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SOIL DEGRADATION IN CHENOPOD SHRUBLANDS

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INTRODUCTION

The chenopod shrublands provide some of the most important rangeland pastures for sheep production in Western Australia. Stable production in the long term requires that these pastures are maintained in good condition. However, as a result of overgrazing, palatable chenopod shrubs can disappear, concomitant with degradation of soil physical properties (1,2). The potential for overgrazing to degrade soil physical properties depends on both the past management history of the pastures and the current stocking rates.

The effects of both these factors on soil physical properties was investigated in chenopod shrublands in good and poor condition near Carnarvon, Western Australia. This work was part of a collaborative project between CSIRO Division of Wildlife and Ecology and the W.A. Department of Agriculture, Carnarvon and was funded by the National Soil Conservation Program.

EXPERIMENTAL

A grazing trial was commenced in August, 1983, at two 1000 ha areas within the Sable Land System on Boolathana Station (24° 39'S, 113° 42'E), Carnarvon, Western Australia. Five stocking rates were established in each area.

The geomorphic units within the Sable Land System comprise level inter-dune swales and low sand dunes with a weak NW-SE orientation (3). Red duplex soils occur in the swales, and deep sands in the dunes. One area, good condition, had a dense population of chenopod shrubs and the other, poor condition, had a sparse population of chenopod shrubs due to extensive overgrazing during the 1920s.

Field measurements of soil physical properties were made between March 1987, and May 1988, at three stocking rates (0, 0.08 and 0.40 sheep/ha) in both the good and poor areas. In the swales, measurements were made in bushmounds (containing *Maireana polypterygia*) and inter-bush areas, whilst in the dunes measurements were made under *Acacia sclereosperma* shrubs and between shrubs.

RESULTS AND DISCUSSION

Infiltration rate and bulk density measurements were made on both the swales and dunes, whilst measurements of aggregate stability and particle size analysis were only carried out on samples from the swales. When the data for the properties bulk density, infiltration rate and particle size analysis were subjected to an analysis of variance, there were no significant effects of stocking rates. Therefore, these results are presented as an average of the three stocking rates. As the main treatment effect on particle size occurred with the coarse sand fraction, only this data is presented. As there was some effect of stocking rate on aggregate stability, the three rates are kept separate.

Table 1. Bulk density values for the soil strata on the Boolathana grazing trial.

Soil strata	Bulk density (0 - 5 cm) (tonnes/m^3) Swale		Dune	
	Good	Poor	Good	Poor
Bushmound/under-shrub	1.38	1.55	1.42	1.39
Inter-bush/inter-shrub	1.62	1.60	1.59	1.58

LSD ($P < 0.05$) = 0.06

Table 2. Infiltration rates for the soil strata on the Boolathana grazing trial.

Soil strata	Infiltration rate (mm/min.) Swale		Dune	
	Good	Poor	Good	Poor
Bushmound/under-shrub	13.7	4.1	11.9	7.0
Inter-bush/inter-shrub	1.3	0.9	6.7	5.0

LSD ($P < 0.05$) = 3.7

Table 3. Coarse sand content (%) for the soil strata on the swales in the Boolathana grazing trial.

Particle size (mm)	Soil strata	Condition Good	Poor	LSD ($P < 0.05$)
0.02 - 2.0 (Coarse sand)	Bushmound	34.8	25.5	3.6
	Inter-bush	25.7	22.6	

Table 4. Aggregate stability values on the swales for the three stocking rates on the Boolathana grazing trial.

Soil strata	Stocking rate (sheep/ha)	Aggregate stability (% > 2.0 mm) Condition Good	Poor
Bushmound	0	70.50	42.95
	0.48	60.25	44.00
	0.40	57.08	24.92
Inter-bush	0	61.72	36.13
	0.48	59.29	49.88
	0.40	52.04	35.94

LSD ($P < 0.05$ = 12.36

The bulk density, infiltration rate and coarse sand results indicate that on the swales the intact bushmounds in the good condition area have more favourable soil physical properties than the inter-bush soils and also bushmounds in the poor condition area. In the poor condition area, there is very little difference in properties between bushmound and inter-bush soils. With the aggregate stability results, there was no difference between bushmound and inter-bush soils in both good and poor condition

areas. However, both the intact bushmound and inter-bush soils in the good condition area have higher aggregate stabilities than the remnant bushmound and inter-bush soils respectively in the poor condition area. There was also an effect of stocking rate on aggregate stability in bushmounds in the good and poor condition areas.

In the poor condition area, previous overgrazing in the 1920s has broken up a coherent, cryptogamic crust that stabilizes the bushmounds and allowed their contents to become dispersed. Therefore, there is very little
difference between remnant bushmounds and inter-bush soils . However, in the good condition area, the bushmounds are still very much intact, even after four to five years grazing, and their physical properties are significantly more favourable than those of the inter-bush soils. The dunes appear to have been more resilient to the period of overgrazing in the 1920s, with the under-shrub soils maintaining their more favourable physical properties compared with the inter-shrub soils. However, there was evidence that the infiltration rate measured under-shrubs was lower in the poor condition area than in the good condition area.

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