through improved property management and following a return to years of average or above-average rainfall; the second state is referred to as '*degraded*', where the system can only be brought back to an acceptable steady state with difficulty. This recovery is generally outside the bounds of economic management, or it cannot be done at all.

There will always be periods of deterioration of the production resources resulting from seasonal and unpredictable annual fluctuations of climate. Differing levels of resilience in the resource to perturbations in different systems lead to different manifestations of system instability.

Agriculturalists and land managers must understand how to reverse these short-term trends to a long-term sustainable level. The resource may not necessarily be in the same state as it was before the perturbation, but, if it satisfies the criteria that it is at a balanced and satisfactory equilibrium which is not further degrading, it should be considered in an acceptable state. The shift from *Themeda triandra* to *Heteropogon contortus* in the north-eastern tropical tallgrass pasture system is an example of acceptable change, and there are other systems in which acceptable exotic species are naturalising.

In developing a procedure for assessing the condition of the pasture resources of northern Australia, we have used a multi-factorial approach to try to achieve an holistic, long-term description of condition states. Using the three criteria of vegetation condition, soil condition and management capability, it has been possible to get a satisfactory and objective definition of the three states indicated —pristine or desirably sustained, deteriorating, and degraded. This also links conceptually with the 'state and transition' model of Westoby *et al.* (1989).

The first state—pristine—is not widely obtainable with domestic grazing on pasture lands, but it may be relevant to certain reserves and national parks. More usually a desirably sustained, but modified, equilibrium of productive species is a satisfactory state.

The second level—deteriorating—is marked by some increasing disturbance which places the pasture at risk of transition to a less productive, degraded state. The risk of this transition is not always apparent, as disturbed pasture communities may, at first, show no loss of productivity, or even enhanced productivity. But unpredictable events, such as drought, may push such a community unexpectedly beyond the critical threshold of transition into the third—degraded—state in which the community cannot be regenerated or stabilised.

It is important that the assessments of degradation at the second (deteriorating) and third (degraded) condition states be kept distinct. They must not be added together to make unqualified statements such as '60% of Australia's grazing lands are in a state of degradation'. These two states are clearly distinct in terms of the problems of resource management and their solutions.

2 The pastoral resources

Presentation of data

We decided that the pastoral resources would be best described using both written text and a map. A suitable model existed in the map entitled *Native Pasture Communities* (scale of 1: 2,500,000) by Weston and Harbison (1980), and the accompanying written material in *Assessment of the Agricultural and Pastoral Potential of Queensland* (Weston *et al.* 1981).

Their interpretation of the pasture communities represented on the Queensland map had been made by Weston and Harbison on the basis of the soil information from the Atlas of Australian Soils sheets, and verified with local knowledge. Since this map of the pasture communities of Queensland is the most embracing and contemporary in northern Australia, and, as the base soil information is available for the whole of the region, we decided to work from it in extending to the remaining areas across the north.

While we encountered much encouragement in our work, there was also some disquiet about the way in which generalities made from maps can be misused; this often happens where the maps are developed at too broad a scale and important fine detail is lost. This point is particularly relevant in Central Australia, parts of the Victoria River District and Kimberley regions of the Northern Territory and Western Australia.

As our report is concerned with issues affecting the whole of all of northern Australia, our map is drawn at the broad regional scale of 1: 4,000,000. The base map, from which this has been produced, was at a scale of 1: 2,000,000 (derived from the Atlas of Australian Soils). Even this scale is inadequate to represent accurately the detail needed to deal with problems at the property or local area level. We realise that, for the Central Australia region of the Northern Territory, it is impossible, even at the scale of 1: 2,000,000, to portray an adequate regional picture of the pasture communities due to their fine mosaic. Maps drawn at scales of 1: 100,000 or 1: 250,000, and used currently in local land systems mapping, are more applicable but they do not cover the whole region.

Collation of data

The map information was digitised onto MAPINFO using longitude and latitude on a Cartesian base at the scale of 1: 2,000,000. There are 5500 pasture community polygons for the whole study area.

Both the map information and that of the condition and productivity resources are contained in a Geographic Information System (GIS) data base named RIANAP, in MAPINFO and DBASE/FOXPRO formats.

Sources of maps and scales

1. *Queensland*

Native Pasture Communities – 1: 2 500 000
Weston and Harbison (1980).

Atlas of Australian Soils, sheets 7,4, 10 (NE) – 1: 2 000 000
CSIRO, various authors.

2. *Northern Territory*

Pasture Lands of the Northern Territory, Australia – 1: 2 000 000
Perry (1960) CSIRO, LRS No. 5.

Lands of the Ord–Victoria Area, WA and NT – 1: 1 000 000
Stewart *et al.* (1970) CSIRO, LRS No. 28.

Lands of the Alice Springs Area, NT – 1: 1 000 000
Perry *et al.* (1962) CSIRO, LRS No. 6.

Survey of the Barkly Region – 1: 1 013 760
Christian (1952) CSIRO, LRS No. 3.

Atlas of Australian Soils, sheets 8, 10 (NE, NW) – 1: 2 000 000
CSIRO, various authors.

3.*Western Australia*

Vegetation Survey of Western Australia Pilbara and Kimberley – 1: 1 000 000
Beard (1975).

Lands of the Ord–Victoria Area, NT and WA– 1: 1 000 000
Stewart *et al.* (1970) CSIRO, LRS No. 28.

Lands and Pastoral Resources of the North Kimberley Area, WA. – 1: 1 000 000 (1960) CSIRO, LRS No. 4.

General Report on Lands of the West Kimberley – 1: 1 000 000
Speck *et al.* (1964) CSIRO, LRS No. 9.

Atlas of Australian Soils, sheets 6, 9, 10 (NW) – 1: 2 000 000
CSIRO, various authors.

Maps showing Pastoral Potential in the Kimberley Region, WA – 1: 500 000
WA Dept. of Agriculture (1985).

Other complementary maps are listed in the bibliography.

In describing the pasture lands of northern Australia, we have tried to keep the identity of the locally known, or published, pasture types or communities. This preserves local common names and entities for which published or known recorded information exists. Their relationships are evident in the 24 generic community groupings into which they have been placed.

These groups have also been organised into the savanna categories and sub-categories which are now widely recognised at the continental level (Mott *et al.* 1985). These are: Tallgrass, with sub-categories Monsoon tallgrass and Tropical/subtropical tallgrass; Midgrass, with 5 sub-categories of pasture types; and Shortgrass, also with 5 sub-categories of pasture types.

The generic groupings, or pasture communities, are coloured individually on the map, and those closely allied are presented in shades of their basic colour. The pasture communities, as they occur locally, have been called local pasture units (LPU) and each has been assigned a number (between 1 and 151). This number is cross-referenced between Tables 1 and 3, Appendix 1 and the map.

It is not always easy to determine the similarities between some of these local pasture units occurring in different parts of the north because pasture composition can vary considerably in space and time. These units are also circumscribed from the predominant pasture unit of the area, even though they may contain minor areas of other pasture types.

Considerable evolutionary change may be occurring in some communities because of differences in time and mode of land use in different regions. This is particularly evident in the 'ribbongrass-other species' pasture type in the Northern Territory; it was originally described by Perry (1960) as being signified by kangaroo grass (*Themeda australis*), but this species is now substantially less dominant. In other cases, black speargrass (*Heteropogon contortus*) is increasing.

Some of these changes may be ecologically non-reversible, but may not represent an undesirable change in the sustainable resource status. A good example is the change last century from kangaroo grass dominance to black speargrass dominance in the now-called black speargrass pasture lands of Queensland. Some of the likely relationships between the entities have been indicated in Table 1. Details of the botanical composition of the pasture communities and Local Pasture Units can be found in Appendix 1.

The statistical areas used in compiling the data for the map, and the condition and productivity status of the pasture lands, are outlined in the supplementary map in Appendix 5. These are shires in Queensland, slightly modified local government regions in the Northern Territory, and areas relating to the CSIRO land use reports plus the vegetation map area of Beard (1975) for Western Australia. Base data for shires in Queensland may be obtained from the Queensland Department of Primary Industries BRAQ data base (Weston *et al.* 1981) and the RIANAP GIS of the Meat Research Corporation. For the Northern Territory, the areas closely follow the local government regions, with the exception of the Katherine region which has been split into two parts—Victoria River District and Gulf. The Alice Springs region has been expanded slightly northward into the Barkly region to accommodate a more natural division of pasture communities; this has been renamed Central Australia. These regions have good agreement with the State GIS of the Conservation Commission of the Northern Territory, but not with the Resource Impact Assessment (RIA) contained in the RIANAP GIS of the Meat Research Corporation. For Western Australia, the boundaries do not relate to local government areas, but there is good agreement with RIANAP.

Map areas may not absolutely agree with the community or LPU areas given in Table 3 because minor areas may be submerged within major areas.

Table 1 The pasture lands of northern Australia

Description	Region (1)	Report (2)	Condition assessed 1991	LPU (3)
TALLGRASS PASTURE LANDS				
Monsoon tallgrass pastures				
Coastal and seasonally flooded lowland pastures				
Rice grass (*Xerochloa*) grassland (Y)*	NT/D	P	+	1
= Lowland tallgrass	NT/VRD	EK/VRD	+	2
Wanderrie grass (*Eriachne*) (Ke)*	NT/D	P	+	3
Cockatoo grass = Marrakai mid-height grassland	WA/NK	NK	+	4
Fringing tallgrass (not mapped)	WA/EK	EK/VRD		5
= Fringing pastures (not mapped)	WA/NK	NK		6
Perennial tallgrass pastures				
Ribbon grass–golden beardgrass (*Chrysopogon*)*				
Golden beardgrass (*Chrysopogon*)	NT/D	P,CC	+	7
Upland tallgrass (K) = Tippera tallgrass	NT/G	P		8
Ribbongrass	WA/NK	NK	+	9
Whitegrass (*Sehima nervosum*)	WA/EK	EK	+	10
Whitegrass	WA/NK	NK	+	11
Whitegrass–plume sorghum–ribbongrass	WA/EK	EK	+	12
Whitegrass–annual sorghum (WGAS)	WA/WK	WK	+	13
Plume/native/perennial sorghum (*Sorghum plumosum*)*				
Native sorghum	Qld	W	+	14
= Plume sorghum, perennial sorghum	WA/NK	NK	+	15
Annual tallgrass pastures				
Annual sorghum (*Sorghum intrans, S. Stipoideum, et al*)*				
Annual sorghum	NT/D	P	+	16
Annual sorghum	NT/VRD	EK/VRD	+	17
Annual sorghum	NT/G	P	+	18
Annual sorghum	NT/BT	CC		19
Annual sorghum	WA/EK	EK/VRD	+	20
Annual sorghum	WA/NK	NK	+	21
Schizachyrium – other tallgrasses*				
Tropical plains and low hills	Qld	W	+	22
Northern flooded alluvial plains	Qld	W	+	23
Curly spinifex–*Schizachyrium*	NT/G	CC	+	24
Tropical/subtropical tallgrass pastures				
Perennial tallgrass pastures				
Rainforest derived pastures (a)#*	Qld	W	+	25
Heathland pastures (c)*	Qld	W	+	26
Blady grass (*Imperata cylindrica*)*	Qld	W	+	27
Black/bunch speargrass (*Heteropogon contortus*)*				
Northern (Bowen and north)	Qld	W	+	28
Central (Proserpine – Calliope)	Qld	W	+	29
Southern (Miriam Vale and south)	Qld	W	+	30
Ribbongrass/golden beardgrass (*Chrysopogon*)*				
Chrysopogon – other species	Qld		+	31
Tippera tallgrass (*Chrysopogon*)	NT/VRD	EK/VRD	+	32
Chrysopogon – other species	NT/G	P	+	33
Chrysopogon – other species	NT/BT	CC		34
Ribbongrass	WA/EK	EK/VRD	+	35
Ribbongrass (RGa)	WA/WK	WK	+	36
Ribbongrass–curly/soft spinifex (RGb)	WA/WK	WK	+	37
Whitegrass-annual sorghum (WGAS)(see LPU 13)	WA/WK	WK	+	38
Whitegrass – bundle-bundle (WGBB)	WA/WK	WK	+	39
Frontage grass pasture land (FG)	WA/WK	WK	+	40

Table 1 The pasture lands of northern Australia: continued

Description	Region (1)	Report (2)	Condition assessed 1991	LPU (3)
MIDGRASS PASTURE LANDS				
Pastures of eucalypt open forest and woodland				
Aristida-Bothriochloa pastures*				
Aristida–Chrysopogon (d)				
Einasleigh western slopes	Qld	W	+	41
Paperbark teatree	Qld	W	+	42
Aristida pruinosa three-awn (P)	NT/VRD	P,EK/VRD	+	43
Aristida pruinosa three-awn (P)	NT/G	P	+	44
Aristida pruinosa three awn (P)	NT/BT	P,BT	+	45
Aristida pruinosa three awn	WA/EK	EK/VRD	+	46
Aristida–Triodia pungens (e)	Qld	W		47
Aristida–Cleistochloa (f)	Qld	W	+	48
Aristida–Thyridolepis (g)	Qld	W	+	49
Bothriochloa–Chloris–Aristida–Eragrostis (h)				
Central	Qld	W	+	50
Southern	Qld	W	+	51
Aristida–Eragrostis (i)				
Southern sandy	Qld	W		52
Cypress pine	Qld	W	+	53
Bothriochloa–Stipa–Danthonia (j) granite-traprock	Qld	W	+	54
Kerosene grass (*Aristida hygrometrica*)	WA/NK	NK	+	55
Seasonal riverine plains pastures*				
Channel pastures	Qld	W	+	56
Eragrostis–Eulalia–Cenchrus	NT/BT	CC	+	57
Eragrostis–Eulalia–Cenchrus	NT/CA	GB		58
Pastures of *Acacia* spp. open forest and woodland				
Brigalow (*Acacia harpophylla*)#*				
Northern #	Qld	W	+	59
Central #	Qld	W	+	60
Southern and belah #	Qld	W	+	61
Gidgee (*Acacia cambagei*)*				
Central (k)#	Qld	W	+	62
Western	Qld	W	+	63
South-western	Qld	W	+	64
Grasslands on clay soils				
Bluegrass grassland pastures				
Queensland bluegrass (*Dichanthium sericeum*)*				
Central	Qld	W	+	65
Southern	Qld	W	+	66
Bluegrass–browntop (*Dichanthium fecundum–Eulalia aurea*)*				
Tropical bluegrass–browntop	Qld	W	+	67
Bluegrass–golden beardgrass	NT/VRD	EK/VRD	+	68
Bluegrass–golden beardgrass	NT/G	CC	+	69
Bluegrass	WA/EK	EK/VRD	+	70
Bluegrass	WA/NK	NK	+	71
Tussock grassland pastures				
Mitchell grass (*Astrebla* spp.)*				
Rolling downs (p)				
Northern	Qld	W	+	72
Southern	Qld	W	+	73
Southern flooded alluvials	Qld	W	+	74
Plains mitchell grass (M)	NT/VRD	P,EK/VRD	+	75
Plains mitchell grass	NT/BT	P,BT	+	76
Plains mitchell grass	NT/CA	GB		77
Mitchell grass plains	WA/EK	EK/VRD	+	78
Black soil plains (BSP)	WA/WK	WK	+	79
Chichester Range basaltics	WA/PIL	WADA	+	80
Stony downs (q)	Qld	W	+	81
Ashy downs (r)	Qld	W	+	82
= drybog	NT/BT	BT	+	83
Mitchell grass – other grasses (Mo)	NT/VRD	P,EK/VRD	+	84
Inferior mitchell grass	NT/G	P,CC		85
Inferior mitchell grass (Mi)	NT/BT	P,BT	+	86
Mitchell grass–gidgee	NT/BT	BT,CC		87
Mitchell grass–gidgee	NT/CA	AS,CC		88
Clayey stony slopes	NT/CA	GB		89

Table 1 The pasture lands of northern Australia: continued

Description	Region (1)	Report (2)	Condition assessed 1991	LPU (3)
Grasslands on sands and skeletal soils				
Hummock grasslands				
Spiniflex (*Triodia, Plectrachne* spp.)*				
Curly spinifex (*Plectrachne pungens*)				
NT Darwin region	NT/D	P	+	90
NT Gulf	NT/G	P	+	91
Barkly	NT/BT	CC	+	92
East Kimberley	WA/EK	EK/VRD	+	93
North Kimberley	WA/NK	NK	+	94
West Kimberley	WA/WK	WK	+	95
Curly spinifex – ribbongrass (CSRG Pindan)	WA/WK	WK	+	96
Curly spinifex – annual sorghum	WA/NK	NK		97
Curly/soft spinifex (*Plectrachne* spp./*Triodia pungens*)				
Curly/soft spinifex	NT/VRD	CC	+	98
Curly/soft spinifex	NT/BT	BT	+	99
Curly/soft spinifex	NT/CA	AS,CC		100
Soft spinifex (*Triodia pungens*)				
North-west (u)	Qld	W	+	101
Eastern-central (s)	Qld	W	+	102
Soft spinifex plains (Ss)	NT/VRD	P,EK/VRD	+	103
Soft spinifex plains	NT/G			104
Soft spinifex plains	NT/BT	P,BT	+	105
Soft spinifex plains	NT/CA	AS,CC		106
Soft spinifex plains	WA/EK	EK/VRD	+	107
West Kimberley (SS)	WA/WK	WK	+	108
Hard spinifex (*Triodia* spp.)				
Western dunefields (t)	Qld	W	+	109
Western acacia/eucalypt (t)	Qld	W	+	110
Sandplains (Sh)	NT/VRD	P,EK/VRD	+	111
Sandplains	NT/BT	P,BT	+	112
Sandplains (Sh)	NT/CA	GB,AS		113
Dune fields (Sd)	NT/BT	P,BT		114
Dune fields (Sd)	NT/CA	GB,AS		115
Pilbara	WA/PIL	PIL	+	116
East Kimberley	WA/EK	EK/VRD	+	117
Lobed spinifex (LS)	WA/WK	WK	+	118
Limestone spinifex	NT/VRD	CC		119
Limestone spinifex (LmSS)	WA/WK	WK	+	120
Spinifex on small hills	NT/CA	GB		121
Hard/soft spinifex				
Central Australia	NT/CA	CC		122
Pilbara	WA/PIL	PIL	+	123
SHORTGRASS PASTURE LANDS				
Perennial shortgrass pastures				
Pastures with top-feed – *Acacia* spp. woodland/shrubland				
Mulga (*Acacia aneura*) – perennial shortgrass*				
Soft and hard mulga (m)	Qld	W	+	124
Mulga on residuals (n)	Qld	W	+	125
Mulga shrubland (=m)	NT/CA	GB		126
Mixed *Acacia* – other genera woodland	NT/CA	GB,P		127
Georgina gidgee (*Acacia georginae*) – shortgrass*				
Georgina gidgee South-west (l)	Qld	W	+	128
Georgina gidgee	NT/CA	GB		129
Pastures without top-feed				
Tussock grass – soft spinifex*	WA/PIL	PIL	+	130
Saltwater couch pastures (*Sporobolus virginicus*)*				
Littoral (b)	Qld	W	+	131
Coastal country (C)	NT/D	P	+	132
Coastal country (C)	NT/VRD	P,EK/VRD	+	133
Coastal country (C)	NT/G	P,BT	+	134

Table 1 The pasture lands of northern Australia: continued

Description	Region (1)	Report (2)	Condition assessed 1991	LPU (3)
Littoral (Lt)	WA/WK	WK	+	135
Littoral	WA/EK	EK/VRD	+	136
Littoral	WA/NK	NK	+	137
Annual shortgrass – forb pastures				
Pastures with top-feed – *Acacia* spp. shrubland				
Mulga – annual shortgrass*				
Mulga – whitewood	Qld	W	+	138
Mulga shrubland	NT/CA	GB,CC		139
Mulga shrubland	WA/PIL	PIL	+	140
Mixed *Acacia* spp. on low hills (Hh)	NT/CA	GB,P		141
Eremophila–Cassia low shrubland	WA/PIL	PIL	+	142
Pastures without top-feed				
Annual shortgrass – low open woodland*				
Northern calcareous pastures (= arid shortgrass)	NT/VRD	P,EK/VRD	+	143
Southern calcareous pastures (= Ca shrubby grassl'nd)	NT/CA	P,GB		144
Shortgrass grassland (= arid shortgrass)	WA/EK	EK/VRD	+	145
Shortgrass grassland – ribbongrass (SGa)	WA/WK	WK	+	146
Shortgrass – curly spinifex (SGb)	WA/WK	WK	+	147
SHRUB PASTURE LANDS				
Chenopod shrubland pastures				
Southern bluebush (A) = chenopod shrubland	NT/CA	P,GB		148
Northern bluebush	NT/VRD	CC		149
Northern bluebush (B)	NT/BT	P,BT	+	150
Saltbush–bluebush samphire	WA/PIL	PIL	+	151

Legend

(1) Regions
Qld = Queensland
NT/D = Northern Territory, Darwin
NT/VRD = Northern Territory, Victoria River District
NT/G = Northern Territory, Gulf of Carpentaria
NT/BT = Northern Territory, Barkly Tableland
NT/CA = Northern Territory, Central Australia
WA/EK = Western Australia, East Kimberley
WA/NK = Western Australia, North Kimberley
WA/WK = Western Australia, West Kimberley
WA/PIL = Western Australia, Pilbara

(2) Reports
AS = Alice Springs, CSIRO (1962)
BT = Barkly, CSIRO (1952)
CC = Conservation Commission of N. Territory (1991)
D = Katherine-Darwin, CSIRO (1946)
EK/VRD = East Kimberley, Victoria River District, CSIRO 1970
GB = Bastin (1988)
NK = Northern Kimberley, CSIRO (1960)
P = Perry, CSIRO (1960)
PIL = Pilbara, Beard (1975)
W = Weston *et al.* (1981)
WADA = Western Australian Dept. of Agriculture (1974)
WK = West Kimberley, CSIRO (1964)

(3) LPU = Local Pasture Unit (Pasture communities as they occur locally)
Species composition for each LPU is given in Appendix 1

\+ indicates that condition was assessed
() alphabetic codes after pasture/area names are those given in the relevant reports
\# pastures developed on cleared land
* Pasture communities with unique map colour

3 Assessment of condition and capability

Assessing the pastoral resource condition

A rapid appraisal approach, based on a *Condition Assessment Matrix*, was used to obtain an overall view of the condition of the northern Australian grazing lands. This allowed structured, qualitative measures of their level of sustainability, or degree of deterioration and degradation, to be derived. We used a simple three level scale of A, B and C, rather than a descriptive scale such as good, fair and poor, which can be perceived differently by different people.

We were able to distinguish lands that were in a *sustainable condition* (level A), those in a *deteriorating* state (level B), and those in a *degraded* state (level C). It was easiest and most objective to determine levels A and C first, and then to arrive at B by subtraction.

To achieve this, we sent out the outline shown in Table 2 to expert resource persons across northern Australia before we visited a large number of centres throughout the region. This gave some advanced guidelines on the procedure to be used and on the type of information required for the working group sessions.

The procedure was developed from the approach used in the *Assessment of the Agricultural and Pastoral Potential of Queensland* by Weston *et al.* (1981). Their approach, and also that of Payne *et al.* (1974) in *Range Condition Guides for the West Kimberley Area W.A.*, was largely based on pasture composition classified under three levels of degradation.

We have broadened this into a multi-factorial approach to consider also soil condition and the level of management needed to permit regeneration (within the context of sustainable livestock production). This last consideration also takes into account other environmental constraints. The procedure was versatile as it allowed the groups to work in their most familiar units of understanding, be they land systems, shires, soils, or land resource areas. Each group adopted a slightly different approach, but our condition assessment matrix enabled the information to be compiled uniformly over all areas. The base data collected from each group for Queensland and Western Australia is contained in Table 5 of Appendix 3.

The use of such a rapid appraisal approach is controversial. However, apart from being rapid and thus able to cover a large area in a single timespan, it is, in most cases, the only form of information available and complete for whole regions. The information was provided by groups which generally were constituted of experts in pasture agronomy, animal production and soil conservation, preferably with ten or more years of experience of the region. We are confident that the assessments are robust, since there was usually less than 10% of dissent within the working group.

Although qualitative in nature, the information could be structured into a quantitative format. Real quantitative assessments cover only fragments of the northern Australian pasture lands; even 10 years after the publication of Weston's report, there is still no assessment methodology being used state-wide in Queensland. We vigorously endorse the need for more objective and quantitative methods and information, particularly if changes over time are to be effectively monitored. It is change that we are most interested in for estimating sustainability and for understanding degradation and regeneration processes.

We realise there is a need for a much larger-scale base of the information and understanding than that used for this report. This is necessary to interpret information at the regional, property and paddock levels, not only for development and implementation of property plans, but also for the adequate understanding and management of landscape variability and dynamics.

Table 2 outlines the matrix; it is given in conceptual terms in part 2a, while a worked example is presented in part 2b. This example is for part of southern black spear grass pasture community of Queensland covering seven shires grouped on the basis of their comparability. The region was apportioned by percentage areas of different soil types.

An alternative approach was adopted by the Western Australian working group (see Table 5b) in which, for each pasture community, the regions were apportioned by actual areas of different land systems.

Table 2 Condition assessment matrix—a matrix of factors x condition levels to assess the condition of a pasture

2a Overall criteria

Condition level	Factor		
	Soil	**Vegetation**	**Management**
A	no soil deterioration	main desirable spp. maintaining >75% dominance	sustained
B	slight soil deterioration – sheeting – rilling – pedicelling – reduced infiltration	increased presence (>25%) of undesirable pasture spp. and/or woody weeds	rehabilitation and stabilisation possible through management
C	severe soil deterioration – incision – scalding – sheeting	predominance of undesirable species	rehabilitation and stabilisation needing major works or land use change

2b Example of matrix outline for Local Pasture Unit 30 in the southern black speargrass community of Queensland (% of area of each soil type shown in brackets)

Condition level	Percentage of each pasture condition for main soil types			
	Clay (15%)	**Coarse-text. duplex (30%)**	**Fine-text. duplex (45%)**	**Alluvial (10%)**
	(%)	(%)	(%)	(%)
A	60	10	5	20
B	35	85	80	40
C	5	5	15	40

Notes:
1. Soil types expressed as clay, coarse-textured duplex, fine-textured duplex, alluvial, red earth, etc. Some pasture communities are characterised by a single soil type; others grow on several different soils.
2. % representation of soil in the estimation area whether it be the whole local pasture unit, community, or cluster of similar shires.

The basic information used in Table 2b is from Table 5 of Appendix 2, with the processed information presented in Table 3.

Table 3 shows the condition matrix for the whole of Queensland, the northern parts of the Northern Territory and Western Australia. This table gives areas of the communities, their carrying capacity range, natural productive capability in good condition, and potential for pasture improvement, for the pasture communities or local pasture units within the community.

The potential for pasture improvement has been ranked as high, medium or low; generally pastures of medium natural production capability have the greatest potential for improvement with legume technology. Since pasture improvement has been adopted mostly in a strategic way within existing native pasture systems, rather than overall, it is difficult to get realistic estimates of its production level. Estimates are available for Queensland (Weston *et al.* 1981) and for the western Kimberley Region (WADA, 1985).

Table 3 also shows the previous condition

assessment (good, fair or poor as percentages) where information is available; the 1991 levels (A, B and C) as percentages; and their areas in hectares. The areas for Queensland were obtained from Weston *et al* (1981), for the Northern Territory from the State GIS of the Conservation Commission, and for Western Australia from the CSIRO and WADA reports. Finally we have estimated total productivity of the pastures in beef equivalent values (BE) for good condition (BE is derived from the average carrying capacity x area). Condition levels B and C have lower carrying capacities than level A and thus lower BE values. This sort of information is available for the West Kimberley region (WADA 1981), but not comprehensively for the whole of northern Australia.

Previous assessments had been carried out in Queensland in the late 1970s by Weston *et al.* (1981), and by Payne *et al.* (1974) in the western Kimberley, but must be compared cautiously against our assessments. While both use the criterion of change in pasture composition to indicate condition, the 1991 assessment also considered soil condition and the opportunity for management to reverse degradation. Thus, while condition level A is substantially comparable to 'good' in the previous assessments in Queensland and Western Australia, condition level C is likely to be more rigorous than the 'poor' of the previous scores. Condition level B in the 1991 assessments is therefore broader than the previous 'fair' assessments. Comparing the data sets in general terms can provide a useful picture of the change in pasture condition with time rather than a precise measure of this change.

