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
									7
			85	10	5	306	36	18	
			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.