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THE BENEFITS OF PALATABLE SHRUBS FOR WOOL PRODUCTION IN A SEMI-ARID ENVIRONMENT.

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ABSTRACT

Palatable shrubs are necessary to ensure continuity of wool production during drought conditions at high stocking rates.

Measurements were made of herbage mass, foliage mass of shrubs, bodyweight and annual wool production of Merino wethers grazing a chenopod/Acacia sandplain pasture near Carnarvon W.A. The experiment ran for five years (1983-1988), with a design of five stocking rates each of 30 sheep by two pasture types, one in a degraded state with low densities of palatable shrubs and one in a non degraded state with high densities of palatable shrubs.

Average clean fleece weights ranged from 2.9 kg to 4.5 kg and total wool production from each paddock ranged from 363 kg to 630 kg. Total wool production from the non degraded site was higher than that from the degraded site only for the paddocks stocked at higher than recommended rates. This was due to their inability to continuously support the grazing pressure applied. At moderate to low stocking rates there was no production advantage evident from the pasture in a non degraded state.

INTRODUCTION

Almost without exception in the shrub rangelands, the process of land degradation has been accompanied by the loss of palatable shrubs. The loss of these shrubs contributes not only to soil erosion but also to the loss of continued useful shrub biomass production.

It would be reasonable to assume that this loss of perennial biomass would also lead to a decline in the ability of the pasture to support animal production, particularly during dry times when herbage availability is low.

Grazing trials designed to compare animal production from areas differing in density of palatable chenopod shrubs have not shown that higher densities of these shrubs confer any production advantage (1,2,3). This is due largely to the increased production from the herbage layer, on the more degraded grazing land, and the grazing preference of the animals for herbage species rather than shrubs.

However, the role of palatable shrubs in providing continuity of production through poor seasonal conditions has not been as well documented. Circumstantial evidence, cited by Wilcox (4) suggests that palatable chenopods were important in ensuring survival during a prolonged drought in the Goldfields area of Western Australia. Most authors however, including Wilcox and Graetz and Wilson (5)conclude that palatable shrubs have other roles to play in the semi-arid grazing environment such as landscape stability, nutrient cycling and as guides to range condition assessment.

In this paper we test the hypothesis that palatable shrubs are important for continuity of animal production during a range of seasonal conditions, including drought.

MATERIALS AND METHODS

The results reported here cover only a small aspect of a sheep grazing trial conducted over five years to look at many parameters of animal production, range stability and vegetation response to five different stocking rates on two range condition sites

This paper reports wool production from each stocking rate over a five year period from a site with high palatable shrub density (non degraded) and from one with low shrub densities (degraded).

Location and Site Description

The study area was located on the Boolathana Pastoral Lease (24°31'S; 113°42'E) 50 km north of Carnarvon, Western Australia. The site is classified as Sable Land System (6).

The study area consists of flat alluvial plains with duplex soils making up 57% of the area while sandy banks and rises 0.5 to 3.0 m above the alluvial plains make up the remaining area. The alluvial plains support a low chenopod shrubland dominated by *Maireana polypterygia* and *M. platycarpa*. Forbs, grasses and other herbaceous species grow between the shrubs with rain. *M. polypterygia* numbers have been drastically reduced while *M. platycarpa* has virtually disappeared from degraded areas.

The sandy banks and rises support a very tall, very sparse acacia shrubland dominated by *Acacia sclerosperma* with a low shrub understorey of *Eremophila* species, *Ptilotus obovatus, Scaevola spinescens, Solanum lasiophyllum* and others (6). Herbaceous species are more abundant on degraded areas.

Annual mean rainfall for the study area is 237 mm (Boolathana homestead record 1897-1984) More rain falls in winter (median rainfall for April to September is 155 mm) than summer (median rainfall for October to March is 43 mm). Mean daily minimum and maximum temperatures range from 9.1°C and 24.2°C in August to 22.3°C and 37.2°C in February, (Brickhouse woolshed records 24°41'; 113°48').

Trial Design and Layout

On the basis of palatable chenopod shrub density two separate areas were selected to represent the Sable Land System in a non-degraded state and a degraded state.