Condition assessments have not been made in Central Australia. The degree of spatial and temporal variability of both environmental and landscape resources make it difficult to develop adequate assessment, monitoring and interpretation techniques for pasture and landscape condition in the drier rangeland areas.

Estimates of livestock carrying capacity

Estimates of the livestock carrying capacities of the pasture units have been drawn largely from the literature, but were checked with the local expert resource groups. Most estimates have a fairly broad range, the mean being used to calculate the average beef equivalent value. The range gives a qualitative estimate of the seasonal, resource and environmental variability associated with the pasture units under long-term good condition. Only disparate experimental or real property data are available as quantitative information.

Discussion of condition assessment data

Table 3 shows that, in Queensland in 1991, more local pasture units are in condition level B than condition A (27 out of 43 LPUs). In the late 1970s, Weston *et al.* (1981) indicated this occurred in only 11 units out of 40 units. The substantial change across the state may be related to higher grazing pressure from the large increase in cattle numbers following the slump in beef cattle prices in the 1970s, as shown in Figure 1 of Appendix 2.

In Queensland, it is widely recognised that there has been a considerable increase in pasture deterioration, typified by the invasion of wiregrasses (*Aristida* spp.) in the black speargrass, *Aristida-Bothriochloa* and southern mitchell grass; by the loss of sown pasture species in the northern brigalow and gidgee lands, and by the increased incidence of woody regrowth in many southern regions.

This decline is associated with increased grazing pressure and consequent reduced burning, resulting partly from a widespread change in cattle breed across the north (with the incorporation of *Bos indicus* genes), an increased adoption of feed supplements (protein, energy and mineral), some adoption of pasture legume technology, and finally a decade of low rainfall.

In the Northern Territory, all 38 cases had a higher proportion of units in level A than in B, and in Western Australia, 38 out of 42 showed a higher proportion in A than in B. This can be compared with only 3 out of 11 situations in which A was higher than B in a limited data set for West Kimberley in 1972. While such comparisons need to be interpreted cautiously, people of long experience in these regions generally agree that the present position is markedly improved.

Table 3 Pasture productivity and condition of the northern Australian grazing lands

3a Queensland

Pasture community	Local Pasture Unit (LPU) (1) Description	No. (1)	Area '000 ha (2)	CC ha/hd (3)	Nat. prod. (4)	Pot. for imp.
Plume sorghum	Native sorghum	14	928	20-40	M-L	L
Schizachyrium	Tropical plains and low hills	22	6 985	>40	L	M
	Northern flooded alluvial plains	23	1 678	20-40	M-L	L
Rainforest	Rainforest-derived pastures #	25	862	0.5-2	L	H
Heathland pastures	Heathland	26	650	NA	L	H
Bladygrass	Southern sandy coastal lowlands	27	697	12-20	L	H
	Northern sandy coastal lowlands	27	790	8-35	M-L	M
	Central sandy coastal lowlands	27	506	10-30	M-L	H
Black speargrass	Northern (Bowen and north)	28	12 135	5-15	M	M
	Central (Proserpine - Calliope)	29	4 580	4-10	H	H
	Southern (Miriam Vale and south)	30	6 182	2.5-6	H	H
Ribbongrass	*Chrysopogon* - other spp.	31	632	12-40	L	L
Aristida - Bothriochloa	*Aristida - Chrysopogon* (i Einasleigh western slopes	41	2 336	18-30	L	M
	(ii paperbark teatree	42	8 826	20-40	L	M
	Aristida - Triodia pungens	47	2 143	20-40	L	L
	Aristida - Cleistochloa	48	2 848	11-30	L	L
	Aristida - Thyridolepis	49	2 561	20-35	M-L	M
	Bothriochloa - Chloris - Aristida - Eragrostis					
	(i central Qld	50	8 020	6-10	M	M
	(ii southern Qld	51	1 760	6-14	M	M
	Aristida - Eragrostis (i southern sandy	52		20-35	L	L
	(ii cypress pine	53	979	12-30	L	L
	Bothriochloa - Stipa - Danthonia (granite-traprock)	54	956		M-L	H
Seasonal riverine plains	Channel pastures	56	5 426	25-40	M-L	L
Brigalow pastures	Northern #	59	3 295	5-8	M	H
	Central #	60	1 648	3-8	M	H
	Southern and belah #	61	3 565	2-6	L	H
Gidgee pastures	Central #	62	940	2-15	M	H
	Western	63	804	12-35	L	L
	South-western	64	940	35	L	L
Qld bluegrass	Central	65	1 424	3-6	H	M
	Southern	66	949	2-4	H	M
Bluegrass - browntop	Tropical bluegrass - browntop	67	4 957	12-16	M	L
Mitchell grass	Rolling downs (i northern	72	20 883	10-15	M	L
	(ii southern	73	3 114	10-15	M	L
	Southern flooded alluvials	74	842	10-15	M	L
	Stony downs	81	2 632	50-100	M	L
	Ashy downs	82	2 411	35-80	L	L
Spinifex	Soft spinifex, north-west	101	8 108	40-150	L	L
	Soft spinifex, eastern-central	102	4 663	20-40	L	L
	Hard spinifex, western dunefields	109	4 501	100-150	L	L
	Hard spinifex, western *Acacia*/eucalypt	110	1 904	35-100	L	L
Mulga - perennial shortgrass	Soft and hard mulga	124	10 064	30-40	M-L	L
	Mulga on residuals	125	7 683	40-50	L	L
Georgina gidgee	South-western	128	1 598	12-35	L	L
Saltwater couch	Littoral	131	802	20-30	M-L	L
Mulga - annual shortgrass	Mulga - whitewood	138	611	50-70	L	L

Notes:

= assumes forests and woodlands cleared
For regional abbreviations, see Table 1.
(1) Tables 1 and 3 are cross-referenced by Local Pasture Unit numbers
(2) Areas are actual pastoral lands, excluding National Parks, Reserves, etc, except where indicated otherwise
(3) CC = carrying capacity in hectares per head
H = High; M = Medium; L = Low; H(M) = High in State context, moderate in NAP context; M-L = Medium to Low;
G = Good; F = Fair; P = Poor; Seas = Seasonal
Compare the condition assessments of 1978 and 1991 with caution (see p.11)
(5) Avg BE = Average Beef Equivalent for LPU

3a

Condition Assessment									Avg. BE '000 (5)	Comments
1978-80 (%)			1991 (%)			1991 ('000 ha)				
G	F	P	A	B	C	A	B	C		
90	5	5	90	5	5	835	46	46	31	
80	10	10	20	70	10	1 397	4 890	699	139	Exotic weeds and inferior grasses
45	35	20	30	50	20	503	839	336	56	
50	30	20	40	50	10	345	431	86	689	Landslip and soil fertility decline
NOT ASSESSED										Mostly urban in south
70	20	10	10	75	15	70	523	105	43	Teatree regrowth, soil fertility decline, urban/hobby farms
10	70	20	10	70	20	79	553	158	37	Teatree regrowth, soil fertility decline
			35	35	30	177	177	152	25	Teatree regrowth, soil fertility decline
60	25	15	30	55	15	3 641	6 674	1 820	1 213	Exotic weeds and timber regrowth, species decline
			50	35	15	2 290	1 603	687	654	Timber regrowth
40	30	30	20	60	20	1 236	3 709	1 236	1 454	Overgrazing and timber regrowth
80	10	10	95	5		600	32	0	24	
50	30	20	75	15	10	1 752	350	234	97	Feed supplements widely adopted, risk of overgrazing
70	20	10	75	15	10	6 620	1 324	883	294	
75	20	5							71	
40	30	30	30	50	20	854	1 424	570	139	Risk of overuse in poor years
20	60	20	20	50	30	5 121	1 281	768	93	Poplar box regrowth
45	35	20	20	50	30	604	4 010	2 406	1 002	Increasing poor species, erosion, parthenium on alluvials
45	35	20	25	50	25	440	880	440	176	Increasing bare areas and erosion, pimelea, o'grazing
60	30	10								Unproductive system
40	40	20	25	55	20	245	538	196	36	Pine density a problem due to lack of fire
			30	60	10	287	574	96	45	Regrowth following clearing
40	40	20	40	40	20	2 170	2 170	1 085	103	Eucalypt regrowth after clearing
50	40	10	35	35	30	1 153	1 153	989	507	Regrowth and parthenium, soil fertility decline
			30	35	35	494	577	577	300	Heavy regrowth and some parthenium, soil fert. decline
40	40	20	50	40	10	1 783	1 426	357	891	Brigalow regrowth, soil fertility decline
40	40	20	20	40	40	188	376	376	110	Gidgee regeneration, soil fertility decline
			70	20	10	563	161	80	34	Mostly uncleared, buffel fails in drought, regrowth and
20	20	60	20	35	45	188	329	423	27	weeds
35	45	20	10	30	60	142	427	854	316	Parthenium dominance
35	45	20	50	45	5	475	427	47	316	Some overgrazing
80	10	10	20	75	5	991	3 718	248	354	Inferior species increase, frontage erosion
80	15	5	70	25	5	14 583	5 208	1 042	1 667	Prickly acacia, risk of mesquite
20	40	40	25	60	15	779	1 868	467	249	White speargrass dominance, gidgee invasion
60	30	10	30	45	25	253	379	211	67	Coolibah regrowth
20	60	20	30	50	20	790	1 316	526	35	
20	60	20	30	50	20	723	1 206	482	42	
80	15	5	75	20	5	6 081	1 622	405	85	Inferior species increase, timber density
70	20	10	55	25	20	2 565	1 166	933	155	
20	60	20	20	60	20	900	2 701	900	36	
70	20	10	20	60	20	381	1 142	381	28	
20	60	20	20	60	20	2 013	6 038	2 013	287	Overclearing trees, incresed turkey bush
20	40	40	20	40	40	1 537	3 073	3 073	171	Regrowth problem
50	30	20	70	20	10	1 119	320	160	68	Some seasonal stock poisoning
70	20	10	90	5	5	722	40	40	32	Little used
20	40	40	20	40	40	122	244	244	10	

Table 3b Northern Territory

Pasture community	Local Pasture Unit (LPU) (1)		Region (1)	Area '000 ha (2)	CC ha/hd (3)	Nat. prod. (4)	Pot. for imp.
	Description	No.					
Ricegrass (*Xerochloa*)	Ricegrass (*Xerochloa*)	1	D	265	1	H	L
	Lowland tallgrass	2	VRD	75	1	H	L
Wanderrie grass	Wanderrie grass (*Eriachne* spp.)	3	D	124	26	L	M
Ribbongrass-monsoon	Golden beardgrass (*Chrysopogon*)	7	D	145	15	M(L)	M
Annual sorghum	Annual sorghum	16	D	1 286	>65	L	L
	Annual sorghum	17	VRD	2 259	>65	L	L
	Annual sorghum	18	G	1 194	>65	L	L
	Annual sorghum	19	BT	18	>65	L	L
Schizachyrium	Curly spinifex – *Schizachyrium*	24	G	1 811	L	L	L
Ribbongrass - tropical	Tippera tallgrass (*Chrysopogon*)	32	VRD	3 955	15	M(L)	L
	Chrysopogon – other species	33	G	4 017	12-40	M(L)	L
	Chrysopogon – other species	34	BT	1 050	12-40	M(L)	L
Aristida - Bothriochloa	*Aristida pruinosa* three-awn	43	VRD	481	L	L	L
	Aristida pruinosa three-awn	44	G	780	L	L	L
	Aristida pruinosa three-awn	45	BT	920	L	L	L
Riverine plains pasture	*Eragrostis - Eulalia - Cenchrus*	57	BT	82	12-66	M	M
	Eragrostis - Eulalia - Cenchrus	58	CA	922	12-66	M	M
Bluegrass - browntop	Bluegrass – golden beardgrass frontage	68	VRD	25	13	H	L
	Bluegrass – golden beardgrass	68	VRD	1 133	13-26	M	L
	Bluegrass – golden beardgrass	69	G	434	12-20	M	L
Mitchell grass (*Astrebla* spp.)	Plains mitchell grass	75	VRD	451	12-20	M	L
	Plains mitchell grass	76	BT	5 528	14-20	M	L
	Plains mitchell grass	77	CA	159	12-16	M	L
	Dry bog mitchell grass	83	BT	294	50	L	L
	Mitchell grass – other grasses	84	VRD	772	13-26	M	L
	Mitchell grass – other grasses frontage	84	VRD	45	13	H	L
	Inferior mitchell grass	85	G	66	26-32	M(L)	L
	Inferior mitchell grass	86	BT	997	28	M(L)	L
	Mitchell grass – gidgee	87	BT	77	25-28	M	L
	Mitchell grass – gidgee	88	CA	331	26-32	M	L
	Clayey stony slopes	89	CA				
Spinifex (*Triodia, Plectrachne* spp.)	Curly spinifex						
	NT Darwin region	90	D	3	L	L	L
	NT Gulf region	91	G	1 816	L	L	L
	Barkly	92	BT	449	L	L	L
	Curly/soft spinifex	98	VRD	1 807	L	L	L
	Curly/soft spinifex	99	BT	4 576	L	L	L
	Curly/soft spinifex	100	CA	2 779	L	L	L
	Soft spinifex plains	103	VRD	1 212	L	L	L
	Soft spinifex plains	105	BT	1 201	L	L	L
	Soft spinifex plains	106	CA	99	L	L	L
	Hard spinifex	111	VRD	421	L	L	L
	Sandplains	112	BT	38	L	L	L
	Sandplains	113	CA	2008	L	L	L
	Sandplains	114	BT	2	L	L	L
	Dunefields	115	CA	62	L	L	L
	Dunefields	119	VRD	1 219	L	L	L
	Limestone spinifex	121	CA		L	L	L
	Spinifex on small hills	122	CA		L	L	L
	Hard/soft spinifex						
Mulga - perennial shortgrass	Mulga shrubland	126	CA	3 683	100	L	L
	Mixed *Acacia* – other genera woodland	127	CA	1 166	17-25	M	L
Georgina gidgee shortgrass	Georgina gidgee	129	CA	1 395	20-26	L	L
Salt water couch	Coastal country	132	D	31	>50	L	L
	Coastal country	133	VRD	171	>50	L	L
	Coastal country	134	G	144	>50	L	L
Mulga - annual shortgrass	Mulga shrubland	139	CA	1 281	33-50	L	L
	Mixed *Acacia* spp. on low hills	141	CA	2 010	33-66	L	L
Annual shortgrassland	Northern calcareous pastures frontage	143	VRD	45	15	H	L
	Northern calcareous pastures	143	VRD	152	20	M	L
	Southern calcareous pastures	144	CA	595	25-50	L	L
Chenopod shrublands	Southern bluebush	148	CA	896	40-50	L	L
	Northern bluebush	149	VRD	42	3-4 seas	H	L
	Northern bluebush	150	BT	969	3-4 seas	H	L

Areas are actual pastoral lands excluding National Parks, Trusts and unoccupied land

3b

Condition Assessment						Avg. BE '000 (5)	Comments
1991 (%)			1991 '000 ha				
A	B	C	A	B	C		
90		10	239	0	27	265	Severe mimosa infestation. Salt intrusion on 0.5% of area
100			75	0	0	75	Little use - lack of stock water
50	50		62	62	0	5	Severe *Sida, Hyptis* invasion
40	40	20	58	58	29	10	*Hyptis, Sida, Cassia* on cleared overgrazed areas
100			1 286	0	0	16	Low quality – little grazing use
100			2 259	0	0	28	Low quality – little grazing use
100			1 194	0	0	15	
						L	Condition not assessed
100			1 811	0	0	L	Little grazing value
95	5		3 795	200	0	266	Little used, some weed and eucalypt regrowth in north-east
90	10		3 615	402	0	268	Some weed problems in east
						70	Condition not assessed
100			481	0	0	L	Little grazing value
100			780	0	0	L	Little grazing value
65	20	15	598	184	138	L	
75	15	10	62	12	8	2	
						23	Condition not assessed
60	30	10	15	8	3	2	Serious frontage erosion now recovering with fencing and seeding
90	10		1 020	113	0	57	Desirable species decline
95	5		412	22	0	27	*Hyptis, Sida* on overused frontages
90	10		406	45	0	28	Increased undesirable annual grasses (*Aristida*)
80	15	5	4 422	829	276	325	Parkinsonia increasing
			235			11	Condition not assessed
80	15	5	463	44	15	6	
60	40		27	309	0	39	Decline in desirable species, active erosion
60	30	10		14	5	3	
			698			2	Condition not assessed
70	20	10		199	100	36	
						3	Condition not assessed
						11	Condition not assessed
							Condition not assessed
100			3	0	0	L	Very little used
100			1 816	0	0	L	Very little used
80	15	5	359	67	22	L	
100			1 807	0	0	L	Very little used
80	15	5	3 661	686	229	L	
						L	Condition not assessed
100			1 212	0	0	L	Very little used
80	15	5	961	180	60	L	
						L	Condition not assessed
100			421	0	0	L	Very little used
100			38	0	0	L	
						L	Condition not assessed
						L	Condition not assessed
						L	Condition not assessed
						L	Condition not assessed
						L	Condition not assessed
						L	Condition not assessed
						37	Condition not assessed
						56	Condition not assessed
						32	Condition not assessed
100			31	0	0	L	Almost no use for regular livestock production
100			171	0	0	3	
100			144	0	0	3	
						31	Condition not assessed
						40	Condition not assessed
40	40	20	18	18	9	3	
60	30	10	91	46	15	8	Past scalding and stream erosion, now recovering. Very fragile.
						16	Condition not assessed
						20	Condition not assessed
						5	Condition not assessed
90	8	2	872	78	19	120	Half year only grazing

Table 3c Western Australia – Kimberley/Pilbara

Pasture community	Local Pasture Unit (LPU) (1)		Region	Area '000 ha (2)	CC ha/hd (3)	Nat. prod. (4)	Pot. for imp.
	Description	No.					
Wanderrie grass	Cockatoo grass = Marrakai m/h grassland	4	NK	205	>65	L	L
Ribbongrass – monsoon	Ribbongrass	9	NK	125	18-35	H(M)	M
	Ribbongrass	10	EK	25	20-40	M	L
	Whitegrass (*Sehima nervosum*)	11	NK	917	20-40	M	L
	Whitegrass – plume sorghum – Ribbongrass	12	EK	188	52	L	M
	Whitegrass – annual sorghum	13	WK	360	50	L	L
Plume sorghum	Perennial sorghum	15	NK	28	>40	M(L)	M
Annual sorghum	Annual sorghum	20	EK	1 643	40-65	L	M
	Annual sorghum	21	NK	3 037	40-65	L	M
Ribbongrass - tropical	Ribbongrass	35	EK	180	18-35	H(M)	M
	Ribbongrass (RGa)	36	WK	389	15-30	H(M)	M
	Ribbongrass – C/S spinifex (RGb)	37	WK	958	18-35	H(M)	M
	Whitegrass – bundle-bundle	39	WK	230	20	M	M
	Frontage grass	40	WK	478	12	H(M)	L
Aristida– Bothriochloa	*Aristida pruinosa* three-awn	46	EK	120	>60	L	L
	Kerosene grass (three-awn *A. hygrometrica)*	55	NK	187	>60	L	L
Bluegrass–browntop	Bluegrass	70	EK	130	20-25	M	H
	Bluegrass	71	NK	17	20-25	M	H
Mitchell grass	Mitchell plains	78	EK	647	10	H	L
	Blacksoil plains	79	WK	1 219	10	H	L
	Chichester Range basaltics	80	PIL	210	10	H	L
Spinifex	Curly spinifex						
	East Kimberley	93	EK	1 202	N/A	L	L
	North Kimberley	94	NK	4 308	N/A	L	L
	West Kimberley	95	WK	2 722	N/A	L	L
	Curly spinifex – ribbongrass (CSRG)	96	WK	3 644	N/A	L	L
	Curly spinifex – annual sorghum	97	NK		N/A	L	L
	Soft spinifex						
	Soft spinifex plains	107	EK	1 518	L	L	L
	West Kimberley (SS)	108	WK	35	L	L	L
	Hard spinifex						
	Pilbara	116	PIL	7 800	80-150	L	L
	East Kimberley	117	EK	715	80-150	L	L
	Lobed spinifex	118	WK	1 485	80-150	L	L
	Limestone spinifex	120	WK	896	80-150	L	L
	Hard/soft spinifex						
	Pilbara	123	PIL	10 600	N/A	L	L
Shortgrass – tussock grassland	Short tussock – soft spinifex	130	PIL	1 300	10	H	L
Saltwater couch	Littoral (Lt)	135	WK	135	>50	L	L
	Littoral	136	EK	280	>50	L	L
	Littoral	137	NK	70	>50	L	L
Mulga – annual shortgrass	Mulga shrubland	140	PIL	2 625	N/A	L	L
	Eremophila – Cassia low shrubland	142	PIL	2 625	N/A	L	L
Annual grassland	Shortgrass grassland	145	EK	688	25-65	M	L
	Shortgrass – ribbongrass (SGa)	146	WK	109	16-40	M	L
	Shortgrass – curly spinifex (SGb)	147	WK	467	25-65	M	L
Chenopod shrubland	Saltbush–bluebush samphire	151	PIL	1 312	N/A	M	L

(2) Areas include National Parks, Reserves and Trust Lands

3c

Condition Assessment									Avg. BE '000 (5)
1972 (%)			1991 (%)			1991 '000 ha			
A	B	C	A	B	C	A	B	C	
			80	20		164	41	0	3
			60	30	10	75	38	13	5
			60	30	10	15	8	3	1
			80	20		734	183	0	31
			25	45	30	47	85	56	4
			85	10	5	306	36	18	7
			80	20		22	6	0	0.6
			45	45	10	739	739	164	31
			80	20		2 430	607	0	58
			55	30	15	99	54	27	7
25	65	10	50	35	15	195	136	58	17
			50	40	10	479	383	96	36
15	60	25	60	25	15	138	58	35	12
5	35	60	25	35	40	120	167	191	40
			95	5		114	6	0	2
			60	30	10	112	56	19	3
			15	45	40	20	59	52	6
			60	40		10	7	0	1
			45	45	10	291	291	65	65
15	65	20	60	30	10	731	366	122	122
			50	40	10	105	84	21	21
			60	30	10	721	361	120	L
			90	10		3 877	431	0	L
65	25	10	90	10		2 450	272	0	L
			75	20	5	2 330	729	182	L
	NA			NA					L
			65	30	5	987	455	76	L
30	70		90	10		32	4	0	L
			95	5		7 410	390	0	68
			60	35	5	429	250	36	6
50	30	20	95	5		1 411	74	0	13
40	45	15	95		5	851	0	45	8
			80	20		8 480	2 120	0	L
60	20	20	45	45	10	585	585	130	130
45	55		50	30	20	68	41	27	2
			100			280	0	0	6
			100			70	0	0	1
			50	40	10	1 313	1 050	263	L
			90	10		2 363	263	0	L
			45	40	15	310	275	103	15
10	40	50	40	40	20	44	44	22	4
			35	35	30	163	163	140	10
			40	50	10	525	656	131	L

Stocking rate effects

Cattle numbers rose in the 1970s throughout almost all of northern Australia (Figure 1, Appendix 2). There were substantial increases in the Northern Territory and northern Western Australia although the total numbers there were much lower than in Queensland; the 1970 population in the N.T. had increased by 56% in 1979 (Australian Bureau of Statistics figures), excluding estimates of feral animals.

The sharp decline in numbers in the Northern Territory and Western Australia in the 1980s probably results from the Brucellosis and Tuberculosis Eradication Campaign (BTEC); this, with the substantial reduction in the feral animals, has had a significant effect on overall grazing pressures.

Figure 2 of Appendix 2 shows how actual stocking rates began to exceed the safe potential stocking rates in both northern and southern regions of the black speargrass community during the 1970s and 1980s. The safe potential stocking rate is calculated from summer pasture growth (December–May) x safe utilisation in summer (30%) ÷ animal intake for six months (1800 kg per cattle equivalent) x a 'Shire Index' (effect of trees and other land-uses). Pasture growth is calculated using the GRASP model with pasture and soil data from Springmount and Gayndah. 'Shire Indices' were calculated for 1945–63 (a period of pasture stability) as the ratio of the actual shire stocking rate to the calculated safe stocking rate for cleared pasture. The actual shire stocking rates were calculated as the ratio of total beef cattle to the shire areas (G.M. McKeon and K.A. Day, personal communication).

Examples of degradation and recovery

Studying three areas of severe degradation, which lie across the breadth of northern Australia and which are directly attributable to overgrazing, may help us to understand better the processes of degeneration and regeneration of fragile grazing lands.

In Queensland, degradation in the Burdekin Basin of Dalrymple Shire has been documented by De Corte *et al.* (1991). However, much of the degradation is now reversing due to good rainfall and to the invasion of Indian bluegrass (*Bothriochloa pertusa*).

The Victoria River District of the Northern Territory is also a notable area of degradation (Condon 1986). Here again good seasons in the past two years have brought about considerable recovery, while the fragile river frontage country, which had been fenced out after suffering severe gully and rill erosion, is also improving.

The Ord River basin of the eastern Kimberley has been a noted area of degradation, and became the first significant regeneration project in northern Australia (Fitzgerald 1968). Some level of pasture decline now occurring in these successfully regenerated areas is not readily explainable in management terms.

Although rill and gully erosion are a more permanent and intractable problem, pasture regeneration can be quite rapid, given the right conditions, and there may be an opportunity to introduce plants to aid regeneration if there are no appropriate native species. The BTEC program has also helped control degradation because of the added fencing and improved control over livestock movements; however, land disturbance, which often accompanies fencing, may cause an additional problem.

This concept of deterioration and regeneration is well enunciated by the 'state and transition model' outlined by Westoby *et al.* (1989). Consideration of this model helps us to understand the difficulties of making condition assessments of the pasture communities of central Australia, since both the states and the transition conditions need to be reasonably well recognised and understood first. There are cases where exclosure of degraded areas for more than 15 years has not resulted in regeneration to the original state. It may be that 15 years is just not long enough in the arid zone, or that regeneration depends on some episodic event to trigger the process.

Weeds

Although many of the weed problems are not

serious, they are a constant risk to the system and weed control is generally an on-going expense. The increasing incidence of exotic weeds in northern and central Queensland is shown in Figure 4 of Appendix 4. Parthenium has caused substantial changes in pastures of Queensland bluegrass, brigalow and *Aristida-Bothriochloa*. In the case of Queensland bluegrass, this has led to a massive jump in the condition level C; although crop-pasture rotations have given successful control in some areas, biological control is probably the only hope for reversing this trend.

Other exotic woody weeds are causing considerable degradation in the northern speargrass and *Schizachyrium* systems, with the serious infestations of river frontages with rubbervine. The northern mitchell grass zone is at risk to prickly acacia, and with a potential threat from mesquite. Most other woody weeds result from regrowth or regeneration of indigenous species, such as eucalypts, brigalow, wattle, gidgee, teatree, cypress pine, turkeybush, and hopbush. Many result from the lack of burning due to insufficient grass from the combined effects of heavier grazing pressures and dry years.

There is still lingering opposition by some researchers and advisers to burning; this is born of a lack of understanding of fire ecology (Roberts 1991).

Soil fertility

Declining soil fertility has led to increased degradation in some systems. Blady grass, carpet grass and other undesirable grasses have increased in pastures developed on cleared rainforest and wet sclerophyll land as the natural fertility has declined and has not been replaced with sufficient inputs of fertiliser.

Pasture decline has occurred on the heavier clay soils of brigalow, bluegrass, gidgee and some southern mitchell grass pastures in Queensland where the nitrogen available for plant growth is tied up in organic matter. This is more a deterioration in the production resource than in the land.

Mulga lands

The mulga pasture lands are another obvious area of pasture and soil degradation. The leaves of mulga are a valuable fodder; this is a positive factor as a dry season and drought feed reserve, but becomes a negative factor if it leads to continued severe overuse of the pasture resource. Both the soils (in terms of low fertility and poor structure) and vegetation (in terms of tree–grass and perennial–annual interactions) are inherently and interactively fragile. Native woody weeds, particularly turkey bush *(Eremophila gilesii)* and hopbush (*Dodonaea* spp.), have also become a problem in mulga lands.

