EFFECTS OF GRAZING AND SEVERE DROUGHT ON A NATIVE PASTURE IN THE TRAPROCK REGION OF SOUTHERN QUEENSLAND

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ABSTRACT

Changes in ground cover, botanical composition and dry matter yield of a native pasture, grazed with sheep at 4 stocking rates in the traprock region of southern Queensland, were followed from 1962 to 1969. This period included a record drought throughout 1965.

Heavy stocking (0.27 ha/sheep with one sixth of the area lucerne) reduced ground cover but the greatest reduction was caused by the drought. Cover declined from 13.9% in 1962 through 9.6% in 1966 at the lowest stocking rate (0.8 ha/sheep) and 6.1% at the highest, to an average of 7.6% in 1969

Heavy stocking reduced the content of Dichanthium affine, Sporobolus elongatus *and* Aristida ramosa *whereas* Dichondra repens *temporarily increased. Drought caused major reductions in the dominant and most valuable species* Bothriochloa decipiens *and* Dichanthium affine. *Increases in the less productive* Chloris divaricata, Tripogon loliiformis, Enneapogon gracilis, *and* Dichondra repens *occurred after the drought ended.*

Pastures showed no recovery towards their pre-treatment levels of ground cover and botanical composition after 12 months free from grazing. At the lighter stocking rates dry matter yields had increased considerably, but at heavier stocking rates they remained depressed.

RESUMEN

En la región Traprock del Sur de Queensland se evaluaron los cambios de cobertura, composición botanica y producción de materia seca de una pastura nativa, pastoreada con 4 cargas de ovejas. Estas evaluaciones se hicieron desde 1962 a 1969 incluyendo un periodo de sequia durante 1965.

La carga alta (3.7 ovejas/ha con un sexto de área de alfalfa) redujo la cobertura, pero la mayor reducción fue causada por la sequia. La disminución de la cobertura de 13.9% en 1962 hasta 9.6% en 1966 en carga Baja (1.3 ovejas/ha) y 6.1% en la alta, lo que dió una media de 7.6% en 1969.

La carga alta redujo el contenido de Dichanthium affine, Sporobolus elongatus *y* Aristida ramosa *mientras que* Dichondra repens *incrementó temporalmente. La sequia causó reducciones mayores en las dominantes y más valiosas especies* Bothriochloa decipiens *y* Dichanthium affine. *Los incrementos en las especies menos productivas* Chloris divaricata, Tripogon loliiformis, Enneapogon gracilis, *y* Dichondra repens *ocurrieron después de terminada la sequia.*

Después de 12 meses libres de pastoreo, las pasturas no mostraron recuperación hacia los niveles de cobertura y composición botánica existentes antes de la applición de los tratamientos. En la carga más ligera las producciones de materia seca incrementaron considerablemente; sin embargo en la carga más pesada se mantuvieron deprimidos.

INTRODUCTION

Native pastures in the traprock region, west of the Stanthorpe-Wallangarra granite belt in southern Queensland, are used extensively for wool production. Pastures are strongly dominated by the summer growing perennial grasses *Bothriochloa decipiens* and *Dichanthium affine*, with other major species *Chloris*

divaricata, *Sporobulus elongatus* and *Aristida ramosa*. Between 1962 and 1969 Lee and Rothwell (1966) and Cassidy *et al.* (1973) studied pasture and animal production of sheep grazing native pasture with and without a grazing lucerne supplement. The combined effects of grazing and the worst drought on record (in 1965), led to major changes in ground cover and botanical composition. This paper examines these changes in relation to long term stability and productivity of the native pastures.

MATERIALS AND METHODS

The experimental site (elevation 300 m) was near Texas, Queensland, on shallow, stony soloths and solodic soils (Stace *et al.* 1968) with hardsetting loamy A horizons. Average annual rainfall is 625 mm, of which 65% occurs in summer (October to March). Mean temperatures range from a maximum of 30°C in January to a minimum of 2.5°C in July. Frosts occur from mid-May to mid-September (Wills 1976). Mild droughts (annual rainfall 25% below average) occur in 15% of years, whereas severe droughts (rainfall 50% below average) occur in 2% of years.