(Plants/ha)	Non degraded site	Degraded Site
M. polypterygia	2 800	240
M. platycarpa	2 400	0

Each area was fenced and subdivided into five paddocks that contained similar proportions of the sand and duplex units. Paddock sizes ranged from 75 ha to 380 ha and each was stocked with 30 Merino wethers to provide stocking rates of 1 DSE (dry sheep equivalents) to 2.5, 3.7, 5.6, 8.4 and 12.7 ha on both sites. In this paper the various stocking rates are referred to as very heavy (VH), heavy (H), moderate (M) light (L) and very (VL) respectively.

The recommended stocking rate for this landsystem in good condition is 5 ha/DSE (6).

Stock watering points were located in the centre of each paddock. The salinity of water supplied in the non-degraded area was 3,100 mg/l TSS and in the degraded area was 3,300 mg/l TSS.

Three separate drafts of 18 month old Merino wethers were used throughout the trial. The first draft was used from November 1983 to November 1985, the second from November 1985 to November 1987 and the third from November 1987 to April 1989.

Sheep were selected from the Boolathana flock which was bred on the property, shorn, weighed and allocated to the treatment paddocks so that average weights for each paddock were similar. Sheep remained in their paddocks unless their liveweight fell below 70% of their commencement weight when the paddock group was either fed a maintenance ration or removed from the paddock.

Sheep production and herbage information was recorded at approximately three monthly intervals from November 1983 to November 1988 as described below.

Pasture Measurements

Vegetation monitoring sites were established at six locations in each paddock. At each location two permanent transects were located, one on the duplex unit and on the sand unit.

The total herbage mass (as defined by Hodgson 7) of the non-woody herbaceous species and the percentage contribution of each of these species was estimated using double sampling (8) and dry weight ranking (9) techniques. Depending on site variability, either 20 or 40 0.5 m^2 quadrats were recorded along each transect.

In September 1987 and 1988 the foliage mass of all perennial plants (excluding vines) to the average grazing height of 1.2 m was estimated using he Adelaide technique (10) on two of the transect pairs in each paddock.

Animal Measurements

Sheep were weighed following an overnight fast in February, May, August and November each year (except February 1984). Data are presented as average liveweight (kg) including wool.

The fleece (including belly wool) for each wether was weighed at shearing in November each year. The percentage of clean wool was established from mid ide samples (each 150-200 g) from ten sheep per group. The average was then used to calculate the clean scoured fleece weight for each wether in each group.

The occasional dead sheep were replaced as soon as practicable in order to maintain required stocking rates, but they were not used in the analysis.

Results from sheep that were injured, obviously ill or flyblown were excluded.

RESULTS

Rainfall

The monthly rainfall totals for the duration of the trial are shown in Fig. 1. Annual totals are shown in Table 1, together with the decile into which each total fits (Boolathana homestead records 1897 - 1982).