In Queensland, little change in the mulga lands is indicated by examining the assessment by Weston *et al.* (1981). This is perhaps understandable because the whole system is fragile; also the recuperative processes are slow, complex and episodic, particularly in view of the dry years that have punctuated the intervening period. A vigorous research program over the last 20 years has thrown more light on the ecology of such systems and their management, and provided a basis for minimising the recurrence of such degradational processes (Burrows *et al.* 1988). However, since 80–90% of mulga properties are smaller than the recommended living area (Local Consensus Data survey of the Maranoa by Clark *et al.* (1992)), there may be little room for managers to manoeuvre.

The land management problems of the mulga carry across into Central Australia and the Pilbara, becoming more significant with decreasing incidence and reliability of rainfall. In moving west, there is a tendency for the pastures to become more predominantly annual; this may be confounded with soil type, for example the calcareous soils carrying the preferred sweet oat grass (*Enneapogon* spp.) pastures. Annual grasses can easily be overgrazed, particularly when coupled with rabbit infestations in the southern part of the region. The woody element also tends to become increasingly mixed with other *Acacia* species and genera of lower feed value.

As pasture systems become more annual,

a different set of dynamic processes governs pasture sustainability, degradation and regeneration. The processes are even more complex in mixed perennial-annual systems.

Productive capability

In Figure 3 of Appendix 2 (page 76), condition assessments, abstracted for the most productive pasture communities, have been plotted against the productive capability, as measured by the beef equivalent (area x carrying capacity) output. The histograms have been plotted at 2.5x the Queensland scale for the Northern Territory and 5x the scale for Western Australia because of the relative difference in the areas of the pasture communities.

There are three major points of interest: Queensland has considerably higher proportions of B and C condition levels than the Northern Territory or Western Australia; there is a clear distinction between the higher productive pastures (with a highly positive ratio of production output : production area) and low production pastures (where the ratio is highly negative); and there is a consistent difference in the ratio when comparing tropical and subtropical zones in Queensland (indicated by the northern and southern separation). For the southern sectors of the most widespread pasture communities, the ratio is more strongly positive than for the northern; the Northern Territory and Western Australia are more closely related to the north Queensland ratios. The ratio tends to be more negative in going west, more particularly for ribbongrass than for mitchell grass.

There are only three productive pasture communities that are comparable across northern Australia. The first similarity is between northern black speargrass and ribbongrass. Though separate communities, they are structurally and functionally comparable (Tothill and Mott 1985), with a production ratio slightly positive in northern Queensland, and slightly to strongly negative in the Northern Territory and Western Australia. This probably relates to the general gradient of decreasing soil fertility, increasingly severe climatic seasonality, and decreasing natural biodiversity.

In the mitchell grass communities, the ratio is neutral for northern Queensland, slightly negative in the Northern Territory, and slightly positive in Western Australia (including the shortgrass-tussock pastures of the coastal Pilbara plains). In the case of Western Australia, the better ratio could relate to the fact that most of the mitchell grass communities are found on alluvial soils of the major river systems and they have a much richer floristic composition than in the mitchell grass plains types of the Northern Territory.

Bluegrass communities in northern Queensland and the Northern Territory are comparable, while, in Western Australia, bluegrass tends to occur with ribbongrass as ribbongrass–bundle-bundle, or with mitchell grass.

Other communities which may be compared on grounds of having similar ratios are the derived pastures under high rainfall on cleared rainforest lands of Queensland and the ricegrass-*Hymenachne* of the Northern Territory. Both have highly positive ratios with very high output per unit area and an additional high potential for improved productivity. On the other hand, the northern *Aristida-Bothriochloa* has a negative ratio; comparable systems in the Northern Territory and Western Australia are similar, but have not been shown because of their low productivity and because little use is being made of them. Western Australia utilises its annual sorghum pastures more than the Northern Territory, largely because they are managed by fire to a greater degree, and because they are frequently associated with small interspersed areas of better pastures on river frontages and better soil outcrops.

In general, a high potential for improved productivity is not a characteristic of the pastures growing on clay soils, except where it is possible to have a crop-pasture rotation—as in the Queensland bluegrass lands and brigalow lands. There are relatively few exotic pasture plants which can surpass the existing natural species on the cracking clay soils for permanent pastures.

The systems with the greatest potential for improvement by oversowing or species replacement, possibly with fertiliser

application, are those of moderate natural production, on well-drained soils with a robust but fairly responsive floristic composition. These are the black speargrass in Queensland, ribbongrass in the Northern Territory and Western Australia, and some of the *Aristida-Bothriochloa* pastures of southern Queensland. Some of the annual sorghum pastures of Western Australia may also be improved by oversowing.

Throughout the tropical region, pasture improvement is likely to remain a strategic management tool rather than a general application.

An important occurrence for the whole of the Northern Territory and northern Western Australia is the BTEC program. This is bringing about a radical change in the character of livestock production in north-western Australia—from a predominantly animal-harvest type to a more intensively managed operation. It is shifting the emphasis away from free-range livestock production to individual animal production units.

A further factor is an expanding market in Indonesia for shipment of both live young animals and meat; it presents, for the first time, a reliable alternative as a marketing objective.

Central Australia

It is only possible to give an overview of the condition of the grazing lands in Central Australia. It is generally agreed that there has been a considerable improvement in condition since the 1960s, when it was realised that the pasture resources were seriously at risk from the ravages of feral animals such as rabbits, and from an inadequate understanding of range management (Purvis 1986). This study emphasises how, in a region of such great spatial and temporal diversity, the graziers need to develop an understanding of the unique situation for each property in formulating management. This cannot come from regional generalisations, as in the more predictable and more broadly scaled regions of higher rainfall. As individual properties encompass much of this diversity, generalised production strategies are difficult to devise, and resources are difficult to describe and assess meaningfully. Monitoring the system is important here; unless the processes and nature of change are understood, there is no basis for devising management that results in sustained, long-term productivity, or for restoring deteriorated areas. Researchers, extension workers and land managers need to integrate to strengthen the basis for management tailored for particular properties.

4 Strategies for sustainability

There are several strategies for ensuring long-term use and sustainability; many of these are interacting.

1. *Establishing guidelines for safe stocking strategies*

With a sufficient understanding of pasture responses to season, grazing pressure and fire, indicators could be developed to guide tactical management of grazing. These indicators would provide for timely adjustments to stocking rate and so avoid damage to grazing resources.

Information to support both tactical and strategic stocking rate decisions is required, such as:

- improved pasture husbandry practices relating to the maintenance of desirable or improved composition, production capability, utilisation and the management of natural or enhanced floristic diversity
- paddock design and the management of watering points
- a better understanding of livestock husbandry and nutritional requirements in relation to feed quality and quantity
- feral animal control and wildlife management.

Producers must have sufficient knowledge to be able to compare alternative strategies, rather than just being told what to do. This requires developing close or interactive links between producer and researcher; field station research should be linked with on-property research so that it can relate research to property management information.

2. *Establishing a better understanding of the management of resource diversity*

Understanding management of a diverse resource is particularly important for large properties where the pasture units are highly variable and the climate is unpredictable during the year; these conditions are found in Central Australia and in the smaller scale diversity of the highly dissected parts of the Top End of the Northern Territory and the Kimberley region.

Another case is large scale diversity within a region, rather than within a property, as found in the Maranoa and central regions of Queensland. In these regions, lands of high and low pastoral and agricultural potential are interspersed—Queensland bluegrass, brigalow, eastern gidgee and eastern mitchell grass are intermixed with *Aristida-Bothriochloa* pasture communities. Here the management of resource diversity must be more at the inter-property, or catchment level, rather than within properties.

Over the whole of northern Australia, there is a problem in the management of frontage country; this has resulted from overuse of land which has higher soil fertility and is adjacent to water.

This strategy (2) overlaps substantially with Strategies 1, 3, 4, 6 and 8, but it is listed separately because, like Strategy 1, it addresses a complex problem. The individual issues need to be understood as well as the complex interactions.

3. *Establishing guidelines and techniques for monitoring the pasture resources*

The pasture resource must be monitored to determine whether its condition is stable, improving or declining. This will involve:

- monitoring of all aspects of the production system to develop the necessary understanding of the resilience, sustainability, degradation and recuperative processes of the system. Land managers must be involved in all phases of the monitoring process to encourage participation, awareness and education (see Strategy 2)
- regular periodic monitoring of the production resources of leaseholds. In all three states making up the northern Australia region, new Land Acts are in various stages of adoption. All will embrace new concepts of leaseholding designed to provide better incentives for responsible, long-term land management, and for regular monitoring (see Strategy 11)
- primary producers are increasingly interested in how they can monitor their own properties. With increasing availability of computerised decision support systems, property managers are likely to start using such information. Appropriate

monitored statistics will need to be considered within the scope of property management (see Strategy 8)
- monitoring is an important element of managing drought and understanding drought processes (see Strategy 6).

4. *Reconsideration of fire as a strategic management tool*

Fire can play a strategic role in grazing management, by helping to maintain pasture composition, and particularly in controlling woody weeds. It has particular relevance to Strategies 1, 7 and 9. In recent years, fire has been down-played as being environmentally unfriendly, however reduced use of fire (Roberts 1991) has more likely come about because of the shortage of fuel due to dry years, increased stocking rates, and more efficient utilisation of pasture biomass through the use of feed and mineral supplements (see Strategies 2, 7 and 9).

5. *Greater use of on-farm research and acquisition of farm-related data*

The wealth of farm information has to be tapped as a means of verifying and making the large amount of available research information relevant to the farm. This process requires a close liaison between researcher and client, i.e. the farm manager, particularly for the development of decision support systems as an aid to management (McKeon *et al.* 1986; Gillard and Moneypenny 1990). This is already taking place in the form of the QDPI decision support packages—GRASSMAN and STOCKMAN (see Strategies 1, 2, 8 and 12).

6. *Strategies for handling drought*

Given that droughts are likely to recur and that some degradation in the pasture and soil resources is likely to follow, the recuperative processes after drought must be understood to develop property management options.

The knowledge base required to support Strategy 1 is also relevant to drought management. However, the contingency planning for drought and the actions taken during drought can have a substantial effect on what those options are after drought. At present drought is invariably dealt with as it occurs, without forward planning. There is, therefore, a need for better predictive capability and interpretation of past events so that drought preparedness and management strategies are in place and degradation effects on the production resources are minimised (CSIRO 1990).

Although still in their early development, such prediction systems as RAINMAN (Clarkson and Owens 1991) are paving the way to better understanding and reliability. They require more feed-back from the producer level to improve their local usefulness (see Strategies 3, 5 and 8).

7. *Addressing the serious weed problems and threats of weed invasion*

Serious incursions of exotic woody and herbaceous weeds have developed in north Queensland over the last 10 years and are outlined in Appendix 3. In many situations, land has been made almost totally unproductive by invasion of weeds, while, in other areas, a formidable threat exists in the form of reservoirs of infection. In addition to these exotic species, and also some native ones, there is a widespread and endemic problem of woody regrowth from eucalypt and acacia species, particularly in southern Queensland (see Strategy 9). This is specifically important in such systems as the mulga and other acacia species in south-west Queensland and Central Australia, where finding the right balance between top-feed and ground-feed is not always easy.

Other areas of northern Australia may not have serious problems now, except for mimosa in the north-west of the Northern Territory, but there is always the threat of the exotic weeds colonising from north Queensland. Understanding fire ecology could be essential to the development of management strategies to address this problem (see Strategy 4).

8. *Enhanced educational programs for producers*

Such educational programs should be participatory and of a 'grass-roots' nature, with a strong emphasis on producer-derived information. This could come through a broadening of Landcare activities or such producer-based organisations as the Victorian River District or Centralia Land Management Associations.

Producers are requiring greater access to technology, and there is need for better channels of feed-back to researchers about their changing situations and requirements.

However, there is need for support and channels to facilitate and empower producer groups so that 'user-pays–user says' messages are representative of the producers and receive an effective hearing. Agricultural advisers need to play a responsive role rather than a command one. Landholders need to be able to access the new technologies, particularly in the use of computerised decision support systems, as this will be one of the most potent ways of advancing both management expertise and the technical base on which tailored systems will operate (see Strategies 1, 2, 3 and 5).

9. *Tree management*

Tree management issues arise largely in southern Queensland and in Central Australia. As mentioned under Strategy 7, woody species regrowth is an endemic problem and is likely to remain so where pasture lands exist on cleared or partially cleared eucalypt woodlands.

Fire is an important factor in control of regrowth. In the acacia woodlands, suckering from old rootstocks can be a serious problem, especially in the brigalow lands, but now only on lands that cannot be cultivated for crop production. In other areas, acacia regeneration by seedlings can be a problem, particularly after fire. This may be the case in the mulga and other top-feed acacia systems of south-west Queensland and Central Australia where a balance is needed between the tree density desirable for top-feed and that for pasture growth.

Another aspect of tree management that is of increasing concern is the effect of clearing on salinisation. Where solodic or texture contrast soils are widespread—as in the *Aristida-Bothriochloa* pasture community, considerable parts of the black speargrass, and some brigalow communities—salinisation could occur between 20 and 100 years after clearing. The Murray Darling Basin Ministerial Council is addressing this issue over a large part of eastern Australia, but little activity is being undertaken in Queensland except by the Queensland Department of Primary Industries (see Strategies 4 and 7).

In many areas where there has been excessive or unnecessary clearing, guidelines should show how to re-establish trees for shade, windbreaks, soil and water conservation, wildlife habitat and landscape aesthetics. For other areas where there is a case for tree reduction, guidelines must show how this should be done, i.e. the degree and pattern of the removal (see Burrows *et al.* 1988).

10. *Feral animals and wildlife*

Uncontrolled populations of feral buffalo, pigs, donkeys, camels, horses and rabbits, and of native herbivores such as kangaroos and wallabies, all contribute to difficulties of management, particularly in the implementation of Strategy 1. For feral animals, there is a need to broaden the approach to their control. There are few examples anywhere of the successful eradication of feral animals, and most programs have eventually opted for control rather than elimination.

In terms of wildlife, while much work has been done in feed resource competition and dietary complementarity, there is a need for better monitoring of numbers, and for setting levels of population control which will balance competition with survival (see Strategies 1 and 2).

11. *Improved conditions of leasehold*

There are several cases where uneconomic sized leases are leading to over-use of the land resource to provide a livelihood for the landholder. Such situations exist in the Northern Territory Gulf region (Holmes 1990), and in the mulga lands in south-west Queensland, especially in the Maranoa district (Clark *et al.* 1992). While this is not a problem for research, it must be viewed as an environmental constraint to good land management.

There should be interaction between land holders, researchers, agricultural advisers and land administrators in setting and reviewing adequate living areas, and in helping to establish acceptable methodologies for monitoring the land resource and its management. At present, all three states comprising the region are developing a new generation of Land Acts (see Strategies 3 and 5), which should address these problems.

12. *Better definitions of markets and formulation of production objectives*

Where there are ill-defined market objectives, management options are decreased and resource-use planning is difficult. If the industry is to be made more efficient by emphasising sustainable improved production

on a per-head basis rather than on a per-hectare basis, market objectives for the necessary investments need to be defined.
A recent example of this is the beef meat and live animal market in Indonesia, which has given producers in the Northern Territory new market objectives, just at the time (following the BTEC program) when they were most needed. Now there is a strong demand for decision support services to help with property planning (see Strategy 5).

Pasture communities at risk

At risk –
from overgrazing:

- with the use of feed supplements, pasture legumes, hardier breeds of livestock; and by feral animals:
  - black speargrass
  - ribbongrass
- on calcareous soils carrying sweet feed:
  - shortgrass annual pastures (Central Australia and Victoria River District)
- on systems carrying top-feed of edible acacias:
  - mulga pastures

from weed invasion and regrowth:

- exotic woody weeds:
  - parkinsonia, mesquite, prickly acacia:
    - mitchell grass (mostly Queensland)
  - rubbervine, chinee apple:
    - frontage country (Queensland Gulf and Peninsula)
  - mimosa:
    - ricegrass-*Hymenachne* (Darwin, north-west coastal)
- native woody weeds:
  - eucalypt regrowth:
    - southern black speargrass (central and southern Queensland (Qld))
  - eucalypt regrowth, shrubs and cypress pine regeneration:
    - *Aristida-Bothriochloa* (central and southern Qld)
  - acacia regeneration with other shrubs:
    - mulga, other acacia (Qld, Central Australia and Pilbara)
  - acacia sucker regrowth:
    - brigalow (Qld)
  - acacia regeneration:
    - gidgee (Qld, Central Australia)
- exotic herbaceous weeds:
  - parthenium:
    - central Queensland bluegrass (Qld)
    - northern brigalow (Qld)
    - central eastern mitchell grass (Qld)
- native herbaceous weeds
  - pimelea:
    - southern alluvials (Qld)
    - southern brigalow (Qld)
- exotic grass weeds:
  - giant rat's tail grass (coastal south and central Qld)

from soil deterioration:

- soil fertility decline:
  - nutrient depletion:
    - derived rainforest pastures (Qld)
    - blady grass pastures (Qld)
    - heathland pastures (Qld)
    - other sown pastures
  - nutrient tie-up:
    - brigalow pastures (Qld)
    - Queensland bluegrass
- soil structural degradation:
  - surface scalding on red earth soils:
    - mulga (Queensland, Central Australia, Western Australia)
    - ribbongrass (Northern Territory, Western Australia)
  - surface scalding on fine-textured duplex soils:
    - some black speargrass (Qld)
    - some *Aristida-Bothriochloa* (Qld)
- soil profile degradation:
  - salinisation due to tree clearing on duplex soils with saline sub-soil:
    - some *Aristida-Bothriochloa* (Qld)
    - some black speargrass (Qld)
    - some brigalow pastures (Qld)

Problems and priorities

In ranking the problems in Table 4, we have chosen to group them into three levels of priority. When we asked people to allocate priorities to this list of 12, we found much diversity in view from individuals between regions as well as within regions. However, there was reasonable consensus when we grouped the responses into three levels. A further difficulty in this exercise is that not all problems are equally important over the four regions.

The listing is an approximate overall order of importance for all of northern Australia. In this ranking, Western Australia places low priority on further research into monitoring, not because it is not considered important but because that state has satisfactory monitoring systems in place. The main problem is in processing the information acquired.

Western Australia places a high priority on fire research as they see fire as an invaluable tool in pasture management. This is apparent in the condition scores and land capability estimates in Table 3, because a much higher use is made of the poor quality pasture land than elsewhere.

Queensland places a high priority on on-farm research and data collection. This probably reflects the higher level of importance that decision support technology is given. It might also reflect more intensive land use in Queensland and more exposure of producers to extension personnel. The state is also strengthening its research on the problems of drought, and on property management strategies for drought.

Table 4 Overall ranking of problems and ratings for each region[1] (rating of 1 indicates highest priority)

Priority	Item	Qld	NNT	CA	WA
1	Stocking strategy	1	1	1	1
2	Managing resource diversity	1	1	1	1
3	Resource monitoring	1	1	1	3
4	Fire research	2	2	1	1
5	On-farm research/data	1	2	2	2
6	Drought	2	2	1	2
7	Weeds	1	2	2	2
8	Education	2	2	2	2
9	Tree Management	2	3	2	3
10	Feral animals/wildlife	3	2	2	3
11	Leasehold sizes/covenants	2	3	3	3
12	Market research	3	3	3	3

[1] Qld = Queensland; NNT = northern Northern Territory; CA = Central Australia; WA = Western Australia

The issues for sustained livestock production

The most important issues for livestock production in northern Australia are stocking strategy, how research is translated into practice, and the custodianship of land.

Stocking strategy

Overgrazing has led to the deterioration or degradation of some pasture land, but, when the grazing pressure is considerably reduced and the growing seasons are favourable, regeneration may be rapid. Long-term set-stocking leads to gradual deterioration of the more palatable species of the pasture, and some form of strategic spelling is beneficial to maintain desirable pasture composition. Spelling should not be confused with rotational grazing. Rotational grazing can lock the grazier into a mechanical pattern of utilisation rather than one in tune with the biological strengths and weaknesses of the desired pasture plants.

Important issues are:

- a long-term safe stocking rate that will maintain the pasture resource in a desirable and productive condition. In Queensland, the industry has been stocking mostly above that level for the past 10 years or more. High resource diversity can make this safe level difficult to determine. Improvement can come only from more efficient livestock production where fewer animals are needed to produce the same or better output. The feed resource must be used more strategically or improved to match both the livestock need and its own sustainability.
- strategic management of the grazing resource to counter either the overuse of the resource which is inevitable at times or any gradual erosion of the desirable pasture composition. In Queensland, there has been a general increase in the unpalatable wire grasses in the black speargrass, southern mitchell grass and *Aristida-Bothriochloa* pasture lands. While this increase can be attributed largely to overgrazing, it appears to be a long-term trend through good and bad years. In the Northern Territory, there has been an obvious decline in the grazing-sensitive kangaroo grass and an increase in black speargrass. While this may not be considered a deleterious change in Queensland, it could be so in the floristically poorer systems of north-western Australia.
- strategic management of the resource to enable the implementation of livestock husbandry practices which will improve the efficiency of livestock output. Production per head, rather than per hectare, needs to be stressed; it may actually improve the per-hectare results.

Translating research into practice

Translating research into practice needs a much closer relationship between landholder and scientist. There is much farm-based information which should be used to help formulate research and to verify research results and assumptions used in computer models. In a two-way interaction, the landholder needs to be a close participant in all aspects of the work; in this way both parties learn and all relevant aspects of the problems are considered.

In structuring relevant research, two important questions need to be answered:

1. How will this work, directly or indirectly, affect the primary producer in terms of his output and the maintenance of a sustainable production resource?
2. How best can this research be organised by the institutional and scientific fraternity, given their different strengths and constraints, so that the results are eventually linked to the producer?

The custodianship of land

Pastoralists cannot be given absolute freedom in the use of leasehold land, and there is now increasing scrutiny as to how well they are managing the resource. However from the overall community point of view, they are generally fair tenants, they do not cost the community unduly in monetary terms, and they generate goods and services which are beneficial. Given a more rational set of checks and balances in the use of land, there is every reason for this land use being improved and sustained.

In turn, it is incumbent on the States to ensure that the leaseholds are fair, equitable and sufficient and that appropriate services are

rendered to maintain the viability of the enterprises and sustainability of their resources. It is not the role of this report to set priorities for land use. The report focuses on those areas which are presently used for pastoral purposes, and its assessments provide some indication of how well this is being done. It poses no alternative land uses—that is a political decision—but there must be discussion between actual and potential user groups so that the most socially, economically and ecologically acceptable forms of use eventuate.

There is likely to be an increased and competitive demand for land resources by such interests as mining, tourism, recreation, conservation (including national parks and reserves), and special cultural groups (aboriginal land). Some of these uses are self-sustaining, but others are not and must be funded by the public purse. Society, through its socio-political processes, will decide on the extent and cost of such apportionments. However, there is room for more conciliation and sharing of the fruits of research.

Off-farm effects of inappropriate resource use, which are long-term in their manifestation, may not be readily discernible on-farm. These may include gradual siltation of regional dams, nitrification and algal growth in waters as a result of the use of fertilisers or heavy concentrations of livestock, and latent salinisation.

Other issues that are more specific include exotic weeds, and the management of fires and of trees.

Exotic weeds

The exotic weeds of northern and central Queensland need to be contained and progressively reduced. While these weeds are now causing degradation of some production resources in that state, they also pose a massive threat to their associated areas and comparable communities in the Northern Territory and Western Australia.

Fire for management

There is widespread recognition of the value of fire in management. It may have had a history of irresponsible use, but, if used wisely and in an ecologically responsible way, it is one of the most beneficial tools in pasture management and the control of weeds. There may be social concern and some community education about the value of strategic burning.

Tree management

Tree management may not be simply a property-based consideration; one example is the case with salinisation affecting land off the property, or even over a whole area if the catchment drainage is involved. Flood peak levels of streams can be increased and water table recharge lessened if widespread clearing is undertaken. There may be a change in ecosystem quality for wildlife. Reafforestation needs to take into account the needs of wildlife habitat in terms of minimal area and linkages of habitat through corridors of forest.

5 Conclusions

Background

This report provides a co-ordinated definition of the main pasture communities, and the relationships of the local pasture units in these communities, in northern Australia. It has linked estimates of production capabilities and condition to this structure.

We recognise the complexity of the northern Australian pastoral production scene; there is a wide range of problems, risks and issues affecting long-term productivity and resource sustainability. Some problems and risks are general to the whole region, others may be very important to a specific sub-region. Issues include: biological and physical constraints affecting the industry as a whole; the differential distribution of resource endowments; inherent production capabilities and livestock demographics; social, political and economic considerations; and, above all, the custodianship of one of Australia's most valued resources—the land.

Cause for concern

We consider there is cause for concern over the deterioration of the pasture resources in much of northern Australia, particularly in the more resource-rich state of Queensland.

Although this deterioration has not yet led to widespread serious degradation, a sound understanding of the causes needs to be developed so that the trend can be reversed while there is still time.

Usually there is no single cause, but persistently high stocking rates are clearly implicated and they show no clear signs of falling. Deterioration is due partly to the alarming spread of weeds, particularly the woody species, in Queensland over the last 10 years. The deterioration may be associated with the widespread change in cattle breed, supplementary feeding strategies, and with the occurrence of droughts. Each cause illustrates the need for a deeper understanding of its interactive effects on the use and sustainability of the resource base.

It will not be easy to address the needs of this complex system in terms of research and development. There are many parties, not all of whom have the same interests and therefore the same research and development objectives—indeed some may be competing for the same resources. However, the sum of these interests, if properly rationalised, should benefit all who have an interest in the sustainability of Australia's land resources.

Role of the Meat Research Corporation

The Meat Research Corporation is central to the interests of the pastoral land users; the pasture users are the largest on an area basis, but second to mining on the basis of value of output from primary resources, and third to mining and tourism on the basis of Gross Domestic Product.

The Corporation's role, by tailoring the nature and degree of its sponsorship for research and development, will be to address the complex problems of the pastoral industry in terms of sustainable production, benefit and economics.

The Corporation must also be aware of all the potentially relevant research being done for a wider range of users of the resource, and know how its own sponsored research complements this. All users of the resource must be aware of the efficiency with which the overall research budget is being applied for the benefit of the resources as a whole.

At a more specific level, the Corporation should be able to evaluate projects on an overall strategic basis, as well as on individual merit. This should enable key issues to be addressed on a broader basis, and draw on the human, technical, institutional, site and regional resources in a more integrated way.

Linking research over both the vertical (technological) and horizontal (environmental) gradients would lead to more efficient use of these resources. When relatively inexpensive regional research is linked with the more sophisticated research carried out at major research establishments, it can be a valuable aid to understanding the breadth of the problem, as well as providing a base to interpret and compare results.

Other aspects that need to be developed are the linkages between research at the national and regional level, and on-farm application. On-property research should complement on-station research, particularly with the active participation of the property

manager.

The development of property planning could be a powerful means of framing these interactions, but it may need new research approaches at the scale of paddock and property. This would provide invaluable feedback from the producer to the researcher and extension officer; it would also open a door to a great deal of property-based production information that is needed to interpret the existing and anticipated research information.

Priorities for funding research lie in several areas. The ranking of problems is an important first consideration, but research funding needs to be rationalised over the whole field of vertical and horizontal research perspectives, and from large to small in areas of application.

There is no point in pursuing research in isolation; the linkages must be clear between research and its application to development and eventual use at the property or landscape level.

There should be open discussion between the sponsor, researcher, extension officer and end-user, with adequate feedback to ensure that the right things are being funded and researched by the right people and organisations for the right reasons.

Just as the Meat Research Corporation should be able to call for particular areas of research when it perceives gaps in the research dossier with which it is presented for funding, so too should the end-users be heard, along with informed society's perceptions as to the relevance of the research. This requires channels, such as the Landcare movement and graziers' Land Management Associations, to help bring forward credible comment.