Grazing treatments

Treatments, arranged in a randomised block, with 3 replications were:

(1) 0.27 ha/sheep with one-sixth of the area lucerne (H/luc)
(2) 0.4 ha/sheep with one-sixth of the area lucerne (M/luc)
(3) 0.4 ha/sheep on native pasture only (M/pas)
(4) 0.8 ha/sheep on native pasture only (L/pas)

Each paddock was stocked with seven 18-month-old Merino × Corriedale wethers in March 1962 and these were removed on March 29, 1966. The area remained unstocked until May 10, 1966 when a second flock of similar 18-month-old wethers was introduced. These remained until February 1968. During the following 12 months the paddocks were ungrazed except for the L/pas treatment which was stocked by the property owner with rams at 0.4 ha/ram between 5 April and 19 September and 0.13 ha/ram from 19 September to 15 December 1968. This was not intended as an additional treatment.

Species

A list of species from 25 genera present at commencement of the experiment, their ground cover and contributions to botanical composition, was provided by Lee and Rothwell (1966). The most commonly occurring species comprising 84% of the pasture, have been used in this paper to follow changes in cover and botanical composition. All are grasses except for the forb *Dichondra repens*. By far the most abundant and productive species were *Bothriochloa decipiens* and *Dichanthium affine* which together comprised 46% of the original pasture. The pasture also contained 7% of *Aristida ramosa*, an unpalatable species whose seed heads cause an undesirable vegetable fault in wool. In the 1962 survey only, *Bothriochloa* and *Dichanthium* were not separated due to an identification problem which was later overcome.

Ground cover and botanical composition

Ground cover and botanical composition were assessed in March/April each year, except during the 1965 drought. The first assessment was in 1962 after 12 months without grazing. The final assessment was made in 1969, 12 months after the trial sheep were removed, to determine any residual effects of grazing on pasture growth.

A point quadrat (Brown 1954) consisting of 5 points spaced 100 mm apart was used to examine 2 000 points in each paddock. Ground cover was measured by the number of points that made contact with the basal crown of the plant, expressed as a percentage of 2 000. Botanical composition was determined by identifying the plants and expressing the strikes on each species as a percentage of total strikes on all species. The ground cover recordings in 1967 were incomplete and consequently have not been presented.

Forage yields

Data on native pasture on offer were presented in the earlier reports (Lee and Rothwell 1966; Cassidy *et al.* 1973). A summary is included in this paper to illustrate pasture degradation and recovery.

Statistical analyses

Initially, treatment effects on ground cover and botanical composition were determined by analysis of variance of each year's measurements. Because there were only 6 degrees of freedom for the error term this analysis was not very sensitive. Data were then analysed across years, treating years as a split-plot factor. Due to high variabililty in pasture composition between paddocks because of topography, these analyses were repeated on the 1963 to 1969 data, adjusted for the 1962 differences by covariance. These latter analyses have been used here with statistical differences being accepted if the F test was significant at the 10% level but using L.S.D.'s at the 5% level.

In the case of *Bothriochloa* and *Dichanthium*, which were not separated in 1962, unadjusted data have been used.

RESULTS

Weather conditions

Conditions before the trial were good with the total rainfall for January, February and March 1962 equalling the long term average. This followed 2 below-average rainfall years in 1960 (471 mm) and 1961 (584mm). Growing conditions were favourable until late 1964 when below-average rain in November and December was the start of the worst drought on record, lasting until November 1965 with only 256 mm rain in 13 months. Effects of above-average rain in December 1965 were short lived as late summer and winter 1966 were dry. Spring and early summer 1966 were favourable but 1967 was dry. Fair growing conditions occurred in summer 1968-69.

Monthly rainfall at the site, from 1962 to 1969 and the long term mean are given in Table 1.

TABLE 1

Monthly rainfall at Kelso and the mean (73 years) at Texas P.O.

Month	1962	1963	1964	1965	1966	1967	1968	1969	Mean
					(mm)				
January	203	9	146	43	5	57	47	106	86
February	40	52	49	47	43	22	38	65	76
March	52	116	124	0	60	0	90	9	56
April	33	2	58	0	36	97	38	11	32
May	21	86	35	12	40	41	43	97	39
June	4	14	34	4	0	61	16	29	44
July	60	9	58	35	3	20	54	26	42
August	37	54	15	9	133	19	49	52	34
September	36	12	59	20	33	5	32	69	40
October	52	0	95	14	79	121	16	67	61
November	85	116	17	26	130	27	30	121	65
December	100	95	29	248	63	60	114	55	77
TOTAL	723	565	719	458	625	530	567	707	652

Species

The most common species throughout the experimental area, and for the duration of the trial, are listed in Table 2.