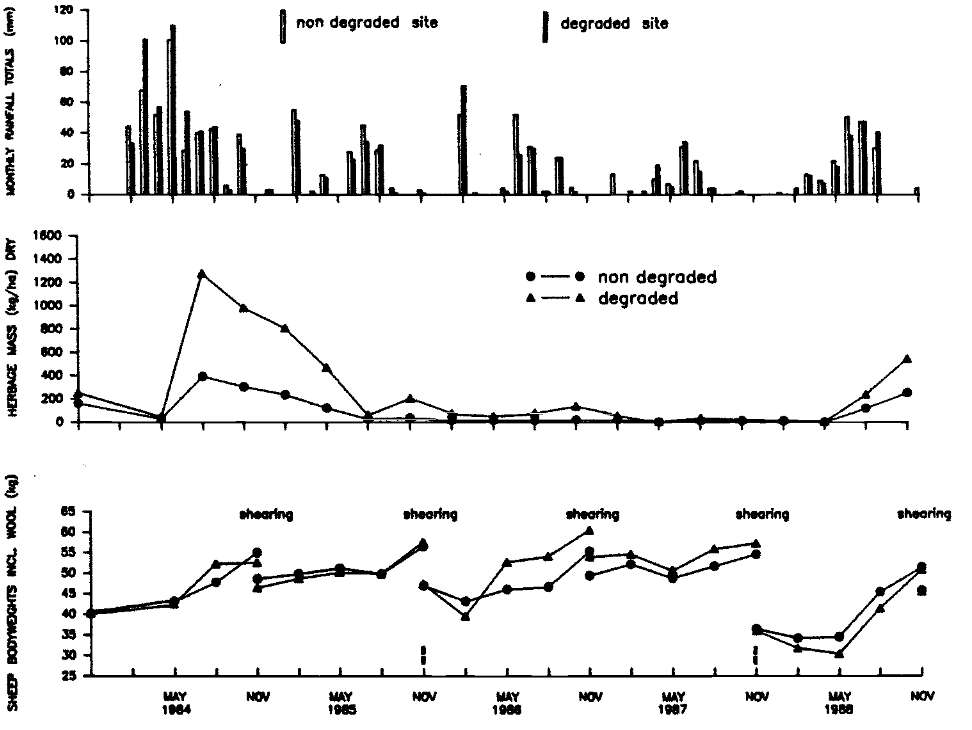

Fig. 1 Monthly rainfall totals (mm) for both degraded and non degraded sites recorded during the trial.The pattern of herbage mass available (kg/ha dryweight) and of sheep liveweights including wool (kg) on the moderate stocking rate paddocks (5.6 ha:DSE) on both sites. Vertical arrows represent sheep replacements.

Table 1. Annual rainfall totals (mm) for each year of the trial for both degraded and non degraded pasture sites. The decile into which each of these totals fits (Boolathana homestead records 1987-1982) is shown in brackets underneath each annual total.

	Degraded	Non degraded
1984	485 (9-10)	424 (9-10)
1985	154 (2-3)	176 (3-4)
1986	155 (2-3)	172 (2-3)
1987	83 (0-1)	88 (0-1)
1988	172 (2-3)	177 (3-4)

Three distinct types of seasonal conditions were encountered during the trial period.

In 1984 rainfall was 424 mm on the non-degraded site and 485 mm on the degraded site. This has only been exceeded in four out of the 93 years since records began. Conversely, in 1987 rainfall was only 88 and 83 mm respectively. Lower rainfall has again only been recorded on four occasions in the last 93 years.

Rainfall for the years 1985, 1986, 1988 fell into either decile 2 or 3. The difference being that 1985 followed a near record good season and 1988 followed a near record drought.

Trial Stocking History

Although the trial was designed to impose set stocking rates on the pasture, in May 1987 it became necessary to handfeed the wethers in the very high stocking rate paddock on the degraded site as the paddock's feed reserves could no longer support them. The animals were handfed a maintenance ration of lupins in the paddock from May 13 to June 19. Average liveweight in this paddock had dropped from 52.0 kg in November 1986 following shearing to 34.7 kg in May 1987. This paddock clearly could no longer support the required stocking rate and wool growth for this year was effectively zero.

Following the very low rainfall in 1987 we judged that this paddock would not be able to support sheep in 1988 and consequently the paddock was not restocked following November 1987 shearing. It was restocked in November 1988.In March 1988 it became necessary to destock the high stocked paddock on the degraded site. Liveweights had fallen from 37.3 kg (Nov.1987) to 27.4 kg (Feb.1988). This paddock was destocked from March 1988 until August 1988 and wool production in 1988 was therefore effectively zero. Sheep were removed and fed a maintenance ration of lupins for the period March to August 1988. They were then returned to the paddock.

In both instances the sheep that were handfed were returned to the paddock, not to continue measuring their wool production but to continue with the other aims of the trial, which were to measure the effect of continuous grazing on the pasture and on range stability.

All paddocks on the non degraded site remained continuously stocked during the five year period of the trial.

Herbage Mass

Herbage mass ranged from 0 kg/ha to 496 kg/ha on the non-degraded site and from 1 kg/ha to 1617 kg/ha on the degraded site. The pattern of herbage mass for the two moderately stocked paddocks is shown in Fig. 1 as an example of all ten paddocks.

Herbage mass measurements showed very high levels midway through the first year of the trial, following very high rainfall and the effect of this lasted until July 1985. Herbage mass then remained relatively low until October 1988 with minima reached in April 1987 and April 1988.

Except at very low levels (<10 kg/ha) the amount of herbage mass on the degraded site was about three to four times that on the non-degraded site.

Perennial Shrub Production

The estimated shrub biomass (kg/ha) available in September 1987 and 1988 is shown in Table 2. Data are presented for the two most common duplex species, both palatable and the three most common palatable species on the sand unit. During the drought almost all the shrub species were browsed to some extent.

The total shrub foliage mass available on the non degraded paddocks was between 2.5 and 3.3 times higher than on their degraded counterparts except in the very heavily and heavily stocked paddocks in 1987, when shrub foliage mass on the non degraded paddocks was 12.5 and 5.3 times higher than the respective degraded paddocks.