Pasture Communities	LPU
Coastal and seasonally-flooded lowland pastures	
Saltwater couch (*Sporobolus*)	131–137
Rice grass (*Xerochloa*)	1–2
Wanderrie grass (*Eriachne*)	3–5
Perennial tallgrass pastures	
Ribbongrass (*Chrysopogon*)	7–13; 31–40
Plume sorghum (*S. plumosum*)	14–15
Rainforest-derived pastures	25
Heathland pastures	26
Blady grass (*Imperata*)	27
Black speargrass (*Heteropogon*)	28–30
Annual tallgrass pastures	
Annual sorghum	16–21
Schizachyrium	22–24
Midgrass under eucalypt woodland	
Aristida–Bothriochloa	41–55
Riverine plains pastures	56–58
Midgrass pastures under *Acacia* woodland	
Brigalow (*A. harpophylla*) pastures	59–61
Gidgee (*A. cambagei*) pastures	62–64
(A. Georginae)	128–128
Midgrass grassland pastures on clay soil	
Queensland bluegrass (*Dichanthium sericeum*)	65–66
Bluegrass–browntop (*D. fecundum*)	67–71
Midgrass tussock grassland pastures on cracking clays	
Mitchell grass (*Astrebla*)	72–89
Midgrass hummock grasslands pastures on skeletal or desert soils	
Spinifex (*Triodia, Plectrachne*)	90–123
Perennial shortgrass pastures	
Mulga (*A. aneura*) pastures	124–127
Tussock shortgrass grassland	130
Annual shortgrass–forb pastures	
Mulga pastures	138–142
Shortgrass grassland	143–147
Chenopod shrubland pastures	
Bluebush–saltbush	148–151

Appendix 1 Botanical composition of the pasture communities and local pasture units of northern Australia

The species are listed for Local Pasture Units (LPU) in each pasture community. The communities, as depicted by colours on the map, are indicated by an asterisk. All abbreviations (for example NT/D, WA/WK) are spelled out in the footnote to Table 1 of the main text.

There was considerable variation in the level of detail provided in the lists of botanical compositon. We have presented the information as provided to us, so note that short lists do not always indicate floristically poor units.

The predominant species are listed in bold type and may represent co-dominants or alternative dominants where the unit is intrinsically variable in its composition. Species within square brackets are non-pasture species; these are not usually utilised.

Where species are listed in three columns, this represents the pasture composition for good, fair and poor condition (from left to right). This information was available for Queensland and West Kimberley.

A list of name changes, or synonomy, is given at the end of the appendix.

TALLGRASS PASTURE LANDS - Monsoon tallgrass pastures

The monsoon tallgrass pasture lands characterise the monsoon zone of northern Australia. This is approximately defined by the regions with >750 mm median annual rainfall and a highly reliable distribution of wet and dry seasons. This includes almost all of Cape York Peninsula, the 'Top End' of the Northern Territory and the northern half of the Kimberley of Western Australia.

Coastal and seasonally flooded lowland pastures

RICEGRASS *(XEROCHLOA)* GRASSLAND*

LPU 1. Ricegrass (*Xerochloa*) grassland (NT/D)
On subcoastal plains; heavy textured, peaty or alluvial soils; deeply flooded for 6-8 months then inaccessible to grazing; valuable dry season feed.
Hymenachne acutigluma
Oryza rufipogon
***Xerochloa* sp.**
Oryza meridionalis
Panicum paludosum
Pseudoraphis spinescens
Ischaemum arundinacea
Eleocharis spp.
Eulalia fulva
Imperata cylindrica var. *major*
Bothriochloa bladhii
Eleocharis spp.

LPU 2. Lowland tallgrass pastures (NT/VRD)
Similar to LPU 1 but less available for grazing due to lack of stock water.
Oryza rufipogon
***Eleocharis* spp.**
Leersia hexandra
Hymenachne acutigluma
Panicum paludosum
Eulalia fulva
Cyperus retzii

WANDERRIE GRASS (*ERIACHNE* SPP.)*

LPU 3. Wanderrie grass (*Eriachne*) tallgrass pastures (NT/D)
On gently sloping alluvial plains; soils yellow podzolics and yellow earths; liable to flooding 3–4 months in wet season; mostly treeless or open parkland of eucalypts and/or low teatree.
Eriachne burkittii
Themeda triandra
Alloteropsis semialata
Sorghum plumosum
Heteropogon triticeus
Coelorhachis rottboellioiodes
Ectrosia leporina
Eriachne avenacea
Sorghum intrans
Ischaemum arundinaceum
Oryza sativa var. *fatua*

LPU 4. Cockatoo grass = Marraki mid-height grassland (WA/NK)
(a) Wanderrie grass on gentle slopes and flats at foot of shale scarps under eucalypt woodland. A low quality, little used pasture; (b) cockatoo grass on coarse-textured podzolised, periodically-flooded soil in broad shallow depressions, slightly more valuable pasture than wanderrie grass as an adjunct to spinifex pastures.

(a) Eriachne obtusa	***(b) Alloteropsis semialata***
Schizachyrium spp.	*Panicum* sp.
Tripogon sp.	*Plectrachne pungens*
Rottboellia formosa	

LPU 5. Fringing tallgrass pastures (WA/EK)
Also frontage tall grass; along stream banks in the northern part of the region; restricted in area and often heavily used due to proximity to water.
Chionachne cyathopoda
Arundinella nepalensis
***Iseilema* spp.**
Vetiveria elongata
Coelorhachis rottboellioides
Leptochloa digitata
Pseudopogonatherum contortum
Sorghum stipoideum
Chrysopogon latifolius
Setaria spp.

LPU 6. Fringing pastures (WA/NK)
On sandy banks of creeks, rivers, streamlines and water holes. They are valuable pastures because they generally lie within large areas of poor quality pastures but are liable to overuse.
Arundinella nepalensis
***Ischaemum* spp.**
***Vetiveria* spp.**
Coelorhachis rottboellioides
Leptochloa digitata
Ectrosia spp.
Pseudopogonatherum sp.
Setaria spp.
Sedges

Perennial tallgrass pastures

RIBBONGRASS/GOLDEN BEARDGRASS *(CHRYSOPOGON FALLAX)**

This pasture community occurs widely, confined mostly to the Northern Territory and Kimberley regions, from the wetter monsoon to the drier semi-arid tropical zone, and over a wide range of soils, though predominantly on red and yellow earths. The vegetation type is eucalypt woodland. Perry (1960) comments on the variable nature of this community in relation to the dominant species, which was then mostly *Themeda triandra* (syn. *australis*) but has now changed towards a predominance of *Chrysopogon fallax* and, to a lesser extent, *Heteropogon contortus*.

LPU 7. Golden beardgrass (*Chrysopogon*) (NT/D)
This is an extensive pasture unit in the region on areas not subject to flooding, on a wide range of soils, but predominantly red earths.
Chrysopogon fallax
Themeda triandra
Sorghum plumosum
Sehima nervosum
Chrysopogon latifolius
Heteropogon triticeus
Alloteropsis semialata
Eriachne triseta
Plectrachne pungens
Aristida holathera
A. ingrata
Eragrostis schultzii

LPU 8. Upland tallgrass = Tippera tallgrass (NT/G)
This unit is found mostly as coastal woodland pastures but also as a mosaic in the very dissected, more rugged country below the Gulf lowlands and in the Roper River area where *Bothriochloa* and *Plectrachne* are more common. On the coast, it is associated with eucalypt–teatree open woodland, inland with eucalypt woodland.
Chrysopogon fallax
Themeda triandra
Heteropogon contortus
Sehima nervosum
Chrysopogon latifolius
Bothriochloa bladhii
Plectrachne pungens

LPU 9. Ribbongrass (WA/NK)
Mostly on shallow red earths, volcanic soils, rocky rises and medium slopes; pastures are rather coarse with little carry-over value into the dry season.
Chrysopogon fallax
Themeda triandra
Heteropogon contortus
Sorghum plumosum
Sehima nervosum
Eriachne spp.
Plectrachne pungens

LPU 10. Whitegrass (*Sehima nervosum*) (WA/EK)
There is not a large area in which whitegrass is the dominant species; it is found mostly associated with other Tippera tallgrass species at the yellow podzolic soil end of the range.
Sehima nervosum
Themeda triandra
Sorghum plumosum
Chrysopogon fallax
Heteropogon contortus

LPU 11. Whitegrass (WA/NK)
While whitegrass is not particularly attractive to cattle, associated grasses provide reasonably useful grazing; generally occurring on fine-textured yellow podzolic and igneous red earth soils under *Eucalyptus tectifica* woodland.
Sehima nervosum
Sorghum plumosum
Themeda triandra
Heteropogon contortus
Chrysopogon fallax
Dichanthium fecundum
Plectrachne pungens
Sorghum spp. (annual)

LPU 12. Whitegrass–plume sorghum–ribbongrass (WA/EK)
While similar to LPU 10, this is more the Tippera tallgrass type where the other pasture elements are frequently alternative dominants. It is more extensive on plains or undulating country of eucalypt woodland. Soils are light to medium textured loams, red earths and alluvials.
Sehima nervosum
Sorghum plumosum
Themeda triandra
Chrysopogon fallax
Heteropogon contortus
S. stipoideum
Plectrachne pungens
Aristida hygrometrica

LPU 13. Whitegrass–annual sorghum (WA/WK)
On hilly country asociated with basic igneous rocks in the north-eastern part of the region; soils are shallow, red, loamy to clayey, derived from basalt and other basic rocks; the hill slopes are generally steep with a boulder mantle.

Sehima nervosum
Sorghum stipoideum
S. plumosum
Chrysopogon fallax
C. latifolius
Themeda triandra
Heteropogon contortus
Cymbopogon procerus
Triodia intermedia
T. pungens
Plectrachne pungens
Eriachne obtusa
Enneapogon polyphyllus

Heteropogon contortus
Eriachne obtusa
Sorghum stipoideum
Sorghum nervosum
Chrysopogon fallax
Heteropogon contortus
Sorghum plumosum

Sorghum stipoideum
Aristida latifolia
A. inaequiglumis
Sehima nervosum
Eriachne obtusa
Heteropogon contortus

PLUME/NATIVE/PERENNIAL SORGHUM *(SORGHUM PLUMOSUM)**

This community, although fairly distinct in Cape York, tends to merge into the complex of the ribbongrass community of the Northern Territory and Kimberley regions where plume sorghum is a common associated species of the sub-communities. Most commonly the vegetation is eucalypt woodland.

LPU 14. Native sorghum (Qld)
Mostly on mottled yellow earths in Cape York Peninsula
Sorghum plumosum
Heteropogon triticeus
Eriachne spp.
Pseudopogonatherum contortum
Bothriochloa bladhii
Themeda triandra

LPU 15. Plume sorghum pastures (WA/NK)
On hilly, usually stony lower slopes and levees in strongly dissected parts of the Mornington volcanics, with predominantly shallow red soils; dense pasture of robust perennials, with numerous forbs and ephemerals, remaining palatable through much of the dry season.
Sorghum plumosum
Sehima nervosum
***Iseilema* spp.**
Themeda triandra
Heteropogon contortus
Sorghum spp. (annual)
Alloteropsis semialata
Eriachne spp.
Dichanthium spp.
Bothriochloa spp.

Annual tallgrass pastures

ANNUAL SORGHUM (*SORGHUM INTRANS, S. STIPOIDEUM* and SPP.)*

This community is most developed in the northern part of the Northern Territory and Kimberley. It occurs on sandy to stony skeletal soils with eucalypt woodland. The pastures are generally bulky but very poor in quality.

LPU 16. Annual sorghum (NT/D)
These are the most extensive pastures of the region, very tall, occurring over a wide range of upland topography; soils are light textured, sandy; pastures grow rapidly in the early wet season, quickly becoming coarse and rank with very low dry season quality; early dry season burning is common.
Sorghum intrans
S. stipoideum
S. australiense
S. plumosum
Heteropogon triticeus
Chrysopogon latifolius
Themeda triandra
Coelorhachis rottboellioides
Heteropogon contortus
Aristida pruinosa
Cymbopogon spp.
Panicum spp.
Eriachne triseta
Plectrachne pungens

LPU 17. Annual sorghum (NT/VRD)
Mostly in the northern part of the region on coarse-textured sandy, skeletal and stony soils; commonly associated with stringybark-bloodwood woodland and deciduous sparse low woodland.
Sorghum australiense (stony volcanic country)
S. stipoideum (northern part)
S. intrans(northern part)
Plectrachne pungens
Alloteropsis semialata
Heteropogon triticeus
Sorghum plumosum
Chrysopogon latifolius
Coelorhachis rottboellioides
Triodia stenostachya
Themeda triandra

LPU 18. Annual sorghum (NT/G)
Sorghum intrans
Heteropogon triticeus
Themeda triandra
Plectrachne pungens
Sorghum plumosum
Schizachyrium fragile
[Arthrostylus aphylla]

LPU 19. Annual sorghum (NT/BT)
A very small area associated with spinifex
Sorghum intrans
Plectrachne pungens
Triodia pungens
Annual grasses

LPU 20. Annual sorghum (WA/EK)
Composition and habitat as for LPU 17.

LPU 21. Annual sorghum (WA/NK)
Very poor pastures characterised by very short growing season, inaccessible to stock and isolated from areas of better quality grazing areas. In some places, the top-feed shrub *Ventilago viminalis* provides better grazing of the otherwise very poor resource.
Sorghum australiense
S. stipoideum
Plectrachne pungens
Triodia mitchellii
Eriachne spp.
Schizachyrium spp.
Alloteropsis semialata

SCHIZACHYRIUM – OTHER TALLGRASSES*

Occurring on a wide range of soils including leached sands, yellow and grey earths, and duplex soils with seasonal waterlogging; open teatree or stringy bark woodland; the pastures are of generally poor quality.

LPU 22. Tropical plains and low hills (Qld)
Schizachyrium fragile
Eriachne stipacea
Chrysopogon fallax
Heteropogon triticeus
Panicum mindanaense
Sorghum plumosum
Thaumastochloa brassii

LPU 23. Northern flooded alluvial plains (Qld)
Mostly on alkaline hard-setting duplex soils on flood plains, in the western Cape York Peninsula.

Dichanthium tenuiculum	***Dichanthium fecundum***	***Aristida* spp.**
D. fecundum	***Chrysopogon fallax***	***Schizachyrium fragile***
Schizachyrium fragile	*Aristida latifolia*	*Eriachne* spp.
Eulalia fulva	*Eriachne squarrosa*	
	Schizachyrium fragile	

LPU 24. Curly spinifex– *Schizachyrium* (NT)
On leached sandy soils with mixed eucalypt– teatree woodland/open grassland plains of the lower Gulf of Carpentaria.
Plectrachne pungens
Schizachyrium fragile
***Eriachne* spp.**
Chrysopogon fallax
Aristida spp.

TALLGRASS PASTURE LANDS - Tropical/sub-tropical tallgrass pastures
These pasture lands are distinguished from the monsoon tallgrass by having less dominant very tall grasses, with a less defined and more unreliable monsoonal rainfall pattern <750 mm median annual.

Perennial tallgrass pastures

LPU 25. RAINFOREST-DERIVED PASTURE LANDS* (Qld)

These are areas of pasture land, in the northern, central and southern coastal and sub-coastal areas, that have been derived from clearing of rainforest. While this practice is not now espoused, those that have been cleared have a high potential for productivity because of their high rainfall. Introduced pasture species are generally the most productive option, since native species are sparse and of low productivity. The lists include introduced species that have naturalised.

Southern (Moreton):

Pennisetum clandestinum	***Paspalum dilatatum***	***Imperata cylindrica***
Trifolium repens	***Axonopus affinis***	***Axonopus affinis***
Paspalum dilatatum	*Trifolium repens*	*Eragrostis* spp.
Axonopus affinis	*Digitaria didactyla*	*Cynodon dactylon*
Digitaria didactyla	*Imperata cylindrica*	

Central (Wide Bay–Burnett):

Paspalum dilatatum	***Sorghum leiocladum***	***Aristida* spp.**
Pennisetum clandestinum	***Eragrostis* spp.**	***Chloris virgata***
Chloris gayana	*Sporobolus* spp.	*[Lantana camara]*
Panicum maximum var. *trichoglume*		*[L. montevidensis]*

Northern (lowland, highland):

(a) Lowland:

Panicum maximum	***Paspalum conjugatum***	***Chrysopogon aciculatus***
Brachiaria decumbens	*[Nimosa pudica]*	*[Cassia obtusifolia]*
B. humidicola	*Sporobolus* spp.	*[Ageratum* sp.*]*
Setaria sphacelata	*Imperata cylindrica*	*[Hyptis capitata]*
Centrosema pubescens		*[Lantana camara]*
Pueraria phaseoloides		
Macroptilium atropurpureum		
Brachiaria mutica		
Digitaria decumbens		

(b) Highland:

Pennisetum clandestinum	***Axonopus affinis***	***Imperata cylindrica***
Setaria sphacelata	*Paspalum paniculatum*	*[Pteridium yarrabense]*
Panicum maximum	*P. dilatatum*	*[Lantana camara]*
Chloris gayana		
Trifolium repens		
Neonotonia wightii		
Desmodium intortum		

LPU 26. HEATHLAND PASTURES* (Qld)

In their natural state the heathlands along the east coast do not carry pastures which can support livestock permanently. Productive introduced pastures can be established with the necessary soil nutrient amendments, given the high reliability and amount of rainfall. Much of the southern heathland has become urban.

Native species:	Sown species:
[Schoenus sparteus]	*Digitaria decumbens*
[Byblis linifolia]	*Paspalum plicatulum*
[Eriocaulon spp.*]*	*Setaria sphacelata*
[Nepenthes sp.*]*	*Chloris gayana*
[Utricularia crysantha]	*Trifolium repens*
	Lotononis bainesii

LPU 27. BLADY GRASS (*IMPERATA CYLINDRICA*)* (Qld)

This is also a substantially derived pasture system. It is found on the well-watered coastal lowlands derived from altered tall open forest (mostly wet sclerophyll), which have moderate to poor natural pastures. The soils are variable from sandy to leached yellow/grey earths to duplex soils. With the gradual decline in soil fertility the original pastures have deteriorated to blady grass, though improved pastures can be developed with suitable fertiliser.

Northern sandy coastal lowlands:

Bothriochloa bladhii	***Alloteropsis semialata***	***Imperata cylindrica***
Heteropogon triticeus	***Bothriochloa decipiens***	***Axonopus affinis***
Themeda triandra	*Capillipedium parviflorum*	*Chloris barbata*
Imperata cylindrica	*Chrysopogon fallax*	*Aristida ramosa*
	Cymbopogon spp.	*Enteropogon aciculatus*
	Dichanthium aristatum	*Eragrostis* spp.
	Hyparrhenia rufa	*Sporobolus* spp.
	Imperata cylindrica	*Rynchelytrum repens*
	Panicum maximum	*Themeda quadrivalvis*
	Spinifex hirsutus	*Cenchrus echinatus*

Southern sandy coastal lowlands:

Themeda triandra	***Imperata cylindrica***	***Cyperus* spp.**
Cynodon dactylon	***Cynodon dactylon***	***Axonopus affinis***
Alloteropsis semialata	*Axonopus affinis*	*Imperata cylindrica*
Imperata cylindrica		

BLACK/BUNCH SPEARGRASS *(Heteropogon contortus)**

This is the second largest pasture community in Queensland, stretching for ¾ the length of the State. It is found on a wide range of soils, generally free draining. The main soil types are duplexes (more particularly in the south), alluvials, red earths (more particularly in the north). The vegetation is characteristically eucalypt woodland.

LPU 28. Northern black speargrass (Qld)
This community occurs north of Bowen.

Heteropogon contortus
Bothriochloa bladhii
Themeda triandra
Heteropogon triticeus
Bothriochloa pertusa

Chrysopogon fallax
***Cymbopogon* spp.**
Bothriochloa decipiens
Bothriochloa pertusa

Cynodon dactylon
***Eragrostis* spp.**
***Sporobolus* spp.**
Chloris barbata
Aristida ramosa
A. armata
Enteropogon acicularis
Panicum effusum
Bothriochloa pertusa

LPU 29. Central black speargrass (Qld)
This community occurs in the Prosperpine–Calliope area of Queensland.

Heteropogon contortus
Bothriochloa bladhii
B. decipiens

LPU 30. Southern black speargrass (Qld)
This community occurs south of Miriam Vale.

Heteropogon contortus
Bothriochloa bladhii
Bothriochloa decipiens

***Eragrostis* spp.**
Cymbopogon refractus
Bothriochloa decipiens

***Aristida* spp.**
Sporobolus elongatus
Chrysopogon fallax
Heteropogon contortus

Note: On hilly to mountainous areas *Themeda triandra, Eragrostis* spp. *Arundinella nepalensis, Stipa verticillata, Eremochloa bimaculata* and *Panicum simile* tend to predominate.

RIBBONGRASS/GOLDEN BEARDGRASS *(CHRYSOPOGON)**

This is a continuation of ribbongrass/golden beardgrass perennial tallgrass into the lower and less reliable rainfall region of <750 mm. Much the same soil affinities exist except that the community may extend onto shallower clay soils where it mixes with some of the drier communities such as mitchell grass, bluegrass, spinifex and shortgrass. The vegetation is characteristically eucalypt woodland.

LPU 31. *Chrysopogon* – other species (Qld)
The very small area of this community occurs in the north-west Gulf of Carpentaria coastal lowland on a podzolic, seasonally waterlogged eucalypt– teatree open woodland. The pasture is of poor quality and little used.

Chrysopogon fallax
Sehima nervosum
Heteropogon triticeus
Eriachne spp.
Eulalia aurea (syn. *fulva*)
Dichanthium fecundum
Heteropogon contortus

LPU 32. Tippera tallgrass *(Chrysopogon)* (NT/VRD)
This, with other related units, is the largest of the productive pasture communities in the region. It occurs mostly under eucalypt woodland and low woodland on red and yellow earths in some substantial areas and also in close mosaic, particularly in the southwest of the Victoria River District.
Chrysopogon fallax
Sorghum plumosum
Sehima nervosum
Themeda triandra
Heteropogon triticeus
H. contortus
Eulalia aurea (syn. *fulva*)
Alloteropsis semialata
Coelorhachis rottboellioides
Aristida holathera
A. hygrometrica
Eriachne spp.
Brachyachne convergens
Schizachyrium obliqueberbe
Panicum majusculum

LPU 33. *Chrysopogon*–other species (NT/G)
This is a rather variable unit occurring mainly in the Gulf of Carpentaria lowlands and adjoining the small section in north-west Queensland. However, it is also found scattered in small areas throughout the rugged hinterland below the Gulf and extending into the Roper valley. In the Gulf lowlands, the sub-community is mostly under eucalypt–teatree woodland whereas, in the other areas, it is eucalypt woodland where the *Eulalia-Dichanthium* elements tend to occur.
Chrysopogon fallax
Sehima nervosum
Heteropogon triticeus
Eulalia aurea
Dichanthium fecundum
Heteropogon contortus

LPU 34. *Chrysopogon*–other species (NT/BT)
Similar in composition to LPU 33.

LPU 35. Ribbongrass (WA/EK)
Similar to LPU 32.

LPU 36. Ribbongrass (WA/WK)
This community occurs throughout the western half of the Fitzroy River basin as a high rainfall sub-type in the region of >500 mm rainfall. The soils are commonly red and yellow earths, some alluvials and juvenile cracking clays. The pasture land is of moderate to high value and readily accessible throughout the year.

Chrysopogon fallax	***Eriachne obtusa***	***Aristida inaequiglumis***
Sehima nervosum	***Chrysopogon fallax***	*A. latifolia*
Sorghum plumosum	*Heteropogon contortus*	*A. holathera*
Eriachne obtusa	*Sehima nervosum*	*A. hygrometrica*
Dichanthium spp.	*Sorghum plumosum*	*A. contorta*
Panicum decompositum	*Aristida inaequiglumis*	*Eriachne glauca*
Brachiaria holosericea	*A. hygrometrica*	*E. obtusa*
Eulalia fulva	*Eriachne ciliaris*	
Chrysopogon fallax		

LPU 37. Ribbongrass–curly/soft spinifex (low rainfall)(WA/WK)
This sub-type is found mainly in the south-western and southern central parts of the region in areas with <500 mm rainfall. The topography is generally flat to gently sloping with some low laterised remnants and large areas of sand or soil covered plains, valley sides and drainage floors. Soils are variable, including yellowish and reddish sands, loams, and some laterite over clay. Pastures are generally poorer than in LPU 36.

Chrysopogon fallax	***Triodia pungens***	***Eriachne obtusa***
Triodia pungens	***Plectrachne pungens***	***Plectrachne pungens***
Plectrachne pungens	*Chrysopogon fallax*	*Triodia pungens*
Sorghum plumosum	*Eriachne obtusa*	*Aristida inaequiglumis*
Sehima nervosum	*Aristida inaequiglumis*	*A. hygrometrica*
Eriachne obtusa		
Aristida inaequiglumis		

LPU 38. Whitegrass–annual sorghum (WA/WK) — See LPU 13.

LPU 39. Whitegrass–bundle-bundle (WA/WK)
This pasture type characterises the basalt-derived, deep red earth soils of interfluves, lower slopes and drainage floors, and is characteristically associated with, and often down-slope from, the whitegrass–annual sorghum pasture lands. It occurs mainly in the north-eastern section of the region. The soils are generally red, loamy to clayey in the surface horizon, merging to dark reddish clay subsoils, often with basalt fragments. The botanical composition of the pastures is variable between the dominant species and it is of moderate value.

Sehima nervosum	***Sehima nervosum***	***Sehima nervosum***
Dichanthium fecundum	*Dichanthium fecundum*	***Aristida inaequiglumis***
Chrysopogon fallax	*Chrysopogon fallax*	*A. hygrometrica*
Eriachne obtusa	*A. inaequiglumis*	
Sorghum plumosum	*Heteropogon contortus*	
Themeda triandra	*Cymbopogon procerus*	
Heteropogon contortus	*Aristida hygrometrica*	
Cymbopogon procerus		
Aristida inaequiglumis		

LPU 40. Frontage grasses (WA/WK)
This pasture type characterises the levees and levee back slopes of the major rivers, particularly the lower Fitzroy and its south-eastern tributaries, and watercourses of the region. Soils are alluvial and variable in texture and colour but generally have loamy to sandy loam surface horizons, merging to hard loamy or heavy clay subsoils. Pastures are floristically rich and variable depending on topography and soil type, and are usually associated with open to very open eucalypt woodland.

Chrysopogon fallax
Dichanthium fecundum
Sorghum plumosum
Cenchrus setiger
C. ciliaris
Sehima nervosum
Trodia pungens
Plectrachne pungens
Cymbopogon procerus
Themeda triandra
Brachiaria holosericea
Eriachne obtusa

Chrysopogon fallax
Dichanthium fecundum
Eriachne obtusa
Heteropogon contortus
Sporobolus mitchellii
Xerochloa barbata
Cenchrus setiger
C. ciliaris
Sehima nervosum
Aristida hygrometrica

Xerochloa laniflora
Brachyachne convergens
Dactyloctenium radulans
Sporobolus australasicus
Chrysopogon fallax

MIDGRASS PASTURE LANDS

The midgrass pasture lands relate generally to the semi-arid zone of northern Australia. They lie between the 500–700 mm median rainfall isohyets in the tropical northern part of the region and between the 300–600 mm isohyets in the south-east subtropics. The pasture lands fall into three fairly distinct types: those associated with eucalypt woodlands on light, relatively poor soils; those with acacia woodlands and shrublands on higher fertility clay soils; and those associated with skeletal or sandy soils as hummock grasslands, sparse woodlands or shrublands.

Pastures of eucalypt open forest and woodland

ARISTIDA–BOTHRIOCHLOA PASTURES*

This is a rather variable pasture community with a range of dominant species, not always including the signature species. The predominant soil type is duplex but there is a fairly wide range of light soils of moderate to poor fertility. In Queensland, the community stretches from the southern border to the Gulf; in the Northern Territory, it is sandwiched between the mitchell grasslands and the ribbongrass lands and is less productive than in Queensland because of the more severe seasons; in Western Australia, it occurs only occasionally.

LPU 41. *Aristida–Chrysopogon*, Einasleigh western slopes (Qld)
This unit occurs in the lower western part of Cape York Peninsula, extending into south-west Gulf uplands. The soils are red, yellow and grey earths or sandy, loamy earths with little seasonal waterlogging. Vegetation is mostly eucalypt woodland.

Themeda triandra
Bothriochloa ewartiana
Chrysopogon fallax
Aristida ingrata
Aristida pruinosa
Sorghum plumosum
Heteropogon contortus

Chrysopogon fallax
***Aristida* spp.**
Sorghum plumosum
Schizachyrium fragile
Eriachne armittii
Eragrostis spp.

Aristida hygrometrica
Aristida spp.
Perotis rara

LPU 42. *Aristida–Chrysopogon*, paperbark teatree (Qld)
This unit is similar to LPU 41, but occupies the lower-lying lands of the southern Gulf and south-west Peninsula inter-river areas. The soils are similar but with mottled subsoils indicating some seasonal waterlogging. The pastures are not as floristically rich or palatable as in the previous unit. It is mostly teatree low woodland with some eucalypts.