Ground cover (Figure 1)

Stocking rates had no significant effect on ground cover (approximately 14%) from 1962 to 1964. However, the 1965 drought induced a highly significant ($P < 0.01$)

reduction in ground cover by 1966 to 9.6% under light stocking (L/pas) and 6.1% under heavy stocking (H/luc). Cover in H/luc was significantly lower than in most other treatments in 1968 and 1969, while in M/pas in 1968, cover was significantly lower than in M/luc and L/pas. From 1966 to 1969 rainfall continued below average; ground cover remained low and did not return to pre-drought levels.

TABLE 2

Ground cover and botanical composition of the principal species of the traprock pasture in January 1962 before grazing treatments commenced

Species	Common name[2]	Mean basal cover	Mean botanical composition
		(%)	
Bothriochloa decipiens[1]	Pitted bluegrass	6.29	45.8
Dichanthium affine[1]	Slender bluegrass	—	—
Chloris divaricata	Slender chloris	1.55	11.5
Sporobolus elongatus	Slender rat's tail grass	1.08	7.6
Aristida ramosa	Purple wiregrass	1.05	7.2
Tripogon loliiformis	Five minute grass	0.86	6.2
Enneapogon gracilis	Slender nineawn	0.15	1.2
Dichondra repens	Kidney weed	0.71	4.7
Miscellaneous species[3]		2.23	15.8
TOTAL		13.92	100.0

[1]Not separated in the 1962 survey
[2]Hartley (1979)
[3]Miscellaneous species included the genera *Alternanthera*, *Arundinella*, *Boerhavia*, *Cheilanthes*, *Chrysopogon*, *Cynodon*, *Cyperus*, *Digitaria*, *Eragrostis*, *Euphorbia*, *Glycine*, *Panicum*, *Paspalidium*, *Sida*, *Stipa* and *Tragus*.

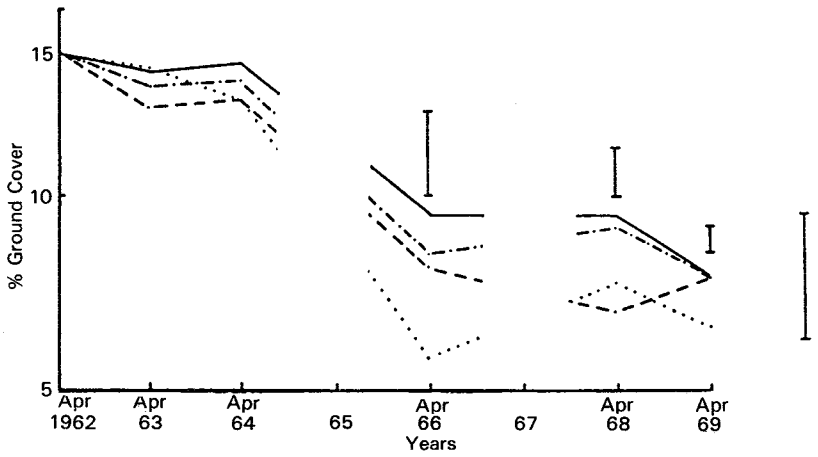

FIGURE 1

Total pasture ground cover (%) in a native pasture from 1962 to 1969 grazed at 4 stocking rates. Significant differences ($P < 0.05$) within years are shown by vertical bars with differences across years shown on the far right.

H/luc 0.27 ha/sheep with one sixth of the area lucerne
M/luc 0.4 ha/sheep with one sixth of the area lucerne
M/pas 0.4 ha/sheep on native pasture only
L/pas 0.8 ha/sheep on native pasture only.

Species composition (Figure 2 (a) to (i))

Heavy grazing significantly reduced the contribution of *Dichanthium* in 1967 (H/luc < M/pas, L/pas); *Sporobolus* in 1968 (H/luc < L/pas), and 1969, 12 months after destocking (H/luc, M/luc < L/pas); and *Aristida* in 1966 (H/luc < L/pas).

The contribution of *Dichondra* was greater in 1968 under heavy grazing (H/luc > M/luc, L/pas) but apparent treatment differences in other years, particularly 1967 were not significant due to high variability.

