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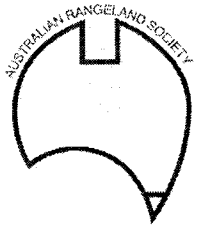

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SOILS RESEARCH ON THE BOOLATHANA GRAZING TRIAL, CARNARVON, WA

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INTRODUCTION

The grazing trial on Boolathana Station, Carnarvon, WA, was established in 1983. In 1987-88, NSCP funds were made available to study the effects of historical and current experimental grazing on soil productive potential. This document is a precis of the work done in that period in terms of landscape function analysis, measurement of nutrient pool sizes and biological pulses in various landscape strata, and conclusions as to appropriate monitoring methods with respect to soil factors.

Trial layout

The trial is located on Sable land system and is comprised of two areas : one which had been heavily grazed in the past (poor condition) and one which had not (good condition). In each area, five levels of sheep stocking rate were imposed (0.08, 0.12, 0.18, 0.27 and 0.40 sheep/ha). The soil studies were made on the lightest and heaviest stocking rate on the good and poor condition sites, as well as adjacent areas enclosed from sheep grazing. Study sites were adjacent to transects established for botanical composition studies by the WA Department of Agriculture and were selected so as to sample substantially upwind and downwind of the established watering points.

Landscape description

Sable land system is comprised of two main units :
1. Substantially flat swales with duplex textured soils, mainly vegetated by a *Maireana polypteryia* shrubland , and occupying about 57% of the land area and
2. low dunes of uniform texture mainly vegetated by *Acacia sclerosperma* and other shrubs covering the remaining 43%. During the time the soil properties were studied, drought conditions mainly existed.

Landscape function analysis

The extreme flatness of the swales means that water-mediated erosion of soil and/or macro-organic matter is minimal. However, redistribution of these resources by wind is relatively frequent, depending on season. In fact, the nature of aeolian erosion/deposition controls the long term productivity and stability of the landscape. The good condition site has a bush density such that resource redistribution is substantially local, with large proportions of material being trapped by shrubs on the dune and swale. The poor condition sites however have swales devoid of perennial vegetation capable of capturing aeolian materials, with the result that light fractions such as clays and organic matter are irrevocably lost to the system. Many of the shrub species on the dunes are unpalatable and so remain intact well into droughts thus preserving their resource entrapment capacity.

Soil measurements

The productive potential of the accretion mounds in terms of nutrient pool sizes associated with the perennial shrubs is very high relative to the inter-shrub soil, and in absolute terms is similar to agricultural soils, particularly in the immediate surface. (Tables 1, 2 and 3). The same is true of microbial respiration rate, which is a measure of biological activity of soil microfauna (Table 4).

On poor condition sites, the vestigial remains of bush mounds were no different to inter-bush soil sites in terms of nutrient pool size and biological activity.

There were no detectable differences between sites situated upwind and downwind of the watering point, however this may only mean that sheep grazing preferences in the relatively small experimental paddocks were not able to be expressed.

Consequences of the soil/landscape research

Perennial shrubs maintain soil at high productive potential due to resource entrapment and efficient nutrient cycling processes, and conserve limiting resources against loss. Long term, stable productive use of these lands requires that the bush systems be monitored, and maintained by regulation of animal numbers in times of environmental stress. In particular, the conditions of soil mound associated with each bush and the entrapment capacity of the stems and foliage by aerodynamic drag need to be monitored at key points in the landscape.

Table 1. Mean nutrient values for under versus inter-shrub sampling sites on dunes

	Under-shrub Nutrient variables						Inter-shrub Nutrient variables				
Depth (cm)	KN	OC	AN	AP	pH	Depth (cm)	KN	OC	AN	AP	pH
0-1	.070	.71	15.2	26.9	6.67	0-1	.015	.12	2.2	11.7	7.71
1-3	.063	.59	11.9	20.6	6.74	1-3	.011	.09	1.8	15.7	7.82
3-5	.049	.45	8.4	21.8	7.13	3-5	.012	.09	1.3	17.5	7.73
5-10	.031	.26	4.6	16.9	7.40	5-10	.011	.08	1.5	17.4	7.55

For all variables at a given depth, under-shrub is significantly different to inter-shrub ($P<0.05$).

KN Kjeldahl nitrogen (%)
OC Organic carbon (%)
AN Available nitrogen (mg/kg)
AP Available phosphorous (mg/kg)
pH pH in (1:5) soil-water extract

Table 2. Mean nutrient values for under versus inter-bush sites for swales in good condition

	Under-shrub Nutrient variables						Inter-shrub Nutrient variables				
Depth (cm)	KN	OC	AN	AP	pH	Depth (cm)	KN	OC	AN	AP	pH
0-1	.081	.74	15.2	14.3	7.92	0-1	.036	.29	5.2	10.7	7.54
1-3.	.063	.49	8.7	15.4	8.02	1-3	.015	.11	2.7	14.4	7.73
3-5	.049	.36	6.7	12.7	8.00	3-5	.012	.08	2.1	13.3	7.52
5-10	.034	.25	5.1	10.6	8.19	5-10	.011	.07	1.6	11.4	7.17

For all variables at a given depth, under-shrub is significantly different to inter-shrub ($P<0.05$).

KN Kjeldahl nitrogen (%)
OC Organic carbon (%)
AN Available nitrogen (mg/kg)
AP Available phosphorous (mg/kg)

pH pH in (1:5) soil-water extract

Table 3. Mean nutrient values for under versus inter-bush for swales in poor conditions

Under-shrub Nutrient variables						Inter-shrub Nutrient variables					
Depth (cm)	KN	OC	AN	AP	pH	Depth (cm)	KN	OC	AN	AP	pH
0-1	.032	.21	2.8	5.1	8.24	0-1	.56	.37	6.7	12.8	7.77
1-3	.021	.12	2.8	7.8	8.85	1-3	.023	.14	1.1	14.6	7.64
3-5	.020	.11	1.8	9.4	8.88	3-5	.015	.08	0.1	11.6	7.81
5-10	.022	.19	.07	10.7	8.48	5-10	.015	.08	1.2	9.7	7.45

There are no significant differences for a given depth for any variable ($P<0.05$).

KN Kjeldahl nitrogen (%)
OC Organic carbon (%)
AN Available nitrogen (mg/kg)
AP Available phosphorous (mg/kg)
pH pH (1:5) soil-water extract

Table 4. Summary of microbial respiration values (mg $CO_2/m^2/h$)

Range	Condition	Stocking rate (sheep/ha)	Swale Mound	Swale Intermound	Dune Shrub	Dune Intershrub
Good		0	255	108	245	59
		0.08	280	115	245	82
		0.40	245	118	213	77
Poor		0	122*	151	227	68
		0.08	82*	104	195	127
		0.40	63*	75	243	56

* These values are for remnant bushmounds. Values for intact bushmounds in this conditions class are 196, 208 and 197 respectively.