Chrysopogon fallax
Sorghum plumosum
Aristida pruinosa

Aristida hygrometrica
Aristida pruinosa
Chrysopogon fallax
Sorghum plumosum

Aristida holathera
Aristida hygrometrica
Schizachyrium fragile
Ectrosia spp.
Eriachne spp.

LPU 43. *Aristida pruinosa*, three-awn (NT/VRD)
This unit is similar to LPU 41, occupying the better-watered parts of the lateritic landscapes in the southern half of the region and drier sites in the north. The soils are mainly yellow earths. The pastures are commonly associated with sparse, low eucalypt woodlands.

Aristida pruinosa
Chrysopogon fallax
Themeda triandra
Sehima nervosum
Cymbopogon bombycinus
Shortgrasses and forbs

LPU 44. *Aristida pruinosa*, three-awn (NT/G)
This unit occurs on the Gulf sub-coastal lowlands and is essentially a continuation of LPU 42 from Queensland.

LPU 45. *Aristida pruinosa*, three-awn (NT/BT)
The unit occurs in the drier part along the north-eastern flank of the Barkly Tablelands. It is more like LPU 43 in the drier northern part of the Victoria River District, but more variable. There are significant areas of *Acacia shirleyii* open forest with little ground cover, interspersed with *Eucalyptus dichromophloia* woodland with spinifex and/or tallgrass.

LPU 46. *Aristida pruinosa*, three-awn (WA/EK)
This is a continuation of the southern Victoria River District unit described in LPU 43.

LPU 47. *Aristida–Triodia pungens* (Qld)
The unit occurs in the central north of Queensland flanking the western edge of the northern black speargrass and the eastern flank of LPU 41, and in central Qld interspersed in LPU 102 (eastern soft spinifex or central Queensland desert). The upper storey is predominantly lancewood occurring on steep scarps and crests, lateritic mesas, breakaways and incised gullies.

LPU 48. *Aristida–Cleistochloa* (Qld)
The unit occurs in central Queensland, generally on shallow sandy soils associated with sandstones and laterised surfaces. The upper storey vegetation is usually acacia open forest and the pastures are of low quality and productivity.

***Aristida* spp.**	***Aristida* spp.**	***Dactyloctenium radulans***
Cleistochloa subjuncea	***Chloris ventricosa***	***Aristida* spp.**
Heteropogon contortus	*Enneapogon* spp.	*Rynchelytrum repens*
Cymbopogon spp.	*Enteropogon acicularis*	*Setaria surgens*
Dimorphochloa rigida	*Eragrostis* spp.	
Eriachne spp.	*Panicum effusum*	
Triodia pungens		

LPU 49. *Aristida–Thyridolepis* (Qld)
In the southern part of the *Aristida–Bothriochloa* community this unit borders on, and is a transitional state with, the adjacent mulga community. It occurs on neutral red earth soils carrying an overstorey vegetation of eucalypt (poplar box–silverleaf ironbark) and mulga open forest or woodland.

Bothriochloa decipiens	***Thyridolepis mitchelliana***	***Aristida jerichoensis***
Thyridolepis mitchelliana	***Bothriochloa decipiens***	*Tripogon loliiformis*
Digitaria brownii	*Eragrostis lacunaria*	*Eragrostis lacunaria*
D. ammophila	*Aristida jerichoensis*	*[Eremophila mitchellii]*
Themeda triandra	*Enteropogon acicularis*	*[Dodonaea attenuata]*
Monachather paradoxa	*Tripogon loliiformis*	

LPU 50. *Bothriochloa–Chloris–Aristida* (Qld)
Largely occurring in central Queensland, with a smaller part in the south. It is generally found on hard-setting duplex soils and some red earths and frequently juxtaposed with brigalow or bluegrass. It is usually associated with poplar box woodland. The pasture is of moderate quality and productivity, occurring on semi-arid woodland plains and low hills in central Queensland.

Bothriochloa ewartiana	***Bothriochloa decipiens***	***Aristida* spp.**
Dichanthium affine	***Chrysopogon fallax***	***Chloris* spp.**
Heteropogon contortus	*Cymbopogon* spp.	*Enneapogon* spp.
Themeda triandra	*Enteropogon acicularis*	*Eragrostis* spp.
Bothriochloa bladhii		*Panicum* spp.
Dichanthium sericeum		*Sporobolus* spp.
Aristida spp.		*Tragus australianus*

LPU 51. *Bothriochloa–Chloris–Aristida* (Qld)
This unit is essentially similar to LPU 50, but occurring in southern Queensland.

LPU 52. *Aristida–Eragrostis* (southern sandy) (Qld)
This unit occurs in the south-east part of the *Aristida–Bothriochloa* community between the Darling Downs and the southern brigalow on hard-setting to sandy surfaced duplex soils. The pastures are of poor quality generally, associated with an open forest of mixed eucalypt–acacia open forest, on sandy surfaced duplex soils derived from granite and sandstone.

Cymbopogon refractus	***Bothriochloa decipiens***	***Aristida* spp.**
Bothriochloa decipiens	***Chloris* spp.**	***Eragrostis* spp.**
Eragrostis spp.	*Chrysopogon fallax*	
Aristida spp.	*Aristida* spp.	

LPU 53. *Aristida–Eragrostis* (Cypress pine) (Qld)
The pastures are of poor quality with an overstorey of Cypress pine (*Callitris columellaris*) often associated with bull oak (*Casuarina leuhmannii*). They occur in the central and southern part of the region.

Bothriochloa decipiens
Cymbopogon refractus
Chrysopogon fallax
Aristida spp.
Eragrostis lacunaria
Panicum effusum

Chrysopogon fallax
Bothriochloa decipiens
Chloris spp.
Aristida spp.
Eragrostis spp.

***Aristida* spp.**
Eragrostis spp.

LPU 54. *Bothriochloa–Stipa–-Danthonia* (Qld)
This unit occurs in the southern border uplands and shows some influence of the temperate pasture land to the south. The soils are shallow, dense and loamy on 'traprock', sandy duplex on granite and sandstone, carrying open eucalypt woodland.

Bothriochloa decipiens
Dichanthium affine
***Chloris* spp.**
***Eragrostis* spp**
***Aristida* spp.**
Stipa scabra
Danthonia spp.
Sporobolus spp.

LPU 55. Kerosene grass (*A. hygrometrica*) (WA/NK)
This unit occurs on deep sandy levee soils of the main upper river systems. It is of limited grazing value due to its rapid maturity and short period of growth.

Aristida hygrometrica
Perotis rara
Aristida holathera
Panicum spp.
Ichnanthus spp.
Brachiaria spp.
Eriachne spp.
Setaria spp.

SEASONAL RIVERINE PLAINS PASTURES*

LPU 56. Channel pastures (Qld)
This unit is found in the irregularly but seasonally flooded channels and flood plains of the great westward-flowing river systems of south-western Queensland. When the floods occur in the warm season, the pastures are predominantly of summer grasses; when the floods occur in the cool season the pastures are predominantly of forbs. The soils are deep grey and brown cracking alluvial clays. A very open stand of river red gum (*Eucalyptus camaldulensis*) and coolibah (*E. microtheca*) occurs along the chanels. The pastures are abundant and of very high quality while they last.

Warm season pastures:
Echinochloa turnerana
Astrebla lappacea
Brachyachne convergens
Chloris pectinata
Chrysopogon fallax
Dactyloctenium radulans
Dichanthium sericeum
Cenchrus ciliaris
Eragrostis spp.
Eulalia fulva
Iseilema membranaceum
I. vaginiflorum
Leptochloa digitata
Panicum decompositum

Cool season pastures:

[Chenopodium cunninghamii]	***[Chenopodium cunninghamii]***	***[Muehlenbeckia cunninghamii]***
[Muehlenbeckia auricomum]	***[Muehlenbeckia auricomum]***	***Sclerolaena* spp.**
Trigonella suavissima	***Trigonella suavissima***	***Eragrostis setifolia***
Atriplex nummularia	*Echinochloa turnerana*	*Eragrostis australasica*
Craspedia pleiocephala	*Iseilema* spp.	*Dactyloctenium radulans*
Echinochloa turnerana	*Eragrostis setifolia*	
Cenchrus ciliaris	*Cenchrus ciliaris*	

LPU 57. *Eragrostis–Eulalia–Cenchrus* (NT/BT)
This unit comprises the river channels and occasionally inundated flood plains of the water courses traversing the region. Also included in this unit is the broken mitchell grass. The soils are grey clays carrying an open woodland of coolibah. The pastures, while being valuable following flooding, do not provide permanent grazing.
Eragrostis eriopoda
Eulalia aurea
Aristida inaequeglumis
Cenchrus ciliaris
Astrebla lappacea
Themeda triandra
Bothriochloa ewartiana
Chrysopogon fallax
Aristida pruinosa

LPU 58. *Eragrostis–Eulalia–Cenchrus* (NT/CA)
This unit includes the riverine channels and flood plains of the ephemeral streams, usually with an open woodland of coolibah (*Eucalyptus microtheca*),and the floodplains of the ephemeral larger river systems, with river red gum (*E. camaldulensis*). The soils range from deep sands to alluvials and shallow grey clays. The pastures are relatively short-lived on the shallower soils but persist for much longer on the deep sands of the larger river systems . They have been severely overgrazed and degraded in the past, but have been considerably regenerated in recent years with buffel grass (*Cenchrus ciliaris*) which is now spreading naturally.

On deep sands:
Eragrostis eriopoda
Themeda avenacea
Triodia basedowii
T. pungens
Plectrachne schinzii
Aristida brownii
Zygochloa paradoxa

On medium textured soils:
Eragrostis eriopoda
Cenchrus ciliaris
Eulalia fulva
Themeda avenacea
T. triandra
Bothriochloa ewartiana
Chrysopogon fallax
Aristida pruinosa
Shortgrasses and forbs

Pastures of *Acacia* spp. open forest and woodland

These vegetation systems grow on highly fertility clay or loamy soils. The native pastures are sparse and unproductive, but clearing or partial clearing enhances native pasture production considerably. Much of these lands have been developed to introduced sown pastures, many on a short to medium term rotation with crop production.

BRIGALOW (*ACACIA HARPOPHYLLA*) PASTURES*

The community extends in an interrupted belt from central Queensland to the southern border, predominantly on cracking clay soils, though duplex and structured earth soils occur throughout. It is divided here into three regions, being northern, central and southern Queensland . The dominant canopy species is brigalow, but it competes with a number of other species and vegetation types.

LPU 59. Northern brigalow (Qld)
The northern part of the brigalow occurs throughout much of subcoastal central Queensland, with widespread brigalow associations such as brigalow–dawson gum, brigalow–yellow wood, brigalow–softwood and brigalow–gidgee.

Bothriochloa bladhii	***Bothriochloa decipiens***	***Aristida* spp.**
B. ewartiana	***Chrysopogon fallax***	***Chloris* spp.**
Dichanthium affine	*Cymbopogon* spp.	*Cynodon dactylon*
D. sericeum	*Eriochloa* spp.	Enneapogon spp.
Eulalia fulva	*Paspalidium* spp.	*Enteropogon acicularis*
Paspalidium spp.	*Chloris* spp.	*Eragrostis* spp.
		Panicum spp.
		Sporobolus spp.
		Dactyloctenium radulans

LPU 60. Central brigalow (Qld)
The most common vegetation type found in the southern part of this region is brigalow–belah–wilga occurring on unconsolidated clay and argillaceous sediments.

Bothriochloa bladhii	***Bothriochloa decipiens***	***Aristida* spp.**
Dichanthium sericeum	***Panicum queenslandicum***	***Chloris* spp.**
D.affine	***Paspalidium* spp.**	***Cynodon dactylon***
Paspalidium spp.	*Cymbopogon* spp.	*Enneapogon* spp.
Ancistrachne uncinulata	*Eriochloa pseudoacrotricha*	*Enteropogon acicularis*
Stipa verticillata	*Chloris* spp.	*Eragrostis* spp.
Chloris spp.		*Panicum* spp.
Diplachne parviflora		*Sporobolus* spp
Leptochloa digitata		*Dactyloctenium radulans*
Stipa setacea		

LPU 61. Southern brigalow and belah (*Casuarina cristata*) (Qld)
The most common vegetation type is brigalow–belah–wilga, but unlike the central region it occurs on level deep gilgaied cracking clays. Composition is mostly as for LPU 60, but *Danthonia linkii* becomes more common, and indicates some temperate zone influence.

GIDGEE (*ACACIA CAMBAGEI*) PASTURES*

This community extends over a comparable, but narrower, belt to brigalow, from the central west to the southern border of Queensland. It is drier than the brigalow region, occurring on cracking clays to loamy surfaced duplexes. The open woodland/shrubland formation allows a better natural pasture understorey than the uncleared brigalow, but much of it has been cleared for improved pastures, with some oversowing of buffel grass.

LPU 62. Central Queensland gidgee (Qld)

Bothriochloa ewartiana	***Bothriochloa decipiens***	***Chloris* spp.**
Dichanthium affine	***Cymbopogon* spp.**	***Enneapogon* spp**
Cenchrus ciliaris	*Paspalidium* spp.	*Enteropogon acicularis*
Astrebla lappacea	*Eriochloa* spp.	*Eragrostis* spp.
Brachyachne convergens	*Cenchrus ciliaris*	*Panicum* spp.
Enneapogon spp.	*Enneapogon* spp.	*Dactyloctenium radulans*
Enteropogon acicularis	*Enteropogon acicularis*	*Sporobolus* spp.
Sporobolus spp		

LPU 63. Western Queensland gidgee (Qld)

This unit occurs mostly on red friable earths, loamy and calcareous earths. It has a similar composition to LPU 62 but without the occurrence of *Astrebla.*

LPU 64. South-west Queenland gidgee (Qld)

Astrebla lappacea	***Chloris pectinata***	***[Sclerolaena* spp.]**
Chloris pectinata	***Eragrostis setifolia***	***[Salsola kali]***
Eragrostis parviflora	*Dactyloctenium radulans*	*Tragus australianus*
E.setifolia	*Enneapogon* spp.	
Eriochloa spp.	*Echinochloa colonum*	
Paspalidium spp.	*Eragrostis cilianensis*	

Grasslands on clay soils

The predominant grasslands in the more favourable rainfall areas are bluegrass (*Dichanthium* spp.) pastures.

QUEENSLAND BLUEGRASS (*DICHANTHIUM SERICEUM*)*

This community occurs on heavy cracking clay soils in a discontinuous belt from central to southern Queensland . In its natural condition, it is a virtually treeless grassland, much of which is now used for permanent crop production or in crop-pasture rotations. It is treated here in two subdivisions of central and southern, the northern part having less winter rain.

LPU 65. Central Queensland bluegrass (Qld)

Dichanthium sericeum	***Dichanthium affine***	***Aristida leptopoda***
***Astrebla* spp.**	***Eriochloa* spp.**	***Aristida latifolia***
Bothriochloa erianthoides	***Paspalidium* spp.**	*Panicum* spp.
Bothriochloa ewartiana	*Iseilema* spp.	*Sporobolus* spp.
Dichanthium queenslandicum	*Enterogogon* spp.	*Chloris* spp.
Thellungia spp.		*Eragrostis* spp.

LPU 66. Southern Queensland bluegrass (Qld)

Dichanthium sericeum
Bothriochloa erianthoides
Themeda avenacea
Astrebla spp.
Paspalidium globoideum
Stipa aristiglumis
Agropyrum scabrum
Danthonia spp.

Dichanthium affine
Bothriochloa decipiens
***Paspalidium* spp.**
Chloris spp.
Enteropogon spp.

***Chloris* spp.**
Aristida leptopoda
Sporobolus spp.
Eragrostis spp.
Panicum spp.

BLUEGRASS–BROWNTOP (*DICHANTHIUM FECUNDUM–EULALIA FULVA*)*

This community is widespread in the tropical north of Australia. It occurs mainly on alluvial grey cracking clay soils in the wetter (>500 mm median annual rainfall) part of the semi-arid areas. The pastures are of medium quality but much better than most other pastures available.

LPU 67. Tropical bluegrass-browntop (Qld)

Occurring on the alluvial grey cracking clays of the extensive Gulf river flood plains.

Dichanthium fecundum
Eulalia fulva
Astrebla elymoides
Astrebla squarrosa
Sorghum australiense
Chrysopogon fallax
Iseilema spp.

Aristida latifolia
Eulalia fulva
***Iseilema* spp.**
Astrebla elymoides
Astrebla squarrosa
Dichanthium fecundum

Cyperus bifax
Brachyachne convergens
Pennisetum basedowii
Sporobolus virginicus
Iseilema spp.

LPU 68. Bluegrass–golden beardgrass (NT/VRD)

Occurring largely on grey cracking clays of the riverine plains of the Victoria and Ord Rivers.

Dichanthium sericeum* ssp. *polystachyum
D. fecundum
Sorghum plumosum
***Sorghum* spp.**
Eulalia fulva
Ophiuros exaltatus
Astrebla squarrosa
Panicum spp.
Aristida latifolia
Chrysopogon spp.
Themeda triandra
Sehima nervosum
Arundinella nepalensis
Short grasses and forbs

LPU 69. Bluegrass–golden beardgrass (NT/G)
Occurring on narrow riverine plains of the Gulf river systems. Soils range from gravelly yellow earths and grey cracking clays to sands with bluegrass or ribbongrass dominance.
***Dichanthium* spp.**
Chrysopogon fallax
Iseilema vaginiflorum
Brachyachne convergens
Astrebla squarrosa

LPU 70. Bluegrass (WA/EK)
Composition approximately as for LPU 68.

LPU 71. Bluegrass (WA/NK)
Occurring on grey cracking clays on restricted riverine plains in the south of the region.
Dichanthium fecundum
D. sericeum
D. sericeum* ssp. *polystachyum
D. annulatum
Bothriochloa ewartiana
B. bladhii
Brachyachne convergens
Panicum decompositum
Eragrostis japonica
Paspalidium spp.
Brachiaria spp.
Eriachne glauca
Elytrophorus spicatus
Iseilema spp.

Grasslands on clay soils – tussock grassland pastures

MITCHELL GRASS (*ASTREBLA* SPP.)*

This is the largest productive pasture community in Queensland, and the Northern Territory and almost the largest in Western Australia; it occurs largely in the semi-arid region as treeless open grassland. It is almost exclusive to the heavy cracking clay soils and represents a very resilient pasture system, withstanding prolonged heavy grazing and recovering well in good years. The pastures are of moderate quality and highly regarded by graziers.

LPU 72. Rolling downs mitchell grass, northern (Qld)

Astrebla lappacea	***Astrebla* spp.**	***[Amaranthus mitchellii]***
A. elymoides	***Aristida latifolia***	***Dactyloctenium radulans***
A. squarrosa	***Iseilema* spp.**	***Panicum* spp.**
A. pectinata	***Brachyachne convergens***	*[Ipomoea* spp.]
Bothriochloa spp.	*[Boerhavia diffusa]*	*[Portulaca oleracea]*
Shortgrasses and forbs	*[Salsola kali]*	*[Salsola kali]*

LPU 73. Rolling downs mitchell grass, southern (Qld)

***Astrebla* spp.**	***Astrebla* spp.**	***Aristida latifolia***
Dichanthium sericeum	***Aristida latifolia***	***A. leptopoda***
Eulalia fulva	***Panicum* spp.**	***Panicum* spp.**
***Iseilema* spp.**	***Sporobolus* spp.**	[Sclerolaena spp.]
Dactyloctenium radulans	*Dactyloctenium radulans*	*[Salsola kali]*
Shortgrasses and forbs		

LPU 74. Southern flooded alluvial plains (Qld)

On the cracking clay soils of the floodplain of the southern and south-western Darling river systems.

Astrebla lappacea	***Astrebla lappacea***	***Aristida* spp.**
Dichanthium sericeum	***Iseilema* spp.**	***Panicum* spp.**
***Paspalidium* spp.**	***Chloris* spp.**	***Dactyloctenium radulans***
Eulalia fulva	*Thellungia advena*	*[Sclerolaena* spp.]
Cyperus spp.	*Eriochloa* spp.	*[Salsola kali]*
	Aristida latifolia	
	[Salsola kali]	

LPU 75. Plains mitchell grass (NT/VRD)

On extensive black soil plains in the eastern and south-eastern part of the region.

Astrebla pectinata
A. squarrosa
A. elymoides
Dichanthium fecundum
Aristida latifolia
Chrysopogon fallax
Themeda avenacea
Sorghum spp.
Iseilema spp.
Echinochloa colonum
Eragrostis japonica
Brachyachne convergens
Shortgrasses and forbs

LPU 76. Plains mitchell grass (NT/BT)

Astrebla pectinata
A. squarrosa
A. elymoides
Aristida latifolia
Panicum whitei
P. decompositum
Eragrostis xerophila
Iseilema spp.
Brachyachne convergens
Dactyloctenium radulans

LPU 77. Plains mitchell grass (NT/CA)
An extensive area occurs in the eastern part of the region at the foot of the Barkly Tableland. Otherwise scattered areas widely dispersed in the central part.
Astrebla pectinata
***Iseilema* spp.**
Dactyloctenium radulans
Tripogon loliiformis
Eragrostis setifolia
E. xerophila
[Helipterum charsleyea]
[H. floribundum]
[Sclerolaena bicornis]
[S. lanicuspis]

LPU 78. Mitchell grass plains (WA/EK)
This unit occurs in the south east part of the region as a continuation of LPU 84.
Astrebla pectinata
A. squarrosa
A. elymoides
Dichanthium fecundum
Aristida latifolia
Chrysopogon fallax
Themeda triandra
T. avenacea
Iseilema spp.
Shortgrasses and forbs

LPU 79. Black soil plains (WA/WK)
Found extensively in the eastern Fitzroy basin and extending north-west in the Meda and May River basins.

Astrebla pectinata
A. elymoides
Chrysopogon fallax
Dichanthium fecundum
***Dichanthium* spp.**
Panicum decompositum
Sorghum plumosum
Eulalia fulva
Aristida latifolia
A. squarrosa
Iseilema spp.

Astrebla squarrosa
Astrebla pectinata
Iseilema vaginiflorum
I. macrantherum
Brachyachne convergens
Dactyloctenium radulans
Sporobolus spp.
Echinochloa colonum
Sorghum australiensis
S. timorense

Aristida latifolia
***Iseilema* spp.**
Astrebla pectinata
A. squarrosa
Chrysopogon fallax
Brachyachne convergens
Sorghum australiense
Eriachne sulcarte
E. glauca
Setaria dielsii

LPU 80. Chichester Range basaltics (WA/PIL)
Occurring on islands of cracking clay soils of basaltic origin on the Chichester and Hammersley Ranges of the Pilbara. There are a few patches of snakewood (*Acacia xiphophylla*) as overstorey.
Astrebla pectinata
A. elymoides
Eragrostis xerophila
Annual grasses and forbs

LPU 81. Mitchell grass stony downs (Qld)
This is a typical gibber plain type of habitat. The pastures are relatively poor and sparse for much of the time.

***Astrebla* spp.**	***Astrebla pectinata***	***Chloris pectinata***
***Iseilema* spp.**	***Dactyloctenium radulans***	***Tragus australianus***
Dactyloctenium radulans	*Sclerolaena* spp.	*[Euphorbia* spp.]
Brachyachne convergens	*[Ptilotus* spp.]	*[Salsola kali]*
Panicum spp.	*[Salsola kali]*	
	[Neobassia proceriflora]	

LPU 82. Mitchell grass ashy downs (Qld)
This is named from the extremely self-mulching grey clay which forms a dry bog or ash heap surfaces. Occurring in the south-west Diamantina region, it is a much less productive unit than the plains mitchell.

Astrebla elymoides	***Astrebla pectinata***	***Dactyloctenium radulans***
A. pectinata	***Dactyloctenium radulans***	***[Salsola kali]***
***Iseilema* spp.**	*Panicum* spp.	
Eragrostis spp.	*[Salsola kali]*	
	[Boerhavia diffusa]	

LPU 83. Dry-bog mitchell grass (NT/BT)
This is the same sub-community as ashy downs and the composition is essentially as for LPU 82. It occurs in the centre of the north-western part of the Barkly Tableland.

LPU 84. Mitchell grass–other grasses (NT/VRD)
Astrebla pectinata
A. squarrosa
A. elymoides
Dichanthium fecundum
D. annulatum
Panicum whitei
P. decompositum
Chrysopogon fallax
Aristida latifolia
Iseilema spp.
Shortgrasses and forbs

LPU 85. Inferior mitchell grass (NT/G)
This unit occurs along the southern inland margin of the Gulf region. The terrain is variable, steeply to gently undulating country with cracking clays on the moderate to gentle lower slopes, complexing with acid yellow earths. The pastures are also variable in their dominant species, with a greater proportion of the less palatable, coarse tallgrasses. They occur as open grasslands to open coolibah woodlands.
Astrebla squarrosa
Dichanthium fecundum
Chrysopogon fallax
Bothriochloa ewartiana
B. bladhii
Panicum spp.
Ophiuros exaltatus
Aristida latifolia
Eulalia fulva
Arundinella nepalensis

LPU 86. Inferior mitchell grass (NT/BT)
This unit is widespread in the northern and north-western Barkly Tableland, fringing the extensive plains mitchell grass. It is mostly restricted to heavy clay soils developed on alluvia, basic sediments or volcanics receiving > 550 mm rainfall. The topography is flat to undulating, carrying treeless grassland or open woodland of coolibah, *Bauhinia cunninghamii, Acacia bidwillii* or *Terminalia* spp.
Astrebla squarrosa
Dichanthium fecundum
D. superciliatum
Bothriochloa ewartiana
***B. intermedia* (syn. *bladhii*)**
Ophiuros exaltatus
Panicum spp.
Chrysopogon fallax
Aristida latifolia
Eulalia fulva
Arundinella nepalensis
Sehima nervosum
Sorghum spp. (annual)

LPU 87. Mitchell grass–gidgee (NT/BT)
In the eastern border parts of the mitchell grass area it is found in association with an open woodland of Georgina gidgee. This provides some shade in an otherwise treeless landscape, and some top feed at times of the year when the gidgee foliage is not toxic.
Astrebla pectinata
Dactyloctenium radulans
Tripogon loliiformis
Eragrostis setifolia

LPU 88. Mitchell grass–gidgee (NT/CA)
This unit is found in the north-eastern part of the region and is essentially a continuation to the south of LPU 87. The pasture composition is similar. It merges with the *Eragrostis xerophila* (neverfail) sub-community in open gidgee woodlands. In good seasons, *Iseilema* spp. may occur commonly along with the forbs *Helipterum charsleyae* and *H. floribundum.*

LPU 89. Clayey stony slopes (NT/CA)
This is a relatively small unit comprising scattered occurrences at the foot of low hills and mesas. It consists of stony, pebbly surfaces overlying medium, stony red clays with scattered fuchsia bushes (*Eremophila* spp.). It is of fairly low productivity and without topfeed.
Astrebla pectinata
[Sclerolaena spp.]
Ephemeral annual shortgrasses and forbs

Spinifex hummock grasslands

SPINIFEX (*TRIODIA, PLECTRACHNE* SPP.)*

The Curly spinifex (*Plectrachne pungens*) community occurs largely in the northern part of the Northern Territory and through the wetter parts of the Kimberley. The soils are generally shallow, skeletal or sandy, and usually associated with a low open eucalypt woodland. The pastures are coarse and of very low quality. Some burning may be carried every few years to encourage young regrowth of the spinifex, but particularly to encourage the growth of associated grasses and forbs which have reasonable palatability.

LPU 90. Curly spinifex, Darwin region (NT/D)
Largely found in the Arnhem Land region and thus alienated from pastoral use because of National Park or Aboriginal Trust land. Mostly rugged escarpment country with a mosiac of shallow rocky to stony soils and deeper sandy soils. Spinifex predominates on the former, and annual sorghum on the latter.
Plectrachne pungens
***Sorghum* spp. (annual)**

LPU 91. Curly spinifex, Gulf region (NT/G)
Near to the coast, curly spinifex is associated with an open woodland of eucalypt and teatree. Further inland to the south, it is associated with bloodwood and stringybark open woodland on sandy soils.
Plectrachne pungens
Schizachyrium fragile
Eriachne spp.
Aristida spp.
Chrysopogon fallax
Heteropogon contortus
Sorghum stipoideum

LPU 92. Curly spinifex (NT/BT)
Curly spinifex occurs in the rugged country in the north-east of the region and in the central south below the mitchell grass on sandy or gravelly soils. The vegetation is generally low open woodland of bloodwood or stringybark.
Plectrachne pungens
Eriachne spp.
Chrysopogon fallax
Aristida spp.
Schizachyrium fragile
Eulalia aurea
Eragrostis spp.
Heteropogon contortus

LPU 93. Curly spinifex (WA/EK)
A large part of the western half of the region is rugged with skeletal sandy soils carrying curly spinifex. The vegetation is low open or sparse bloodwood and stringybark woodland.
Plectrachne pungens
Sorghum spp. (annual)
Aristida hygrometrica
A. holathera
Thaumastochloa sp.
Schizachyrium sp.
Setaria spp.
Ichnanthus spp.
Eriachne spp.