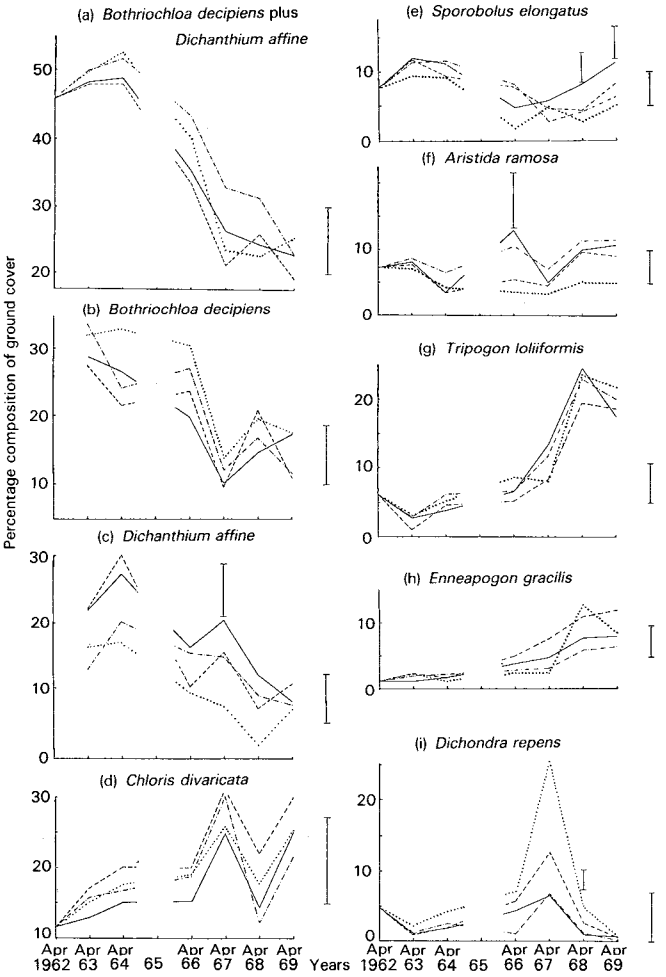

FIGURE 2

Composition of main species in the ground cover of a native pasture from 1962 to 1969 grazed at 4 stocking rates.

Significant differences ($P < 0.05$) within years are shown by vertical bars with differences across years shown on the far right.

H/luc 0.27 ha/sheep with one sixth of the area lucerne
M/luc 0.4 ha/sheep with one sixth of the area lucerne
M/pas 0.4 ha/sheep on native pasture only
L/pas 0.8 ha/sheep on native pasture only.

The 1965 drought had a substantial effect on species contribution to ground cover between years. It reduced the combined *Bothriochloa/Dichanthium* content from an average in all treatments of 50% in 1964 to 26% in 1967. The main decline in *Bothriochloa* from 30% in 1963 to 12% in 1967 occurred 1 year after the drought. On the other hand, the content of *Dichanthium* declined immediately and continued to do so until 1968 in H/luc and M/pas, and until 1969 in L/pas and M/luc. Neither species recovered to pre-treatment levels before the end of the experiment.

Species which increased from their pre-treatment levels were *Chloris* (1962 to 1967), *Enneapogon* (1962 to 1968) and *Tripogon* (1962 to 1968). *Dichondra* peaked in 1967 with a significant increase from the 1966 levels in H/luc and M/pas but then declined to 1969.

Miscellaneous species (see Table 1) contributed 15.8% of the pasture initially but declined to 5.6% by 1969.

Dry matter yields

Dry matter yields of native pasture on offer declined in all treatments during the drought. Recovery was quicker in the lightly grazed treatments (M/luc and L/pas) and this trend continued for 12 months after de-stocking (Table 3).

TABLE 3

Summary of native pasture dry matter yields during the experiment

Date	D.M. Yield			
	H/luc	M/luc	M/pas	L/pas
	(kg/ha)			
April 1962 —ungrazed for 12 months	1 123	1 327	1 164	1 225
November 1965 —drought, lowest recorded	0	37	0	141
August 1967 —recovery under grazing	227	549	271	809
March 1969 —ungrazed for 12 months	200	858	409	699[1]

[1]Grazed by rams

DISCUSSION

In judging whether degradation has occurred in this pasture, it would be useful to know what the natural dominant species are under grazing. In temperate rangelands, it is generally considered that increased grazing intensity decreases the dominant tall summer-growing perennial grasses, e.g. *Themeda australis*, and increases short summer-growing perennial grasses (Lodge *et al.* 1984).

The pasture in our experiment most resembles, in structure and complexity, the temperate rangelands with similar soils on the north-west slopes of New South Wales. In those pastures it is considered that *Bothriochloa macra* (redleg grass) is the natural dominant because its frequency is apparently independent of land use effects, and because other possible dominants such as *Themeda* and *Poa* are not now present in the flora (Williams 1979). In any case, *Bothriochloa macra* is at least a dominant species under grazing.