On both degraded and non degraded paddocks much of the available shrub foliage mass was *M. polypterygia*. A significant proportion of the total foliage mass was *M. platycarpa* on the non degraded paddocks but this was absent from the degraded site.

Table 2. The estimated shrub foliage mass (kg/ha) available in September 1987 and 1988 for each paddock on non degraded (ND) and degraded (D) pasture for selected palatable species.

Paddock	VH		H		M		L		V.L	
Stocking rate ha/DSE	2.5		3.7		5.6		8.4		12.7	
	ND	D	ND	D	ND	D	ND	D	ND	D
					1987					
Duplex										
Maireana										
polypterygia	192	1	209	7	200	81	211	7	386	137
M. platycarpa	31	0	80	0	46	0	188	0	154	0
Sand										
Ptilotus obovatus	1	0	1	0	1	0	3	2	25	4
Rhagodia eremaea	4	0	7	5	5	1	1	0	16	3
E. * *maitlandii*	0	0	0	0	10	0	6	0	12	3
Total	275	22	362	68	317	125	561	170	746	251
* *Eremophila*										
					1988					
Duplex										
M. polypterygia	270	56	328	31	353	118	300	84	418	145
M. platycarpa	23	0	102	0	61	0	129	0	166	0
Sand										
P. obovatus	8	1	10	4	9	1	15	2	68	11
R. eremaea	37	1	24	35	12	2	5	1	53	6
E. maitlandii	2	2	1	0	17	2	9	0	13	5
Total	459	139	586	195	539	184	617	206	767	262

Sheep Liveweight

The pattern of sheep liveweight (including wool) from November 1983 to November 1988 is shown in Fig. 1 for the moderately stocked paddocks on both sites.

Annual Wool Production

The annual estimated average clean fleece weight for each paddock is shown in Table 3.

Table 3. The annual estimated clean scoured fleece weights (kg) for the five stocking rates for both non degraded (ND) and degraded (D) pasture sites. The data in square brackets are for handfed sheep.

Stocking Rate ha/sheep	1984 ND	1984 D	1985 ND	1985 D	1986 ND	1986 D	1987 ND	1987 D	1988 ND	1988 D
2.5	4.4	4.3	4.5	4.0	3.7	3.8	3.4	[2.8]	2.8	-
3.7	4.4	4.4	4.5	4.0	4.0	4.3	4.0	3.5	3.3	[2.5]
5.6	4.4	4.5	4.2	4.0	3.9	4.4	3.7	4.1	3.5	3.2
8.4	4.5	3.9	4.5	3.8	4.3	4.3	4.1	4.0	3.6	3.5
12.7	4.3	4.4	4.3	3.9	4.0	4.3	4.3	3.9	3.8	3.8

In 1984 average clean wool production from the non degraded site was 4.4 kg and from the degraded site was 4.3 kg. There were no effects due to either stocking rate or condition. There were again no stocking rate effects found in 1985 but the average wool cut on the non degraded site was 4.4 kg compared to 3.9 kg from the degraded site.

By 1986 there were again no obvious stocking rate effects, although wool production from both very heavy stocked paddocks was low. Average wool production from the degraded site was 4.2 kg and from the non degraded site 4.0 kg. In 1987 and 1988 there is some evidence of stocking rate effects becoming apparent,but the major results were that lack of production on the degraded site from the very heavy stocked paddock in 1987 and 1988 and from the heavy stocked paddock in 1988 meant that wool production from the non degraded site was higher than from the degraded site.