LPU 94. Curly spinifex (WA/NK)
This is the predominant pasture type of the north Kimberley region. The soils are mainly sands or coarse-textured podzolics on steep to gently sloping sandstones and shales. The vegetation is eucalypt open forests to woodlands of messmate or woollybutt. The vegetation is substantially that of LPU 93.

LPU 95. Curly spinifex (WA/WK)
This pasture type occurs widely throughout the northern and eastern parts of the region but is of isolated occurrence elsewhere. Because of the greater mosaic of pasture types throughout the region, curly spinifex also complexes with other communities. The topography ranges from rocky and steep to rounded and undulating. The soils are usually yellowish or red, gravelly sands and loams derived from sandstones, shales or quartzite. Burning is frequently carried out on a 4–5 year rotation to provide green pick and encourage other interstitial grasses.

Plectrachne pungens
Sorghum australiensis
Chrysopogon fallax
Triodia intermedia
T. pungens
Themeda triandra
Dichanthium spp.
Eulalia fulva
Brachiaria holosericea
Eriachne obtusa

Plectrachne pungens
Eriachne obtusa
Cymbopogon bombycinus
Eriachne sulcata
Triodia spp.
Sorghum stipoideum
Aristida inaequiglumis
A. latifolia
A. hydrometrica

Aristida inaequeglumis
Plectrachne pungens
Aristida latifolia
A. holathera
A. hygrometrica
Eriachne obtusa

LPU 96. Curly spinifex–ribbongrass (WA/WK)
The Pindan pasture region is characterised by red and yellow sandy soils carrying a low scrubby woodland with an open tree canopy of bloodwood, bauhinia and ironwood and a tall shrub layer of wattle. It is the major pasture type of the sand plain and dune fields in the western part of the region. It is often managed by periodic burning.

Plectrachne pungens
Chrysopogon fallax
Sorghum plumosum
Sorghum stipoideum
Triodia pungens
Sehima nervosum
Eragrostis eriopoda
Eriachne obtusa

Plectrachne pungens
Eragrostis eriopoda
Eriachne obtusa
Sorghum stipoideum
Panicum cymbiforme
Chrysopogon fallax

Aristida holathera
A. inaequiglumis
Sorghum stipoideum
Aristida hygrometrica
Plectrachne pungens
Eriachne obtusa
Eragrostis eriopoda

LPU 97. Curly spinifex–annual sorghum (WA/NK)
This is a widespread pasture system in the eastern and western sectors of the region on rugged sandstone with sandy skeletal soils. It is all within the monsoon zone, but largely inaccessible for grazing. The vegetation is eucalypt open forest and woodland.
Plectrachne pungens
Sorghum australiense
S. stipoideum
Eriachne spp.
Schizachyrium spp.

Curly/soft spinifex (*Plectrachne* spp., *Triodia pungens*)
This co-dominance of curly and soft spinifex grasses is more characteristic of the Northern Territory than of the other states. The communities are variable with respect to their relative proportions of the species.

LPU 98. Curly/soft spinifex (NT/VRD)
This pasture type occurs in the southern part of the region on deep red and yellow sandy soils and red and yellow gravelly earths. It is virtually unused for grazing.
Plectrachne schinzii
Triodia pungens
P. pungens
Aristida pruinosa
A. holathera
Chrysopogon fallax
Eulalia aurea
Sehima nervosum
Eragrostis eriopoda
Eriachne spp.
Enneapogon spp.

LPU 99. Curly-soft spinifex (NT/BT)
This unit occurs mostly on sandy red earths and some deep sands to the north, south and west of the mitchell grass area. It is mostly unused for pasture.
Plectrachne pungens
Triodia pungens
Chrysopogon fallax
Eulalia aurea
Sehima nervosum
Aristida holathera
Aristida spp.
Eragrostis eriopoda
Eragrostis spp.
Eriachne spp.
Enneapogon spp.

LPU 100. Curly/soft spinifex (NT/CA)
This unit occurs mainly across the northern part of the region. In the east, it is associated with shallow calcareous gravelly loams with acacia tall sparse shrubland, while in the western part with

red earthy sand plains. Scattered patches of inland teatree also occur.
Plectrachne schinzii
Triodia pungens
P. pungens
Eragrostis eriopoda
Eragrostis spp.
Aristida holathera
Eriachne spp.
Panicum spp.

Soft spinifex *(Triodia pungens)*
This is the largest spinifex community in Queensland, moderate in area in the Northern Terrirtory and smallest in Western Australia.

LPU 101. Soft spinifex, north-west (Qld)
The unit occurs in the Mt Isa highlands on a fairly wide range of shallow, gravelly sands, loams and earths. Frontages to drainage lines have high phosphate loams and carry naturalised *Cenchrus pennisetiformis* (Cloncurry buffel grass). Neighbouring LPUs with intrusions of these drainage lines carry similar grass communities (See Mitchell grass, LPU 72)

Triodia pungens	***Enneapogon polyphyllus***	***Tragus australianus***
Enneapogon polyphyllus	*Triodia pungens*	*Aristida* spp.
Aristida spp.	*Aristida* spp.	*Schizachyrium fragile*
(Cenchrus pennisetiformis)		
Triodia pungens		

LPU 102. Soft spinifex, eastern-central (Qld)
This is the easternmost significant occurrence of soft spinifex in Queensland. The predominant soils are sandy red and yellow earths associated with a low, open eucalypt woodland. A much higher level of utilisation of the spinifex pastures occurs because of relatively productive pastures surrounding the area. Reduction of tree density and periodic burning are two management inputs which have placed pressure on the sustainability of the system.

Triodia pungens	***Cymbopogon refractus***	***Aristida* spp.**
T. mitchellii	*Triodia mitchellii*	*Enneapogon* spp.
Cleistochloa subjuncea	*T. pungens*	
Heteropogon contortus	*Aristida* spp.	

LPU 103. Soft spinifex plains (NT/VRD)
This unit is widespread in the southern part of the region. The soils are predominantly loamy or sandy neutral red earths carrying low open woodland of snappy gum. The pastures are little used.
Triodia pungens
T. spicata
Aristida pruinosa
A. holathera
Chrysopogon fallax
Annual shortgrass and forbs

LPU 104. Soft spinifex plains (NT/G)
This unit was not mapped because of very limited distribution. It is an extension of LPU 101.

LPU 105. Soft spinifex plains (NT/BT)
This unit occurs extensively in the lower part of the region below the mitchell grass area on gently undulating plains. The soils are mainly red earths which are sandy or with calcareous gravels at the surface. The vegetation is a low open eucalypt bloodwood woodland.
Triodia pungens
Eulalia aurea
Enneapogon polyphyllus
Eragrostis eriopoda
Aristida spp.
Enneapogon spp.

LPU 106. Soft spinifex plains (NT/CA)
This unit is of relatively minor occurrence in the north of region. Its composition is approximately that given for LPU 103 with the exception of ribbongrass.

LPU 107. Soft spinifex plains (WA/EK)
This unit occurs in the south-east corner of the region where it forms a continuation of LPU 103 from the Victorian River District of the Northern Territory.

LPU 108. Soft spinifex (WA/WK)
The soft spinifex pasture lands are found throughout the southern portion of the Fitzroy River catchment in the west Kimberely. The soils are mainly deep reddish sands and loams with finer textures near the active flood plains. It occurs as an open grassland or very open grassy woodland of eucalypt bloodwood, beefwood or *Bauhinia* sp. Because of the diversity of pasture types of different production capabilities in the area, the utilisation of this pasture unit may be more intensive than normally expected.

Triodia pungens	***Eragrostis eriopoda***	***Aristida holathera***
Chrysopogon fallax	***Triodia pungens***	***A. inaequiglumis***
Plectrachne pungens	*Xerochloa barbata*	***Eriachne obtusa***
Enneapogon polyphyllus	*Panicum cymbiforme*	*E. glauca*
Eragrostis eriopoda	*Aristida* spp.	*A. hygrometrica*
Eriachne obtusa	*Eriachne obtusa*	*Triodia pungens*

Hard spinifex (*Triodia intermedia, Triodia* spp.)
Hard spinifex applies to a number of species of which *T. intermedia* is the most common. It occurs mostly in sand plains and dunefields in the more arid environments.

LPU 109. Hard spinifex, western dunefields (Qld)
This unit occurs in the south-western corner of Queensland on dunefields of siliceous sands between interdune corridors of grey clays. Feral animals such as horses, camels and donkeys impose an unmanaged grazing element on these lands.

Triodia basedowii	***Triodia basedowii***	***Triodia basedowii***
Zygochloa paradoxa	*Aristida* spp.	
Eriachne aristidea	*Zygochloa paradoxa*	
[*Calotis* spp.]	[*Helipterum* spp.]	
[*Crotalaria* spp.]	[*Calotis* spp.]	
[*Helipterum* spp.]		

LPU 110. Hard spinifex, western acacia-eucalypt (Qld)
This unit occurs in the central west of Queensland. The predominant soils are shallow loams associated with an open woodland of acacia and eucalypt. The area is largely surrounded and broken by mitchell grass pasture lands, and therefore is utilised more heavily than its natural capability would indicate.
Triodia molesta
T. longiceps
T. burkensis
T. pungens
Enneapogon polyphyllus
Eragrostis eriopoda
Tripogon loliiformis
Aristida contorta
A. holathera
Digitaria brownii

LPU 111. Hard spinifex sandplains (NT/VRD)
Common on shallow stony soils and outcrop areas, particularly on basic rocks in the drier rainfall central western part of the region. The vegetation is a sparse woodland of scattered trees and shrubs of eucalypt bloodwood and snappy gum. The pasture land varies in its dominant species of hard spinifex which may be *T. basedowii, T. intermedia, T. wiseana* var. *wiseana, T. brizoides, T. roscida, T. fitzgeraldii,* or *T. inutilis.*
Triodia basedowii
***Triodia* spp.**
Plectrachne pungens
Chrysopogon fallax

LPU 112. Hard spinifex sandplains (NT/BT)
This is a relatively restricted unit occurring on red clayey sands to sandy red earths associated with a tall sparse mallee shrubland.
Triodia basedowii

LPU 113. Hard spinifex sandplains (NT/CA)
This is the most extensive pasture unit in the region, but it is of very little value, even in times of drought. Periodic burning enables some more useful grasses to develop and provides some feed. The associated vegetation is usually an open shrubland of acacias and eucalypts.
Triodia basedowii
Plectrachne schinzii

LPU 114. Hard spinifex dunefields (NT/BT)
There is only a small amount of this unit in the Barkly region. Although it is considered a hard spinifex community, there is a higher proportion of *Plectrachne schinzii* than in the more southern dunefield areas.
Triodia basedowii
Plectrachne schinzii

LPU 115. Hard spinifex dunefields (NT/CA)
There is a very large area of these dunefields but most is excluded from the pastoral zone as it is Aboriginal Trust Land.
Triodia basedowii

LPU 116. Hard spinifex, Pilbara (WA/PIL)
This unit occurs as a shrubby hummock grassland with scattered shrubs of *Acacia inaequilatera, A. bivenosa, A. translucens* and *Corchorus walcottii.*
Triodia wiseana
T. angusta
T. lanigera

LPU 117. Hard spinifex, east Kimberley (WA/EK)
This unit is a continuation of LPU 111 of the Victorian River District of the Northern Territory.

LPU 118. Lobed spinifex (WA/WK)
This unit is widespread in the southern, southeastern and eastern sections of the region with <500 mm of rainfall. The topography ranges from flat plains to rugged sandstone country with predominantly skeletal soils of red-brown sandy loams and loamy clays. The tree and shrub layer is poorly developed and sparse, comprising snappy gum, conkerberry, beefwood or acacias.

Triodia intermedia	***Eriachne obtusa***	***Triodia intermedia***
T. pungens	***Triodia intermedia***	
T. wiseana	*Eragrostis eriopoda*	
Chrysopogon fallax	*Chrysopogon fallax*	
Eulalia fulva	*Sehima nervosum*	
Brachiaria holosericea		
Sehima nervosum		
Eriachne obtusa		
Eragrostis eriopoda		

LPU 119. Limestone spinifex (NT/VRD)
A small area of limestone spinifex occurs on shallow, gravelly, sandy loam soils on rocky limestone rises in the Victoria River District. It is usually associated with a low open woodland of nutwood (*Terminalia arostrata*).
Triodia wiseana

LPU 120. Limestone spinifex (WA/WK)
This unit is confined to the central section of the west Kimberley region where calcareous soils occur on gently sloping interfluves to rocky hills and plateaux with poor soil development. A sparse or open woodland of bloodwood is characteristic. The pastoral value is very low, with coarse, very tall, and very pungent tussocks. Where the soils are slightly better developed, more palatable species occur.

Triodia wiseana	***Triodia wiseana***	***Triodia wiseana***
Chrysopogon fallax	*Eragrostis eriopoda*	*Eriachne obtusa*
Dichanthium fecundum	*Eriachne obtusa*	*Enneapogon polyphyllus*
Sehima nervosa	*Enneapogon polyphyllus*	
Eragrostis eriopoda	*Brachyachne convergens*	
Eriachne obtusa		
Enneapogon polyphyllus		

LPU 121. Hard spinifex (NT/CA)
Occurring on small hills of quartzite or sandstone dispersed through the region.
***Triodia* spp.**

Hard/soft spinifex (*Triodia basedowii, T.* spp., *T. pungens*)
This community comprises species of both hard and soft spinifex throughout the arid parts of Central Australia and the eastern Pilbara.

LPU 122. Hard/soft spinifex (NT/CA)
This is a fairly large unit located in the central southern part of the region. It occurs on sandplains and rises of earthy sands and red siliceous sands associated with tall sparse shrubland of blue mallee (*Eucalyptus gamophylla*) and *Acacia* spp.
Triodia basedowii
T. pungens
Eragrostis eriopoda
Aristida contorta
Sclerolaena spp.

LPU 123. Hard/soft spinifex, Pilbara (WA/PIL)
This larger unit occurs as a shrubby hummock grassland with scattered shrubs of *Acacia inaequilatera, A. bivenosa, A. translucens* and *Corchorus walcottii.*
Triodia wiseana
T. pungens
T. angusta

SHORTGRASS PASTURE LANDS

Perennial shortgrass pastures

Pastures with top-feed – *Acacia* spp. woodland/shrubland
There is an important division to be made within the shortgrass pasture—those with and those without top-feed. Pastures with top-feed are those carrying edible woody species which provides additional feed resilience to the system as a dry season and drought fodder reserve.

MULGA (*ACACIA ANEURA*) – PERENNIAL SHORTGRASS*

LPU 124. Soft and hard mulga pastures (Qld)
This large unit occurring in the central south-west of Queensland is associated with mulga open forests, low woodlands or tall open shrublands on extensive red earth plains. The soils are fragile and, once exposed, are subject to erosion. Mulga is an important top-feed, used extensively in late dry season and in drought feeding. If not used wisely, this can lead to overgrazing the pasture lands, and an increase in woody weeds.

***Digitaria* spp.**	***Digitaria* spp.**	***Aristida* spp.**
Monachather paradoxa	*Eriachne helmsii*	*Amphipogon caricinus*
Thyridolepis mitchelliana	*Aristida* spp.	*Tripogon loliiformis*
Themeda triandra	*Eragrostis eriopoda*	*Eragrostis eriopoda*
Eriachne helmsii	*Thyridolepis mitchelliana*	*[Sida* spp.]
Aristida spp.	*Amphipogon caricinus*	
Eragrostis eriopoda		

LPU 125. Mulga on residuals (Qld)
The mulga and bastard mulga pastures on dissected residuals are interspersed with mitchell grass and spinifex pasture lands. The mulga is more of a shrubland in form on shallower red earth to shallow loamy soils of poorer fertility.

Digitaria ammophila	***Eriachne mucronata***	***Eriachne mucronata***
Eriachne mucronata	***Aristida* spp.**	***Aristida* spp.**
E. pulchella	*[Ptilotus* spp.]	*[Eremophila latrobei]*
Neurachne munroi	*[Sclerolaena* spp.]	*[Dodonaea* spp.*]*
Aristida spp.	*[Chenopodium rhadinostachyum]*	*[Cassia sturtii]*

LPU 126. Mulga shrubland (NT/CA)
This unit occurs as moderately dense to dense stands of mulga on red earth plains. The understorey is a mixed perennial and annual grass pasture, with the perennials dominant. Although less productive, it provides better drought reserve feed along with the top feed. *Sclerolaena cornishiana* is an undesirable invader in poor condition rangeland.
Eragrostis eriopoda
Aristida inaequiglumis
Monochather paradoxa
Enneapogon spp.
[Sclerolaena spp. (seasonally)]
A. contorta

LPU 127. Mixed *Acacia* – other genera woodland (NT/CA)
This is a mixture of various top-feed woody genera consisting of *Acacia, Atalaya, Ventilago* at different levels of dominence in an open woodland. The unit occurs widely on alluvial plains at the base of ranges and hills.
Digitaria coenicola
Enteropogon acicularis
Aristida contorta
Enneapogon spp.
Eragrostis eriopoda
Aristida holathera

GEORGINA GIDGEE (*ACACIA GEORGINAE*) SHORTGRASS*

LPU 128. Georgina gidgee pastures (Qld)
This unit occurs in the western border region of Queensland and is contiguous with that of Central Australia. Georgina gidgee is seasonally poisonous to stock as a top-feed, particularly late in the dry season. The soils are sandy to loamy plains usually associated with dolomitic or calcareous parent materials.

Astrebla pectinata	***Aristida latifolia***	***Dactyloctenium radulans***
Iseilema vaginiflorum	*Astrebla pectinata*	*Aristida* spp.
Dichanthium affine	*Eragrostis setifolia*	
Eragrostis setifolia		
Enneapogon spp.		
A. elymoides		
Aristida latifolia		

LPU 129. Georgina gidgee (NT/CA)
Pastures of this unit occur on sandy plains and gently undulating shallow gravelly loam soils on limestone and dolomitic country in the eastern and southern-central part of the region. Georgina gidgee top feed is known to be seasonally poisonous to livestock in the late dry season. The vegetation is woodland to shrubland with the pasture a mixture of perennial and annual grasses and forbs.
Eragrostis setifolia
Tripogon loliiformis
Fimbristylis dichotoma
Dactyloctenium radulans
Enteropogon spp.
Aristida contorta
Enneapogon spp.
[Salsola kali]
[Helipterum pterodhaetum]
[Maireana aphylla]

Pastures without top-feed
Such pastures are a less reliable dry season and drought feed resource. However, with perennial pastures this is a less serious drawback than with annual pastures.

LPU 130. Tussock grass–soft spinifex (WA/PIL)

This unit combines two fairly distinct broad communities making up the sub-coastal pasture lands of the Pilbara. In the north of the region, sub-unit (a) is a tussock grassland of perennial shortgrass (Roebourne plains grass), without trees and only a few shrubs. In the southern part of the region, sub-unit (b) is a shrubby hummock grassland of soft spinifex and some ribbongrass, the shrub layer comprising *Acacia inaequilatera, A. pyrifolia* and *A. ancistrocarpa*, and occasional small trees of *Eucalyptus dichromophloia* and *Hakea suberea.* The naturalisation of *Cenchrus ciliaris* has added considerably to the value and stability of these pastures.

(a) Tussock grassland:	(b) Shrubby grassland:
Eragrostis xerophila	***Triodia pungens***
Eriachne benthamii	*Chrysopogon fallax*
Cenchrus ciliaris	

SALTWATER COUCH PASTURES (*SPOROBOLUS VIRGINICUS*)*

Mostly these are developed on coastal saline flats of loams or grey plastic clays.

LPU 131. Littoral (Qld)
Occurring discontinuously along the east coast and extensively in the southern Gulf of Carpentaria.
Sporobolus virginicus
Paspalum distichum
Hemarthria uncinatata
Leersia hexandra
Stenotaphrum secundatum

LPU 132. Coastal country, Darwin (NT/D)
This unit occurs mostly along the north-west coastal area on loams and saline clays of the saline tidal flats. It merges into fringing saltpans with samphire or mangrove on the one hand, and the seasonally flooded lowland pastures (LPU 1) on the other.
Sporobolus virginicus
Xerochloa imberbis
[Halosarcia spp.*]*

LPU 133. Coastal country (NT/VRD)
Also called saline shortgrass, it occurs mostly on the treeless coastal plains of the Victorian River District with occasional trees of *Excoecaria parviflora, Pandanus* sp. or *Grevillea striata* or mangrove.
Sporobolus virginicus
Brachyachne imberbis
Dactyloctenium radulans
[Salsola kali]
[Neptunia sp.]
Fimbristylis spp.

LPU 134. Coastal country (NT/G)
The littoral zone of the Gulf of Carpentaria in Queensland is continuous with that of the Northern Territory. Mostly it occurs on the saline plastic grey clays of the littoral strip.
Sporobolus virginicus

LPU 135. Littoral (WA/WK)
This unit occurs on bare saline mud flats of yellowish sands or loamy alluvials over a tough grey clay, and is frequently flooded by the tides. It merges with the samphire flats and mangrove communities. Usually it is adjacent to the Pindan pastures in the western part of the region. The useful pasture lands are on the sand covered margins which are elevated above the tidal effects and which merge into the Pindan.

Xerochloa barbata	***Eriachne obtusa***	***Eriachne obtusa***
Sporobolus virginicus	***Xerochloa barbata***	***Xerochloa laniflora***
Diplachne fusca	*Sporobolus virginicus*	***E. glauca***
Eragrostis falcata	*Xerochloa laniflora*	
Chrysopogon fallax	*Eriachne glauca*	
Dichanthium fecundum	*Diplachne fusca*	
Eriachne obtusa		

LPU 136. Littoral (WA/EK)
This unit, also called saline shortgrass, is of very limited occurrence in the east Kimberley region and, since it is a continuation of that in the Victorian River District of the Northern Territory, the information given for LPU 133 should be appropriate.

LPU 137. Littoral (WA/NK)
There is only a very small area of this unit in the northern Kimberley region, most of which is inaccessible.
Sporobolus virginicus

Annual shortgrass–forb pastures

Pastures with top-feed – *Acacia* spp. woodland/shrubland
The presence of top-feed in annual shortgrass pastures is especially important in extending the dry season feed value of the resource. However, if managed unwisely, it can quickly lead to degradation through the loss of the more desirable species.

MULGA (*ACACIA ANEURA*) – ANNUAL SHORTGRASS*

LPU 138. Mulga whitewood (Qld)
This unit occurs in the south-west of Queensland as a mulga–whitewood *(Atalaya hemiglauca)* low, open woodland. The soils are predominantly red earthy sands, siliceous sands and sandy red earths on flat or gently undulating plains.

Eragrostis eriopoda	***Eragrostis* spp.**	***Aristida contorta***
Enneapogon avenaceus	*Dactyloctenium radulans*	*[Ptilotus polystachyus]*
Dactyloctenium radulans	*Aristida contorta*	*[Salsola kali]*
Aristida contorta	*[Ptilotus polystachyus]*	*[Cassia desolata]*
Eragrostis spp.	*[Salsola kali]*	*[Dodonaea attenuata]*
Aristida spp.	*Aristida* spp.	*[Eremophila duttonii]*
Eriachne spp.		
[Ptilotus polystachyus]		

LPU 139. Mulga shrubland (NT/CA)
This unit occurs on stable red earth soils on flat or undulating country. The annual grass–forb pastures are very palatable and stock do well on them; however there is little carryover dry season feed other than topfeed. The grasses predominate following summer rain whereas forbs may dominate with winter rain. *Sclerolaena cornishiana* indicates poor condition.
***Enneapogon* spp.**
Aristida contorta
[Helipterum floribundum]
Dactyloctenium radulans
[Sclerolaena spp.]

LPU 140. Mulga shrubland (WA/PIL)
This unit is a tall mulga shrubland with a woody understory of *Cassia* and *Eremophila* spp. and a few low palatable shrubs (*Ptilotus* spp.).
Aristida contorta
Other grasses and forbs in season

LPU 141. Mixed *Acacia* spp. on low hills (NT/CA)
This widely dispersed unit is associated with hills comprising granitic and metamorphic rock. The shrub layer carries edible, mostly *Acacia* species. The pasture is a typical annual grass–forb type.
***Enneapogon* spp.**
***Aristida* spp.**
Dactyloctenium radulans
Eriachne spp.
Sporobolus spp.

LPU 142. *Eremophila–Cassia* low shrubland (WA/PIL)
This unit is found on calcareous loamy soils in the central Ashburton area. This is a low shrubland with unpalatable *Eremophila cuneifolia, E. freelingii, Cassia leurssenii, C. desolata* and *Eremophila* spp. and some palatable *Acacia aneura* and *A. tetragonophylla.* The pasture is a rather sparse, annual grass–forb type.
Aristida contorta
Other grasses and forbs in season

Pastures without top-feed
Where annual pastures are without top-feed their value for pasturage is very short-lived, even though they may have a good nutritional level for that period. Adequate seed bank of the desirable species is allowed to fall each year.

ANNUAL SHORT GRASSLAND – LOW OPEN WOODLAND*

LPU 143. Northern calcareous pastures (NT/VRD)
This unit, also referred to as arid shortgrass, occurs mainly in the central Victoria River basin where it is rather diffusely distributed on calcareous loamy soils. The pastures are very sweet and often selectively grazed by livestock, often being very severely degraded by overgrazing. Much of this pasture is now recovering. The pastures are sometimes an open grassland, but more usually associated with a bloodwood–southern box woodland.
***Enneapogon* spp.**
Aristida contorta
Sporobolus australasicus
Tragus australianus
Chloris scariosa
[Sida fibulifera]
[Portulaca oleracea]
[Cleome viscosa]

LPU 144. Southern calcareous pastures (NT/CA)
This unit, also called southern calcareous shrubby grassland, is associated with calcareous, generally loamy soils, usually with scattered witchetty bush (*Acacia kempeana*). Mostly it occurs in the southern part of the region. The pastures are soft or sweet and are therefore selectively grazed, which can place them at risk of overgrazing if not carefully managed and periodically spelled. Witchetty bush has also declined. Rabbits are a further problem, both from their grazing and their burrowing.
***Enneapogon* spp.**
Aristida contorta
[Sclerolaena spp.]
[Sida spp.]

LPU 145. Shortgrass grassland (WA/EK)
This unit, also called arid shortgrass, is essentially the same as that for the Victorian River District of the Northern Territory. (See LPU 143.)

LPU 146. Shortgrass grassland–ribbongrass (WA/WK)
This unit is widespread in the southeastern and central part of the region, occurring on nearly flat alluvials to undulating slopes of the interfluves. The soils are variable from skeletal reddish sands to deeper red to yellow sands or sandy loams over clay. The vegetation is a low, open eucalypt woodland.

Enneapogon polyphyllus	***Enneapogon polyphyllus***	***Aristida contorta***
Aristida contorta	***Aristida contorta***	***Enneapogon polyphyllus***
Chrysopogon fallax	*Aristida inaequiglumis*	*A. inaequiglumis*
Dactyloctenium radulans	*Sporobulus australasicus*	*Sporobolus australasicus*
Brachyachne convergens	*Brachyachne convergens*	
Eriachne obtusa	*Eriachne obtusa*	
Sehima nervosum	*Heteropogon contortus*	
Eulalia fulva		
Dichanthium sp.		

LPU 147. Shortgrass–curly spinifex (WA/WK)
This unit occurs mostly in the southeast part of the region where it is associated with sandy and gravelly skeletal soils. It is a very open eucalypt woodland with annual shortgrass associated with curly spinifex rather than ribbongrass.