For the same reasons, we believe that the desirable grasses *Bothriochloa decipiens* and *Dichanthium affine* are probably the dominant species of grazed native pastures on the traprock country of southern Queensland. However, our results suggest that drought may be a major factor periodically reducing that dominance, and increasing the proportion of less productive species.

When the experiment commenced, the pasture was in good condition having a high ground cover (important in minimising runoff on these hard-setting soils), a dominance of *Bothriochloa* and *Dichanthium* and average productivity for a community on the traprock country. It had benefited from above-average rain from January to March 1962 and protection from grazing for the previous 12 months. The pasture remained in good condition until 1964 although grazing treatments reduced forage presentation yields (see Lee and Rothwell 1966). The main subsequent changes commenced during the severe 1965 drought. Drought appeared to have a greater effect than grazing on pasture cover and botanicial composition, but without an ungrazed treatment, direct comparisons were not possible. Drought, followed by mostly unfavourable conditions for pasture recovery, reduced mean ground cover by 6.4% units between 1962 and 1969 whereas the greatest reduction in cover due to stocking rate was 3.7% units in 1966 (refer Fig. 1). As the effects of drought were exacerbated by heavy grazing, reducing stock numbers during drought would minimise damage to the pasture.

The major grasses (*Bothriochloa* and *Dichanthium*) were replaced by the smaller, less productive grass *Chloris divaricata* and later by *Tripogon loliiformis* and *Enneapogon gracilis*, which produced little herbage. Because the reduction in ground cover came mainly from the most valuable grasses, these changes together constitute degradation, although probably reversible.

The increase in *Chloris* by 1967 apparently reflected the wet period during spring and early summer of 1966 which allowed rapid colonisation of bare ground by this species as reported for *Chloris truncata* (Whalley 1978). Everist (1935) reported that *Chloris* comes away quickly after rain and, under heavy grazing, tends to spread out as a sward. This was certainly the case in 1967 when it contributed significantly to the pasture.

Sporobolus elongatus, a moderately useful species (Lodge *et al.* 1984), showed moderate drought resistance except under heavy grazing, and its density increased considerably under lenient grazing after the drought.

Aristida ramosa was stable and a fairly minor pasture component under a wide range of grazing pastures, but in 1966, its contribution to the pasture was reduced by heavy grazing as reported in northern New South Wales (Lodge *et al.* 1984). Heavy grazing has also been shown to reduce other species of *Aristida* such as *A. latifolia* (Hall and Lee 1980). Swann (1982) reports that both *A. ramosa* and *A. calycina*, 2 species that are common in the traprock region, do not survive grazing as well as more palatable pasture species. It appears that stock must be forced to eat them.

Drought *per se* did not reduce the *Aristida* population in our experiment as it has done with *A. latifolia*, for instance, in western Queensland (Lee *et al.* 1980). Despite this, there was no subsequent increase by this species in the pasture weakened by drought.

Tripogon, a small grass with low herbage yield, became prominent in 1968 having been increasing since 1966. It is a coloniser (Lazarides 1970) and grows rapidly after rain (Tothill and Hacker 1983). It obviously benefited from the good falls received from 1966 onwards.

Enneapogon in the western pastures of southern Queensland, is not rated highly as a forage because it seeds quickly and has low herbage production. It increased from 1966 onwards and like *Tripogon* colonised bare ground.

Dichondra repens also colonised bare ground. The plants did not appear to be grazed; this species is regarded as a nuisance. Kleinschmidt and Johnson (1977) have classed this low-growing perennial forb, which roots at the nodes, as an aggressive weed in some areas of south-eastern Queensland.

One of the important results of this study was the slow recovery of the heavily grazed paddocks H/luc and M/pas; both were stocked at heavier than the district average of about 0.6 ha/sheep. Even after de-stocking for 12 months, there was little indication of the pasture being able to produce dry matter yields similar to those

recorded before the trial began (about 1 200 kg/ha). Dry summers restricted recovery, partly through lack of opportunity for seed set and recruitment of seedlings; the lightly grazed paddocks, M/luc and L/pas, were far less affected. The grazing pressure on the native pasture was greater in M/pas than in M/luc as during periods of lucerne availability sheep made little use of the native pasture.

Because of the severity of the record drought, it is probable that the adverse changes measured in the pasture were greater than would be expected from less severe, though more frequent, droughts. However, this experiment shows that when traprock native pastures are degraded by drought or overgrazing, it will probably be several years, or until above-average summer rainfall occurs, before substantial improvement in ground cover, proportion of desirable species and dry matter yield will take place.

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