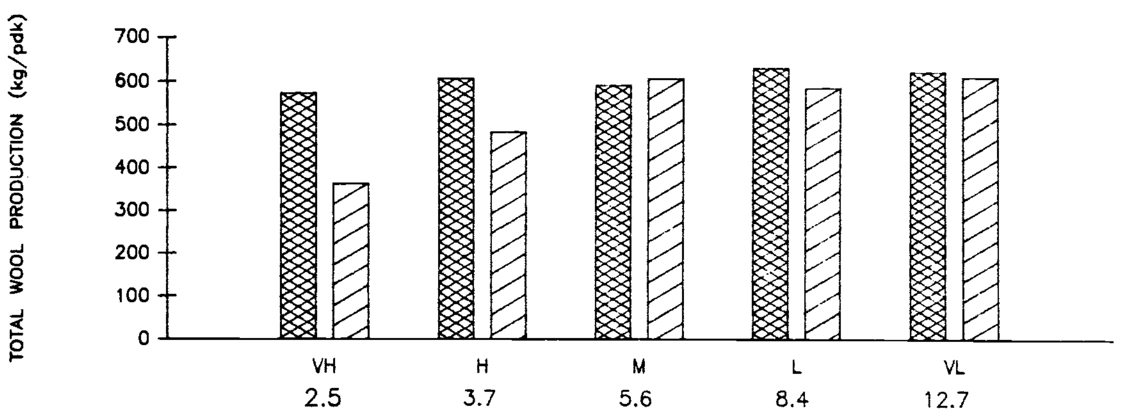

Figure 2. Total wool production (kg/paddock) recorded from each paddock for all years pooled.

The net effect over the trial period is shown in Fig.2 Total clean wool production from each of the paddocks over five years was calculated by multiplying the mean clean wool cut by 30 sheep per paddock over five years and is expressed as kg/paddock. Total clean wool production ranged from 363 kg for the very heavily stocked paddock on the degraded site to 630 kg from the lightly stocked paddock on the non degraded site. There was no difference in wool production over the five years of the trial between non-degraded and degraded paddocks for the moderate to very lightly stocked pairs of paddocks, combined.

DISCUSSION

Our results show that total wool production over five years was higher from the paddocks containing high densities of palatable shrubs compared to those containing low densities, but only at high stocking rates.

At moderate to low stocking rates, total wool production from the degraded and non degraded paddocks was similar. Due to poor seasonal conditions the very heavy and heavy stocking rate paddocks on the degraded site could not support animal production at the required stocking rates for the full five years. By contrast the other paddocks supported continuous sheep grazing over the entire trial period.

The two sites used in the trial differed in the composition of the pasture that each produced. The degraded paddocks produced about three to four times the herbage mass of the equivalent non degraded paddocks generally. By contrast, the non degraded paddocks produced comparatively large quantities of palatable shrub biomass which enabled them to remain continously stocked while their degraded counterparts had to be destocked and the animals hand fed to prevent their deaths. Because there was little shrub drought reserve on the degraded site, the animals simply ran out of feed during the drought.

Those animals grazing at more conservative stocking rates in the degraded paddocks found sufficient feed reserves to maintain bodyweight similar to those in the non degraded paddocks. In the degraded paddocks at conservative stocking rates palatable shrub biomass was available through the drought and greatly contributed to the ability of these paddocks to support continuous animal production.

In the non degraded paddocks, the shrub drought reserve provided sufficient forage to maintain continuity of production from all stocking rates even though there was no available herbage in both April 1987 and 1988. Whilst we acknowledge that high stocking rates were maintained on the non degraded site through the drought and wool production from these paddocks was continuous, we do not suggest that range condition was maintained in these paddocks. Observations and data still to be presented suggest that there was a decline in range condition in some continuously stocked paddocks from 1983 to 1988.

There were no consistent trends in reasonable to good seasons in the ability of either site to produce wool. The conclusion to be drawn is that high densities of palatable shrubs are only important for ensuring continuity of animal production in those years when rainfall is insufficient to produce adequate herbage mass.

Diet composition and quality work by various authors in chenopod shrublands of various pasture conditions has shown that sheep are able to maintain adequate nutritional intake by being highly selective of the different types of feed on offer. (1,3,11). However this mechanism can only operate while sufficient feed reserves are available. The most highly tuned foraging behaviour cannot provide an adequate nutritional intake when there is nothing left to eat.

Trials from western New South Wales (1, 2, 3) have not shown any productive advantage from areas containing high densities of chenopod shrubs compared to low densities. These studies, however have been on sites showing smaller shrub density differentials between degraded and non degraded sites and did not encounter seasonal/stocking rate combinations sufficient to force the destocking of any treatment paddocks. The advantage in having shrubland pasture in good range condition may lie in the inherent stability rather than the productive elements of the vegetation. The shorter lived plants that replace the shrubs may be no less productive, given adequate seasonal and stocking conditions than the shrubs they replace (5).

The results from this trial demonstrate that high densities of palatable shrubs are important for continuity of sheep production, through a range of seasonal conditions, including drought and particularly at higher stocking rates.

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