Enneapogon polypyllus	***Plectrachne pungens***	***Plectrachne pungens***
Aristida contorta	***Enneapogon polyphyllus***	***Aristida* spp.**
Plectrachne pungens	*Eriachne obtusa*	*Ennaepogon polyphyllus*
Sporobolus australasicus	*Aristida contorta*	
Dactyloctenium radulans	*Dactyloctenium radulans*	
Aristida spp.	*Aristida* spp.	
Chrysopogon fallax		
Eriachne obtusa		

SHRUB PASTURE LANDS

Chenopod shrublands – pastures mostly of top-feed

CHENOPOD SHRUBLAND PASTURES*

LPU 148. Southern bluebush (NT/CA)
(a) Southern bluebush (*Maireana astrotricha*), also known as chenopod shrubland, is found dispersed in pockets over much of the country in the southern half of the region. Towards the South Australian border, there are some areas of (b) bladder saltbush (*Atriplex vesicaria*). These shrubs are only lightly grazed, most grazing being confined to the forbs and few grasses growing amongst the shrubs. This unit is often found in association with mulga, witchetty bush, georgina gidgee and myall.

(a) Southern bluebush:	(b) Bladder saltbush:
Maireana astrotricha	***Atriplex vesicaria***
Enneapogon cylindrica	***Astrebla pectinata***
***[Maireana* spp.]**	
[Salsola kali]	
Eriachne spp.	
Eragrostis spp.	
Aristida spp.	
[Sclerolaena spp.]	

LPU 149. Northern bluebush (NT/VRD)
This small unit is a low open shrubland with ephemeral grassland understorey, occurring mainly in the south-west of the region on drainage depressions or swamps subject to shallow seasonal or periodic flooding. The soils are usually heavy clay and the shrub layer dominated by bluebush (*Chenopodium auricomum*), which also provides good top-feed.
Chenopodium auricomum
Panicum whitei
Astrebla elymoides
Eriachne spp.
Astrebla spp.
Iseilema spp.

LPU 150. Northern bluebush (NT/BT)
On the Barkly Tableland, this unit combines the two sub-communities, both of which are low open shrublands, denoted by (a) the presence of an open coolibah woodland, or (b) absence of coolibah. As the former, it occurs largely as a single area within the north-western sector of the mitchell grass plains, while, as the latter, in a scatter of small islands, mostly around the perimeter of the former. Both systems occur on grey to yellow-grey cracking clays, though the coolibah system is characterised by having red earth or calcareous rises. The pastures are seasonally very attractive for livestock, but because of the ephemeral nature of the pastures, care in management is needed during the pasture regeneration period after rain.

(a) Coolibah present:	(b) Coolibah absent:
Chenopodium auricomum	***Chenopodium auricomum***
Zygochloa paradoxa	***Panicum whitei***
Eulalia aurea	***Astrebla elymoides***
Dichanthium fecundum	*Eriachne* spp.
Aristida latifolia	*Astrebla* spp.
Panicum spp.	*Iseilema* spp.

LPU 151. Saltbush–bluebush samphire (WA/PIL)
This is a rather variable and minor unit. Along parts of the Fortescue River Valley, largely on plastic clay soils, it has a samphire (*Halosarcia* spp.) low shrubland with some *Atriplex bunburyana*. In the southwest of the region, mostly on duplex soils of hard setting loams over red clayey subsoils, it has a Gascoyne bluebush (*Maireana polypterygia*) low shrubland with saltbush and a scattered overstorey of snakewood (*Acacia xiphophylla*) Sparse seasonal grasses occur.
***Halosarica* spp.**
Atriplex bunburyana
Maireana polypterygia
Maireana spp.
Sclerolaena spp.
Ephemeral grasses and forbs

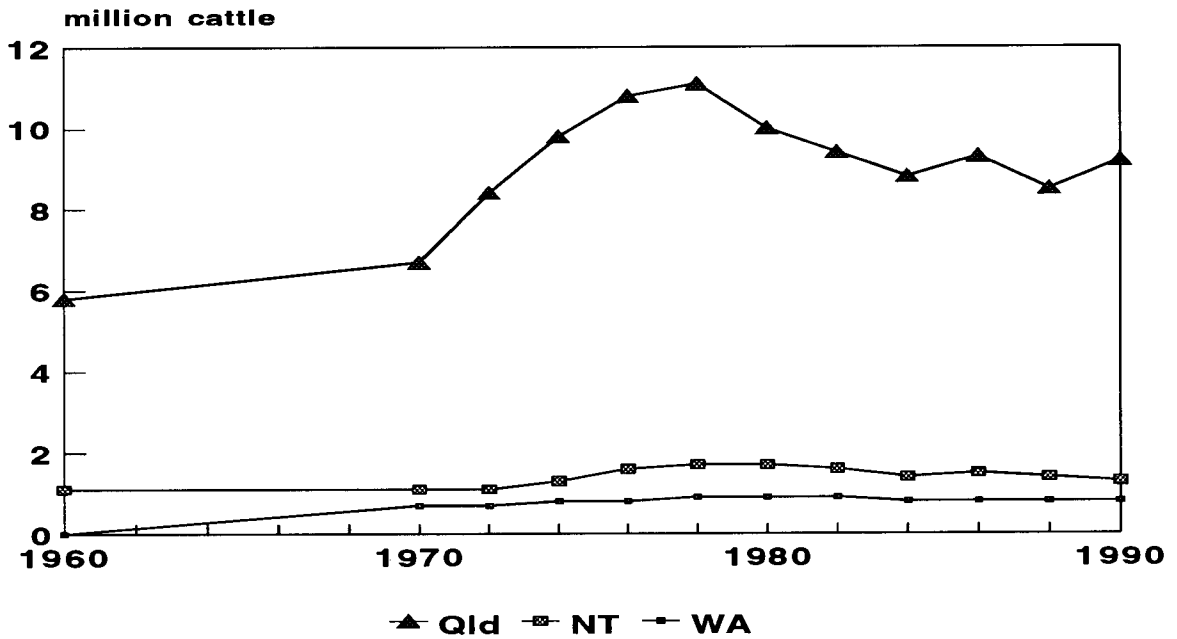
Name changes

There have been numerous changes to botanical names in recent years. Recent changes to names in this appendix include:

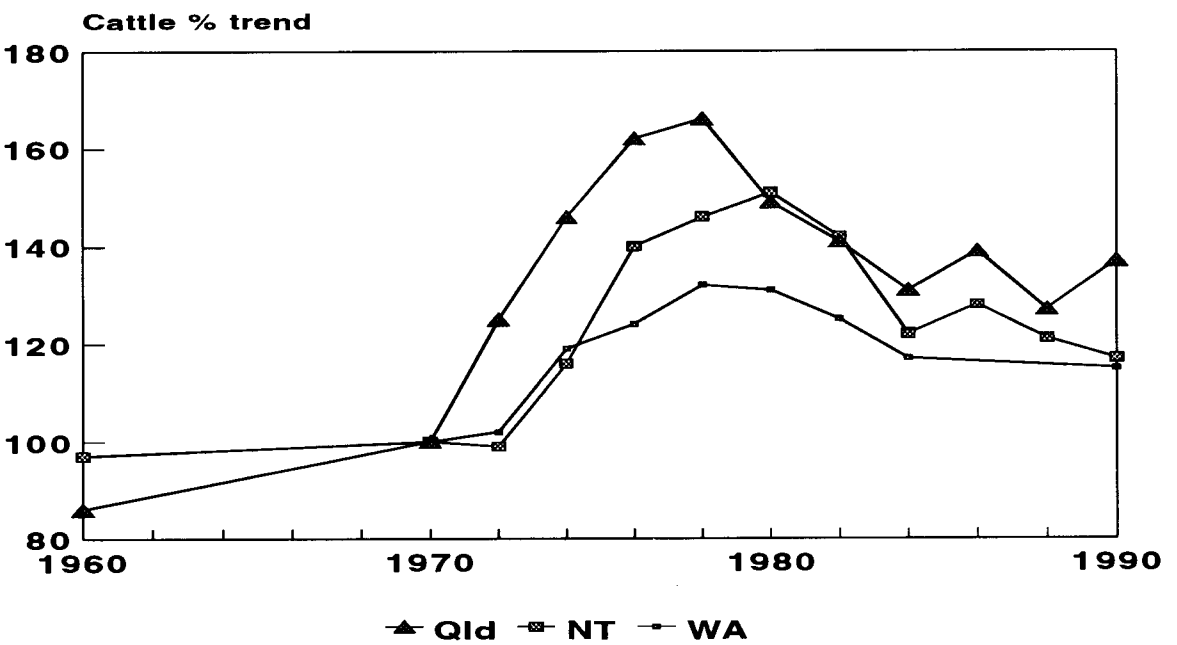
Old name	New name
Aristida arenaria	*Aristida contorta*
Aristida armata	*Aristida calycina*
Aristida browniana	*Aristida holathera*
Chloris scariosa	*Oxychloris scariosa*
Coelorhachis rottboellioides	*Mnesithea rottboellioides*
Dichanthium affine	*Dichanthium sericeum* subsp. *sericeum*
Digitaria decumbens	*Digitaria eriantha* subsp. *pentzii*
Echinochloa colonum	*Echinochloa colona*
Echinochloa turnerana	*Echinochloa turneriana*
Eulalia fulva	*Eulalia aurea*
Monachatha paradoxa	*Monachatha paradoxus*
Sorghum australiense	*Sorghum timorense*
Themeda australis	*Themeda triandra*

Appendix 2 Livestock statistics and pasture condition

Figure 1 Changes in beef cattle populations in northern Australia (1960-1990 for Queensland and Northern Territory, 1970-1990 for Western Australia)

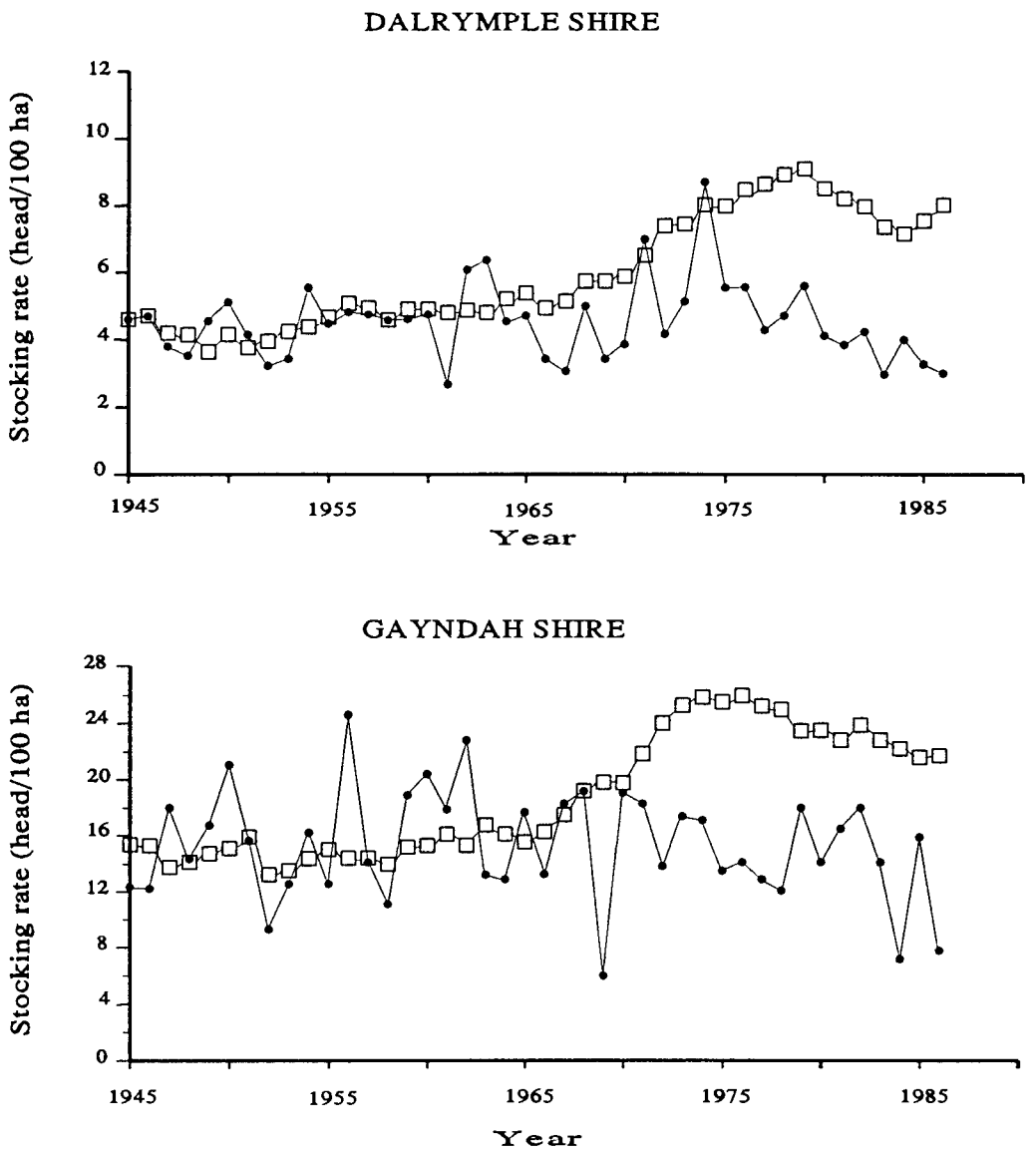


1a Cattle populations



1b Relative changes in cattle populations – using 1970 as a base

Figure 2 Potential (•) and actual (□) stocking rates in Dalrymple shire (northern black speargrass) and Gayndah shire (southern black speargrass) 1945-1986. (See explanatory notes below)



Comparison of potential and actual stocking rates between 1945 and 1986 in the shires of Dalrymple (Pressland and McKeon 1989) and Gayndah (McKeon and Orr, unpublished data).

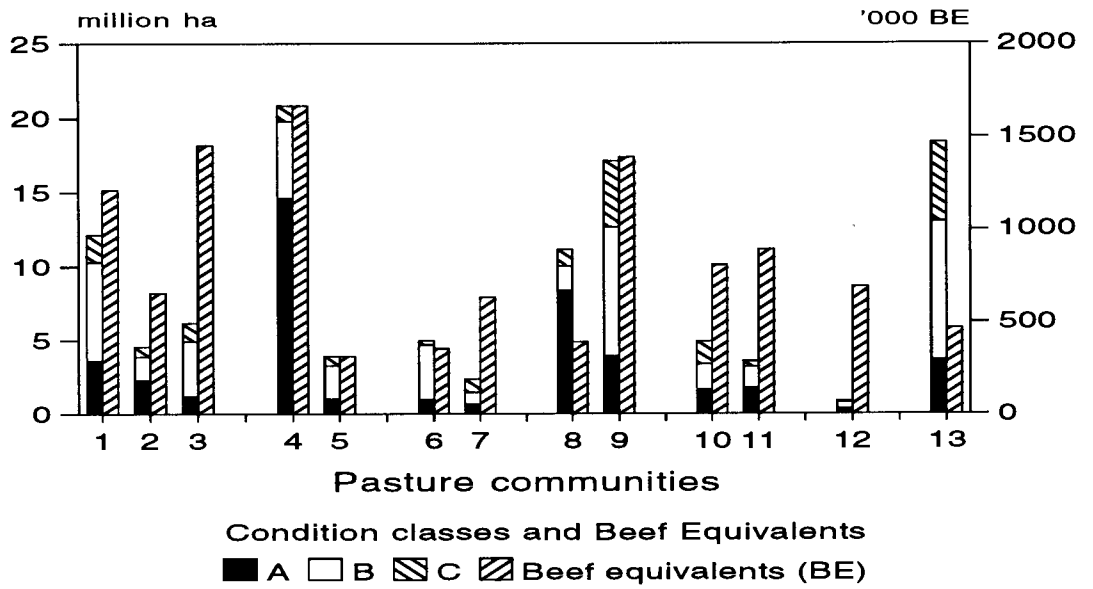
Potential stocking rate = summer pasture growth (kg/ha Dec-May) x safe (30%) utilisation ÷
animal intake for 6 months (1800 kg/Adult Equivalent dm) x Shire Index (to account fo effect of trees and other land uses).

Pasture growth was calculated using the GRASP model with data from Springmount and Brian Pastures Research Station, Gayndah.

Shire Indices were calculated for 1945-1963 (a period of pasture stability) as the ratio of the actual shire stocking rates to the calculated safe stocking rate for cleared pasture; actual shire stocking rates were calculated as the ratio of total number ofbeef cattle to the shire areas.

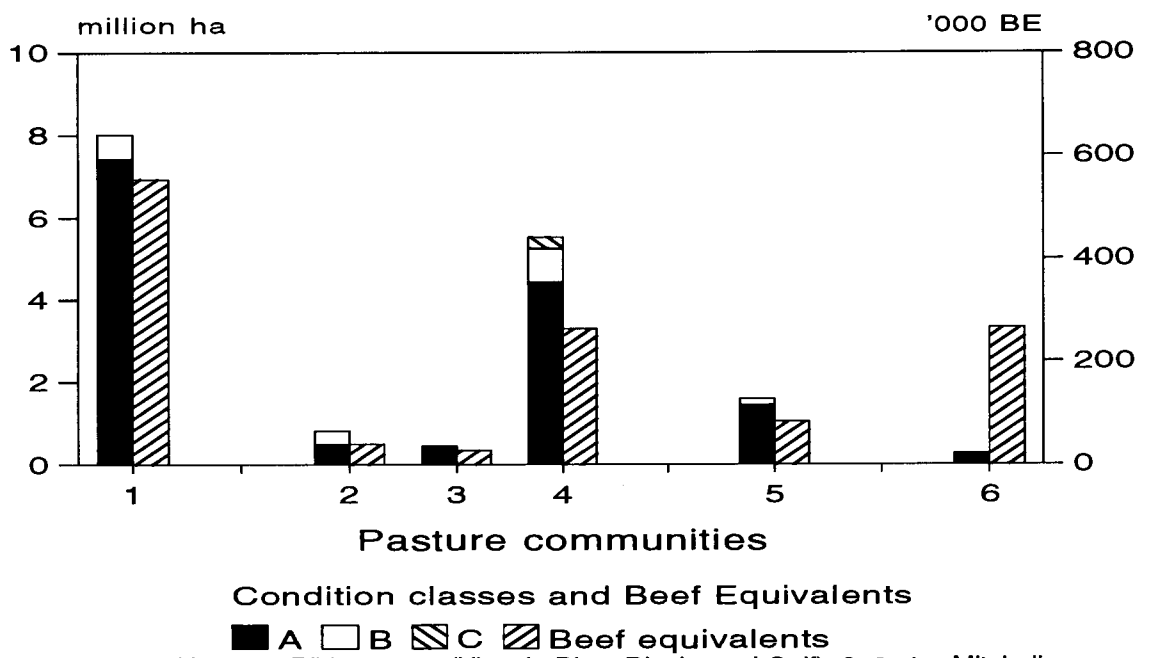
Figure 3 Condition and productive capability of northern Australian pasture lands

3a Queensland



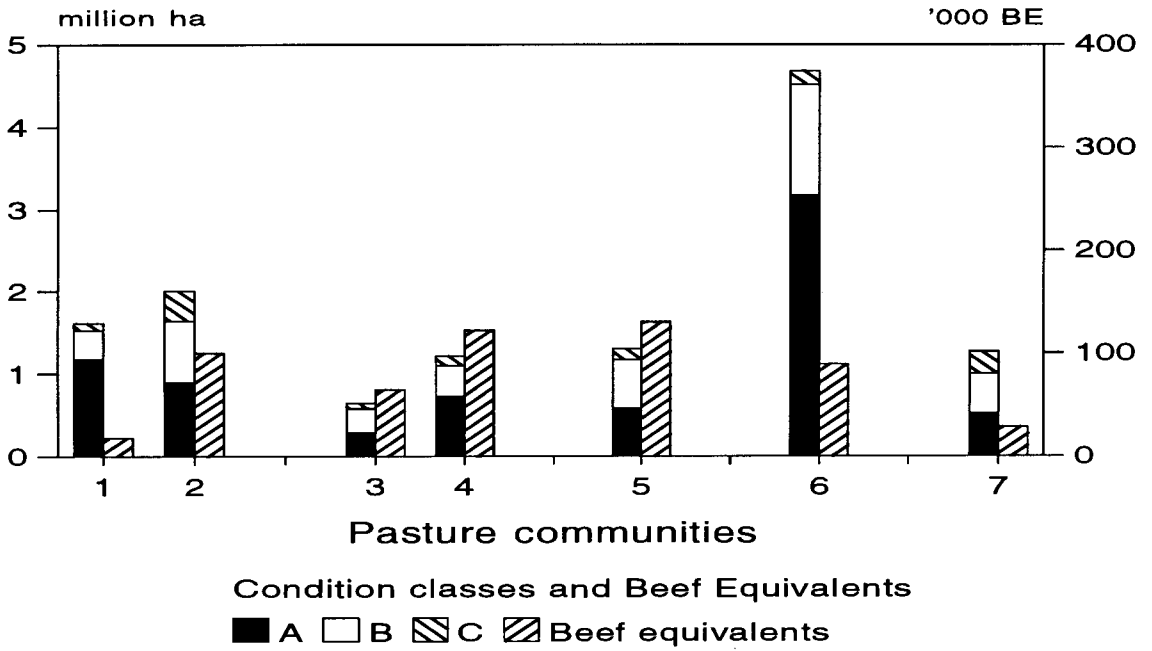
Pasture communities: 1, 2, 3 = Black spear grass (northern, central, southern); 4, 5 = Mitchell grass (northern, southern); 6, 7 = Tropical bluegrass-browntop, Qld bluegrass; 8, 9 = *Aristida-Bothriochloa* (northern, southern); 10, 11 = Brigalow (northern, southern); 12 = Rainforest-derived; 13 = Mulga.

3b Northern Territory (northern part)



Pasture communities: 1 = Ribbongrass (Victoria River District and Gulf); 2, 3, 4 = Mitchell grass (other spp. VRD, plains VRD, Barkly); 5 = Bluegrass-browntop (VRD and Gulf); 6 = Ricegrass-*Hymenachne* (Darwin).

3c Western Australia



Pasture communities: 1, 2 = Ribbongrass (monsoonal, tropical); 3, 4 = Mitchell grass (East Kimberley, West Kimberley); 5 = Shortgrass-tussock (Pilbara); 6 = Annual sorghum; 7 = Annual shortgrass

Appendix 3 Basic pasture condition data

Table 5 Basic pasture condition data

5a Condition assessment data for Queensland

Pasture community / Shire or region	Soil type	% of community	Condition (%) A	B	C
Rainforest-derived pastures					
Albert, Beaudesert, and Gympie district shires		22	30	50	20
Pioneer	Earths		30	50	20
Proserpine	Duplex (f)		20	60	20
	Earths	18	30	50	20
Mirani	Clays		5	50	45
	Duplex (c)		5	50	45
	Duplex (f)		5	55	40
	Earths		40	55	5
Douglas, Mulgrave Eacham		60	50	50	0
Littoral – saltwater couch					
Gulf and Peninsula coasts		90	90	5	5
Townsville south		10	70	20	10
Heathlands	not assessed				
Blady grass					
Bowen and north		40	10	70	20
Livingstone	Clays		80	10	10
	Duplex (c)	7.5	60	20	20
	Duplex (f)		70	15	15
Sarina	Clays		25	65	10
	Duplex (c)	4	30	50	20
	Duplex (f)		40	45	15
Mirani Shire	Clays		5	55	40
	Duplex (c)	2.5	5	35	60
	Duplex (f)		30	55	15
Pioneer	Clays		5	55	40
	Duplex (c)	5	5	35	60
	Duplex (f)		30	55	15
	Earths		40	55	5
Proserpine	Clays		5	55	40
	Duplex (c)	6	5	20	75
	Duplex (f)		5	25	70
	Earths		40	55	5
Miriam Vale and south		35	10	75	15
Black speargrass (southern)					
Gayndah, Eidsvold, Mundubbera, Monto, Biggenden, Kilkivan, Kingaroy, Nanango, *et al.*	Clays		60	35	5
	Duplex (c)	11.6	10	85	5
	Duplex (f)		5	80	15
	Alluvial		20	40	40
Boonah			25	65	10
Moreton			30	50	20
Esk		8.1	40	50	10
Gatton, Laidley			15	55	30
Kilcoy			25	60	15

5a Queensland continued						
Pasture community		Soil type	% of community	Condition (%)		
	Shire or region			A	B	C
	Miriam Vale, Woocoo, Tiaro, Widgee, Isis, Perry, Kolan, *et al.*		7.3	10	65	25
Black speargrass (central)						
	Calliope	Clays		85	5	10
		Duplex (c)	2.7	45	45	10
		Duplex (f)		65	25	10
		Alluvial		85	5	10
	Fitzroy	Clays		85	10	5
		Duplex (c)	2.5	65	20	15
		Duplex (f)		80	10	10
		Alluvial		65	25	10
	Mt. Morgan	Clays		30	30	40
		Duplex (c)	0.3	40	40	20
		Duplex (f)		50	40	10
	Livingstone	Clays		50	35	15
		Duplex (c)		40	50	10
		Duplex (f)	5.3	50	40	10
		Earths		40	40	20
		Alluvial		50	20	30
	Broadsound	Clays		30	40	30
		Duplex (c)	2.7	40	35	25
		Duplex (f)		45	35	20
	Banana	Clays		40	40	20
		Duplex (c)		40	40	20
		Duplex (f)	2.5	50	30	20
		Earths		20	60	20
		Alluvial		30	40	30
	Nebo	Duplex (c)		30	50	20
		Duplex (f)	2.1	40	45	15
		Earths		5	35	60
	Sarina	Clays		25	65	10
		Duplex (c)	0.5	30	50	20
		Duplex (f)		40	45	15
	Mirani	Clays	1 .0	25	65	10
		Duplex (c)		30	50	20
		Duplex (f)		40	45	15
		Earths		40	50	10
	Pioneer	Duplex (c)		30	50	20
		Duplex (f)	0.3	40	45	15
		Earths		40	50	10
	Proserpine	Duplex (c)	0.2	30	50	20
		Duplex (f)		40	45	15
		Earths		40	50	10
Black speargrass (northern)						
	Etheridge, Mareeba		20	15	70	15
	Herberton		4	70	25	5
	Dalrymple	Sands	3.9	30	60	10
		Loams, clays, brown duplex	2.6	50	30	20
		Earths	7.8	20	50	30
		Red duplex	3.9	40	40	20
		Yellow, grey duplex	5.2	35	40	25
		Basaltics	2.6	60	30	10

5a Queensland continued						
Pasture community		**Soil type**	**% of community**	**Condition (%)**		
	Shire or region			**A**	**B**	**C**
	Bowen coastal		3	10	80	10
	Ayr coastal			10	80	10
	Thuringowa			10	70	20
Queensland bluegrass (central)						
	Bauhina	Clays Alluvials	16.2	20 10	40 30	40 60
	Emerald	Clays	4.8	10	60	30
	Belyando	Clays	24	10	10	80
	Peak Downs	Clays	12	5	45	50
	Nebo	Clays	3	15	25	60
Queensland bluegrass (southern)						
	Darling Downs	Plains Uplands	12 28	70 40	25 50	5 10
Brigalow (northern)						
	Bowen, Dalrymple	Uncleared Cleared	5.6	40 25	55 75	5 0
	Nebo	Clays Duplex (c) Duplex (f)		20 10 30	40 55 40	40 35 30
	Belyando	Clays Duplex (c) Duplex (f) Alluvials	3.6	10 15 15 5	20 25 30 25	70 60 55 70
	Broadsound	Clays Duplex (f) Alluvial	5.6	30 40 10	40 35 30	30 25 60
	Peak Downs	Clays Duplex (f)	1.6	20 10	75 50	5 40
	Emerald	Clays Duplex (c)		30 5	65 55	5 40
	Duaringa	Clays Duplex(c) Duplex (f) Alluvial	6	35 30 35 10	40 55 30 20	25 15 35 70
	Bauhinia	Clays Duplex (c) Duplex (f)	8	35 30 30	35 20 20	30 50 50
	Banana	Clays Duplex (f) Alluvial	8	60 55 40	35 30 45	5 15 15
	Fitzroy	Clays Duplex (f)	1.6	75 75	20 20	5 5
	Livingstone	Clays Duplex (f)		55 55	35 35	10 10
Brigalow (central)						
	Booringa, Bungil, Warroo, Bendemere	Clays	20	30	35	35

5a Queensland continued

Pasture community / Shire or region	Soil type	% of community	Condition(%) A	B	C
Brigalow–belah (southern)					
Taroom		12	60	35	5
Murilla, Chinchilla and south		28	45	45	10
Aristida – Chrysopogon					
Western slopes, Einasleigh and Paper barked teatree		100	75	15	10
Aristida – Triodia					
Not assessed					
Aristida					
Broadsound, Duaringa, Bauhinia, Emerald Booringa, Bungil		70	25	55	20
Taroom		30	40	30	30
Aristida – Thyridolepis					
Booringa, Murweh, Warroo		40	10	40	50
Balonne, Waggamba		60	25	55	20
Bothriochloa – Chloris – Aristida					
Dalrymple, Bowen	Sands Earths Yellow duplex	12	45 25 40	45 60 50	10 15 10
Broadsound	Duplex (c) Duplex (f) Earths	7.7	35 55 20	50 35 60	15 10 20
Duaringa	Duplex (c) Duplex (f) Earths Alluvial	11.2	25 20 15 50	45 60 45 35	30 20 40 15
Bauhinia	Clays Duplex (c) Duplex (f) Earths	10.5	10 20 20 10	40 40 50 30	50 40 30 60
Emerald	Duplex (c) Duplex (f) Earths Alluvials	9.1	15 5 10 5	50 50 30 25	35 45 60 70
Belyando	Duplex (c) Duplex (f) Earths Alluvials	14	15 5 15 5	50 50 50 55	35 45 35 40
Jericho	Duplex (c) Duplex (f) Earths	7.7	10 10 15	50 50 55	40 40 30

5a Queensland continued						
Pasture community		**Soil type**	**% of community**	**Condition (%)**		
	Shire or region			**A**	**B**	**C**
	Peak Downs	Duplex (c) Duplex (f) Earths	5.6	15 5 10	50 50 40	35 45 50
	Nebo	Duplex (c) Duplex (f) Earths Alluvials	4.2	10 10 10 5	60 50 40 35	30 40 50 60
	Southern Queensland	Clay, box Duplex, box Duplex, alluvial	4.3 6.5 7.2	35 20 20	60 40 50	5 40 30
Aristida - Eragrostis (Cypress – bull oak)						
	Roma	Sandy, skeletal	35	25	55	20
	Taroom, Chinchilla, Murilla, Wambo, Tara, Millmeran, Inglewood		65	60	30	10
Bothriochloa – Stipa – Danthonia						
	Rosenthal, Inglewood, Stanthorpe	Traprock Granite Sandstone	40 20 40	25 60 20	60 30 70	15 10 10
Gidgee (Central Queensland)						
	Flinders	Clays	35	20	50	30
	Aramac, Belyando	Clays Alluvial		20 5	35 20	45 75
	Blackall, Barcaldine, Tambo		10	30	50	20
Gidgee (South-west Queensland)						
	Quilpie, Paroo west		15	20	20	60
	Paroo east, Balonne		10	5	50	45
Gidgee (Western Queensland)						
	Cloncurry, Boulia	Clays Duplex Alluvial Skeletal	30	70 60 60 70	20 20 20 20	10 20 20 10
Georgina gidgee						
	Boulia	Clays Desert loams Alluvial	100	70 70 50	20 20 35	10 10 15
Soft and hard mulga						
	Charleville		100	20	60	20
Mulga on residuals						
	Charleville		100	20	40	40
Mulga – whitewood						
	Charleville		100	20	40	40

5a Queensland continued						
Pasture community		**Soil type**	**% of community**	**Condition (%)**		
Shire or region				**A**	**B**	**C**
Mitchell grass on rolling downs						
	Julia Creek, Winton		55	70	25	5
	Winton, Blackall		32	70	25	5
	Blackall, Augathella		10	25	60	15
	Maranoa	Downs	3	40	50	10
		Clay, alluvial		40	50	10
Mitchell grass on southern alluvials						
	Paroo		60	34	33	33
	Balonne, Waggamba		40	20	65	15
Mitchell grass on stony downs						
	Charleville		100	30	50	20
Mitchell grass on ashy downs						
	Charleville		100	30	50	20
Spinifex						
	Dalrymple, Flinders	Earths	10	50	30	20
		Yellow duplex		40	40	20
	Belyando	Earths	2.5	60	20	20
	Jerico	Earths	12.5	65	20	15
	North-west Qld, Mt.Isa	Skeletal	40	80	15	5
		Earths		70	20	10
		Brown		70	20	10
		Alluvial		50	35	15
	West Qld, Charleville		35	20	60	20
Channel Pastures						
	West Qld, Charleville		100	40	40	20
Bluegrass – browntop						
	Burke, Carpentaria, Cloncurry, McKinlay		100	20	75	5
Schizachyrium						
	Tropical plains and low hills		50	20	70	10
	Northern flooded alluvial plains		50	30	50	20
Native sorghum (perennial)						
	Cook		100	90	5	5

5b Condition assessment data for Western Australia

Pasture community / Region	Land System	Area sq. km	Condition % A	B	C
Littoral					
North Kimberley	Carpentaria	700	100	0	0
East Kimberley	Carpentaria	2 700	100	0	0
	Legune	100	100	0	0
West Kimberley	Carpentaria	960	45	30	25
	Roebuck	390	60	30	10
Cockatoo grass					
North Kimberley	Pago	2 045	80	20	0
Perrennial sorghum					
North Kimberley	Foster	285	80	20	0
Annual sorghum					
North Kimberley	Barton	1 035	80	20	0
	Napier	6 565	80	20	0
	Pago	2 045	80	20	0
	Buldiva	20 720	80	20	0
East Kimberley	Pinkerton	7 500	60	30	10
	Weaber	700	90	10	0
	Antrim	2 425	35	55	10
	Cockatoo	3 400	20	70	10
	Macphee	900	45	50	5
	Napier	455	60	30	10
	Angellari	650	70	25	5
	Cockburn	390	30	50	20
Whitegrass					
North Kimberley	Barton	4 145	80	20	0
	Kennedy	1 245	80	20	0
	Isdell	250	80	20	0
	Napier	3 535	80	20	0
East Kimberley	Napier	245	60	30	10
Whitegrass – annual sorghum					
West Kimberley	Forrest	830	60	30	10
	Looingnin	2 775	95	5	0
Whitegrass – Sorghum – *Themeda* – *Chrysopogon*					
East Kimberley	Dinnabung	1 000	5	50	45
	Franklin	110	40	50	10
	Frayne	765	50	35	15
Whitegrass – bundle-bundle					
West Kimberley	Cowendyne	925	60	20	20
	Looingnin	1 370	60	30	10
Tropical bluegrass					
North Kimberley	Isdell	165	60	40	0
East Kimberley	Ivanhoe	1 300	15	45	40
Three-awn speargrass					
East Kimberley	Buchanan	1 200	95	5	0

5b Western Australia continued

Pasture community / Region	Land system	Area sq. km	Condition (%) A	B	C
Kerosene grass					
North Kimberley	Karunjie	1 865	60	30	10
Ribbongrass – high rainfall					
West Kimberley	Calwynyardah	1 140	50	25	25
	Egan	1 554	40	50	10
	Gladstone	78	50	40	10
	Sisters	1 120	60	30	10
Ribbongrass – monsoon					
North Kimberley	Kennedy	1 245	60	30	10
Ribbongrass					
East Kimberley	Richenda	1 800	55	30	15
Ribbongrass – curly/soft spinifex					
West Kimberley	Coonangoody	2 072	25	60	15
	Luluigui	583	40	50	10
	Mamilu	798	65	35	0
	Myroodah	1 970	10	65	25
	Richenda	1 630	65	25	10
	Yeeda	2 210	85	10	5
	Lowangan	78	90	10	0
	Mandeville	78	90	10	0
	Tarraji	156	70	20	10
Frontage grass					
West Kimberley	Amy	725	40	20	40
	Djada	2 155	20	30	50
	Glenroy	560	40	30	30
	Gogo	1 336	20	40	40
Mulga shrubland					
Pilbara	Red clay	26 250	50	40	10
Eremophila – Cassia shrubland					
Pilbara	Stony skeletal	26 250	90	10	0
Acacia – Atriplex shrubland					
Pilbara	Alluvial	13 000	40	50	10
Shortgrass – ribbongrass					
West Kimberley	O'Donnell	1 088	40	40	20
Shortgrass – curly spinifex					
West Kimberley	Bohemia	310	40	20	40
	Burramundi	310	60	30	10
	Koongie	1 368	20	30	50
	Margaret	130	40	45	15
	Pigeon	2 390	40	40	20
	Rose	166	50	35	15
Shortgrass grassland					
East Kimberley	Antrim	1 940	35	55	10
	Koongie	100	20	40	40
	Ruby	50	35	55	10
	Gordon	720	60	25	15
	Nelson	2 200	55	30	15
	O'Donnell	1 785	40	40	20
	Argyle	80	40	50	10

5b Western Australia						
Pasture community		**Land system**	**Area sq. km**	**Condition**		
Region				**A**	**B**	**C**
Mitchell grass plains						
	East Kimberley	Antrim	485	35	55	10
		Frayne	85	50	35	15
		Gordon	80	70	20	10
		Wave Hill	1 600	30	45	25
		Argyle	720	50	40	10
		Inverway	3 500	50	50	0
Black soil plains						
	West Kimberley	Alexander	1 295	60	20	20
		Cowendyne	888	70	15	15
		Djada	1 989	50	40	10
		Duffer	518	50	40	10
		Fossil	3 108	65	35	0
		Gladstone	52	50	40	10
		Gogo	218	50	40	10
		Leopold	388	55	35	10
		Neillabublica	881	50	40	10
		Oscar	2 850	50	40	10
Shortgrass - tussock - soft spinifex						
	Pilbara	Cracking clays, coastal plain and red duplex	13 000	45	45	10

Notes:

(c) = Coarse surface texture e.g. derived from granite
(f) = Fine surface texture e.g. derived from mudstone

Data for Northern Territory was collected as in Table 3b

Appendix 4 Problem weeds of pasture lands in northern Australia

The most significant weeds of pasture lands are:

Prickly acacia (*Acacia nilotica*)

Mimosa (*Mimosa pigra*)

Mesquite (*Prosopis* spp.)

Rubber vine (*Cryptostegia grandiflora*)

Parthenium (*Parthenium hysterophorus*)

The areas with infestations of these species are shown in Figure 4 (a)–(b)

The following weeds occur at varying levels of nuisance value:

Acacia: brigalow – suckering (*A. harpophylla*)
gidgee – regeneration (*A. cambagei*)
georgina gidgee – feed poisoning (*A. georginae*)
mulga – regeneration (*A. aneura*)
wattle – regeneration (*Acacia* spp.)

African box thorn (*Lycium ferocissimum*)

Calotropis (*Calotropis procera*)

Chinee apple (*Ziziphus mauritiana*)

Eucalypt regrowth (*Eucalyptus* spp.)

Grasses Blady grass (*Imperata cylindrica*)
Carpet grass (*Axonopus affinis*)
Rats-tail grasses (*Sporobolus* spp.)
Giant rats-tail (*Sporobolus pyramidalis*)
Wire grasses (*Aristida* spp.)

Harrisia cactus (*Harrisia martinii*)

Heart leaf (*Gastrolobium bilobum*)

Hopbush (*Dodonaea* spp.)

Hyptis (*Hyptis suaveolens*)

Lantana (*Lantana camara*)

Parkinsonia (*Parkinsonia aculeata*)

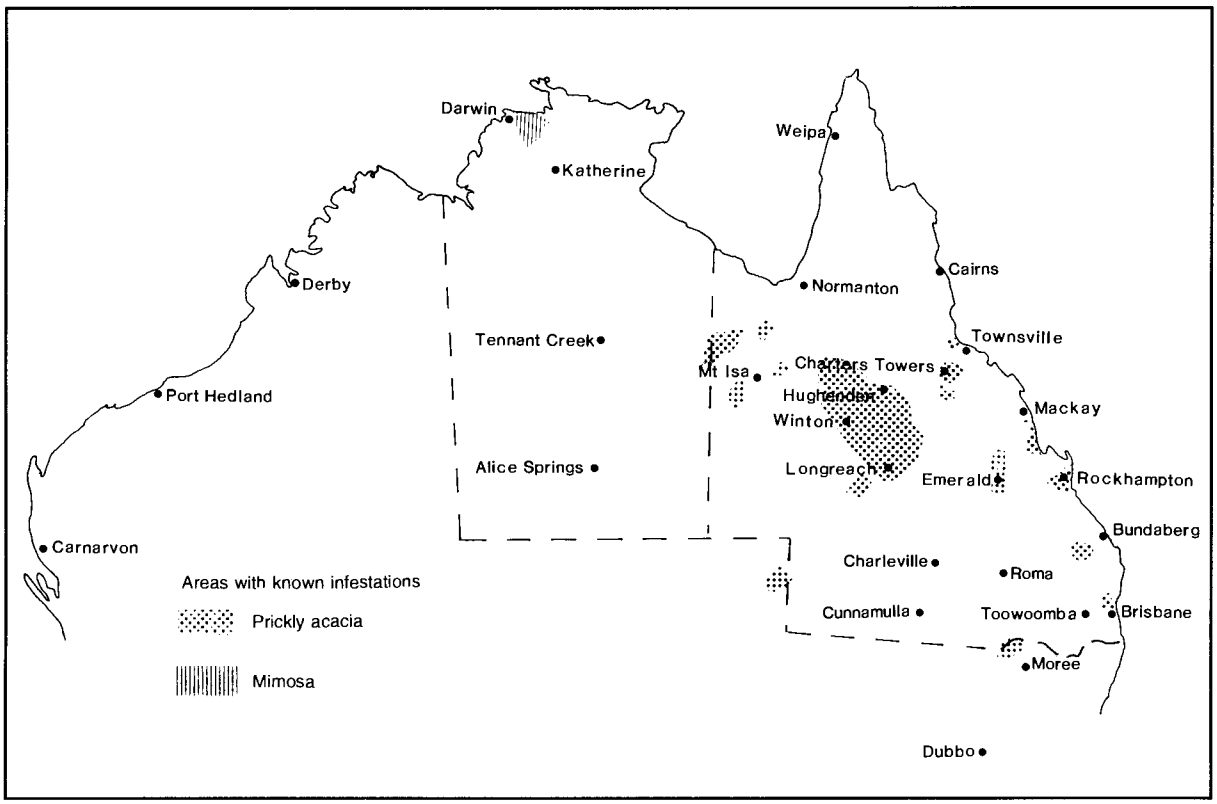
Pimelea (*Pimelea pauciflora*)

Sida (*Sida* spp.)

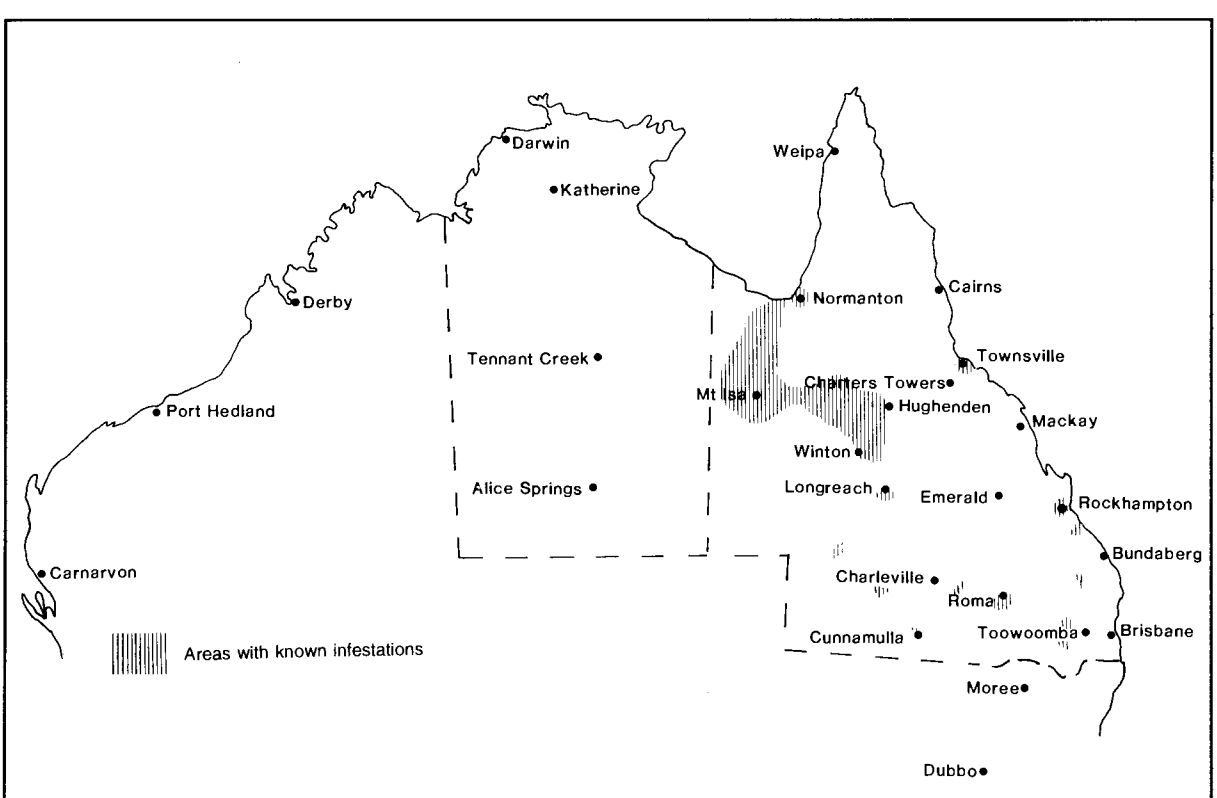
Teatree (*Melaleuca* spp., *Leptospermum* spp.)

Turkey bush (*Eremophila gilesii*)

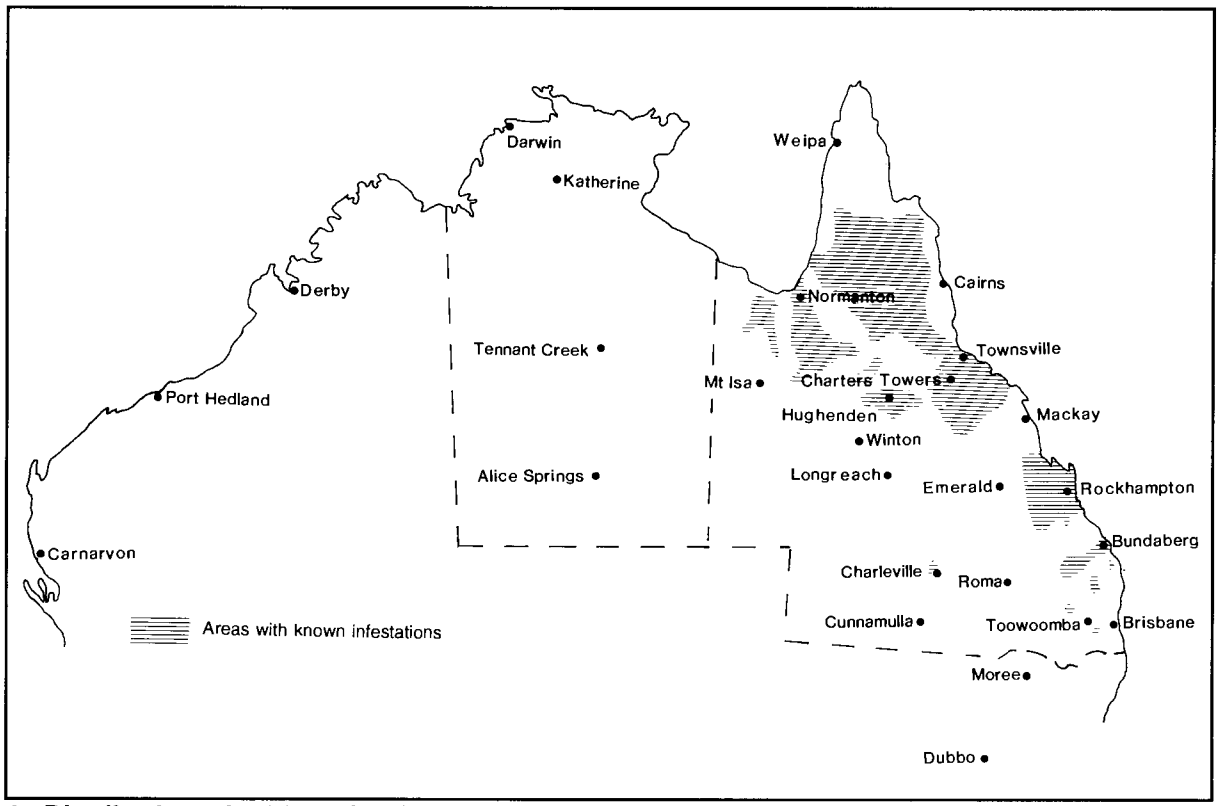
Figure 4 Infestations of 5 serious exotic weeds in northern Australia (Source: Tropical Weeds Research Centre, Charters Towers)



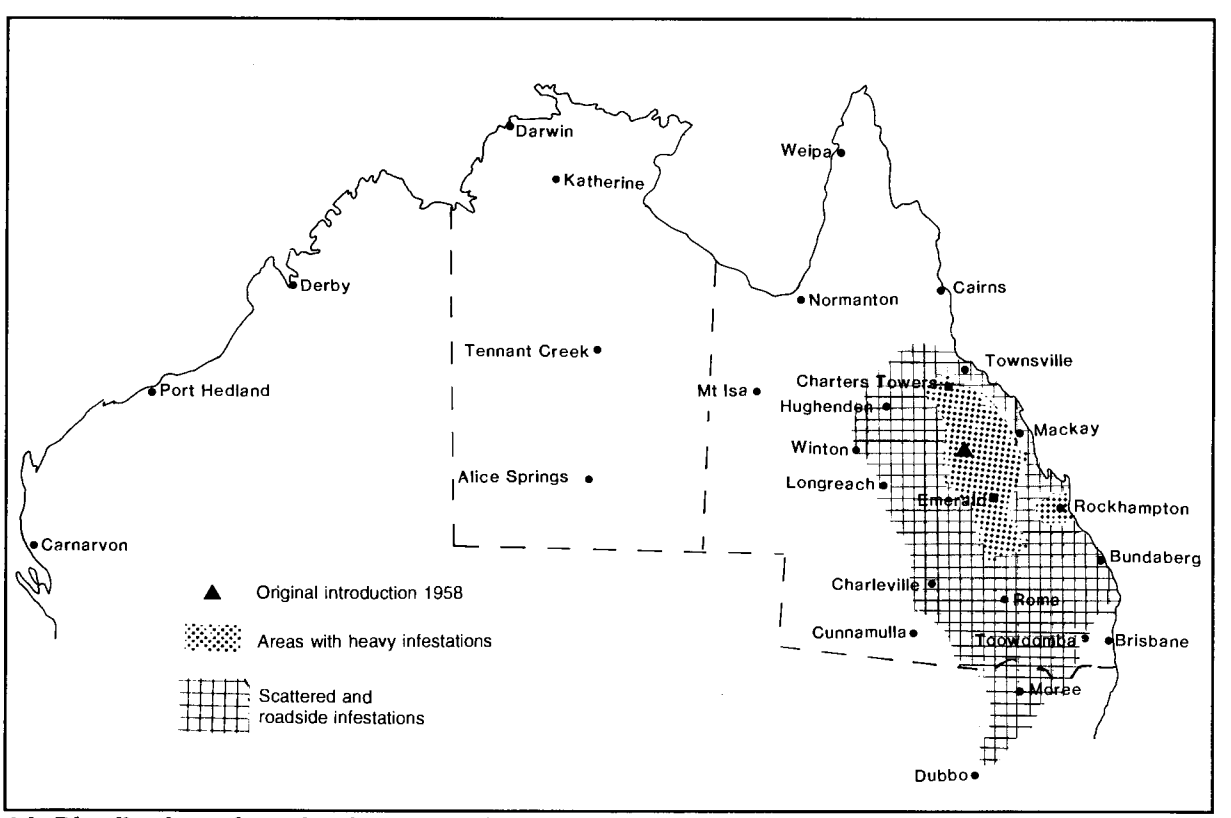
4a Distribution of prickly acacia (*Acacia nilotica*) in 1988, and mimosa (*Mimosa pigra*) in 1992



4b Distribution of mesquite (*Prosopis* spp.) in 1990



4c Distribution of rubber vine (*Cryptostegia grandiflora*) in 1985



4d Distribution of parthenium weed (*Parthenium hysterophorus*) in 1989

Appendix 5 Statistical areas (regions and shires)

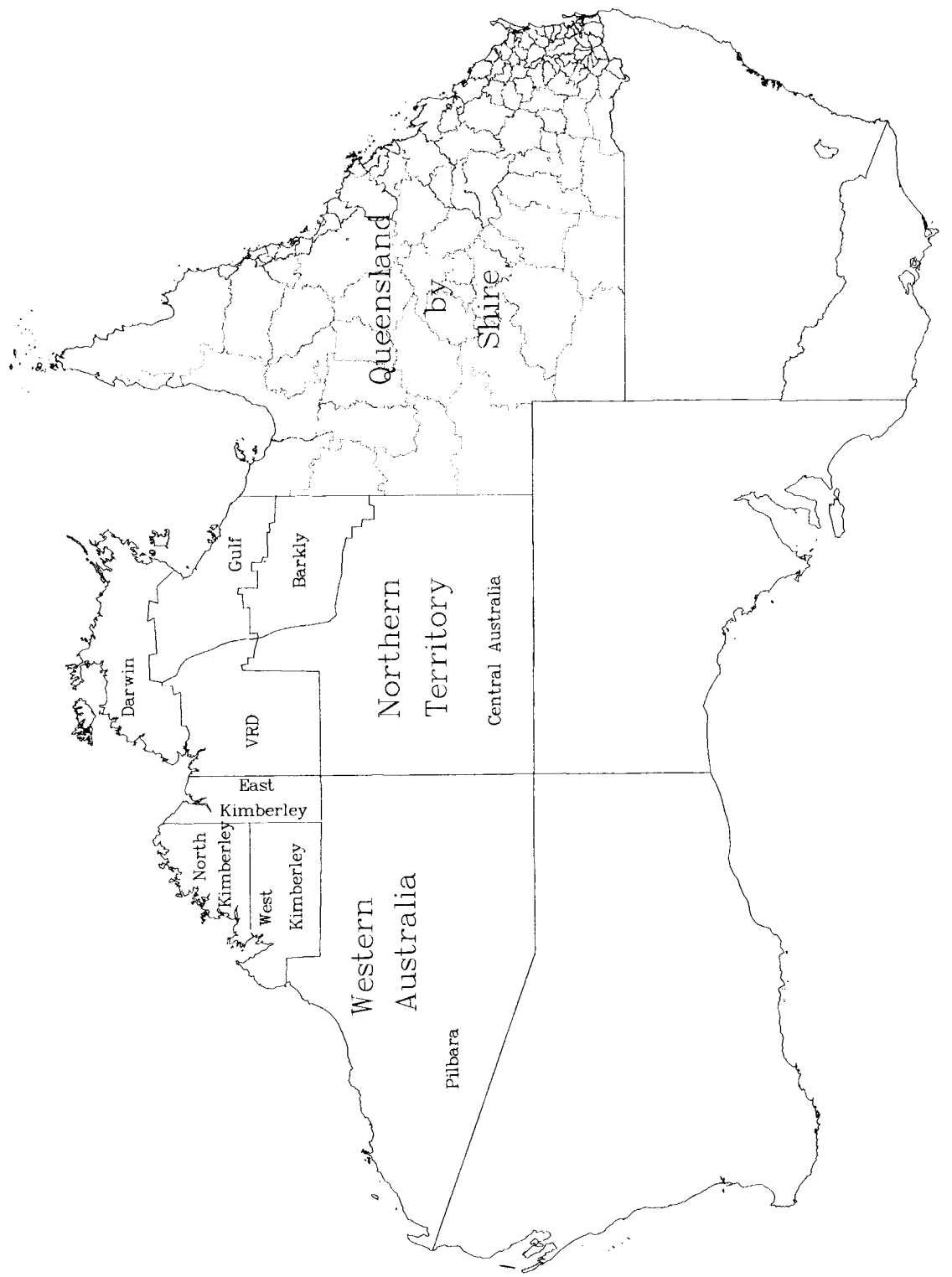


Figure 5 Statistical areas referred to in this report

Bibliography

This bibliography is divided into sections for resource references and for general information. It lists references quoted in the text of the report, and also other information gathered during the preparation of the report which may complement the bibliographies given in some of the references.

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