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DEGRADATION AND POTENTIAL FOR RECOVERY IN SOME CENTRAL AUSTRALIAN RANGELANDS: I. SOILS AND LANDSCAPE.

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ABSTRACT

We studied three sites in Central Australia with a range of use by cattle to see whether the soil had lost its capacity to support the vegetation assemblages present prior to grazing, and also to investigate whether degradation processes might reverse if stocking policy is changed. On the most heavily utilised sites, the soils were unstable and infertile and the landscape had lost nearly all its capacity to trap and use scarce resources effectively. The moderately utilised site had lost some of the soil/landscape productive potential, but could improve given good seasons and light stocking.

A site which had been de-stocked for 10 years had stable, fertile soils and a number of means in the landscape of capturing and utilising scarce resources such as water, top-soil and organic matter.

INTRODUCTION

The calcareous shrubby grasslands of Central Australia are highly preferred grazing for cattle. As a consequence, there has been heavy utilisation of the pasture, and the landscape has received persistent trampling and/or treading by cattle.

In these circumstances, can we assess or predict whether vegetation change is reversible by changes to stocking management, or not, because the condition of the soil as a habitat for grazed species has been degraded or destroyed?

To answer this question, we need to understand how physiographic features, vegetation and soil properties control scarce resources such as water and organic matter in relatively undegraded systems, then investigate how those processes and properties have altered in pasture which are perceived to be degraded.

METHODS

We selected three areas with a range of grazing histories for our study: Site 1, 0.3 km from a dam and actively grazed; Site 2, 4.5 km from the dam open to grazing; and site 3, a similar distance from a dam as site 2 but having been fenced off and ungrazed by cattle for 10 years. At each site we set up a transect about 300 m long running directly down the maximum slope. The transect was divided into a number of strata using geomorphic and soil surface descriptors to discriminate the strata and to infer their functional attributes (eg run-off slope, sand bank, depositional zone etc). An accurate levels survey was made at 1m intervals along the transect and the data used to plot the landform shape, and locate the strata on it. Soil samples were taken in triplicate at random positions in each landscape stratum and analysed later in the laboratory for organic carbon, nitrogen, available phosphorus, pH and electrical conductivity. Soil respiration measurements adjacent to the soil sampling sites were also made, over a 24 hour interval.

RESULTS AND DISCUSSION

Table 1 indicates the landscape strata types identified at the three sites and characterises their size and soil stability.

Some very unstable soil surfaces are the exclusive domain of Site 1 (nearest dam), whilst the most stable soils are on Site 3. In addition, the relative areas of unstable soil decreased form Site 1 to Site 3; stable soils showed the opposite trend.

In terms of nutrient pool sizes and biological activity, soil strata assessed as most stable were also more fertile. Soil respiration values for Site 1 are unable to be used, as erosion has exposed richly calcareous surfaces which gave off copious amounts of CO_2 when wet, due to decomposition of limestone by rain which is effectively acid.

These soil and landscape data are supported by plant life-form, palatability and productivity data which is reported in a complementary presentation (Friedel and Tongway).

Taking these approaches together, it is possible to attribute pasture condition to underlying soil properties which affect pasture growth, as well as germination/establishment likelihood. The physical models of ecosystem function permit the judgement to be made about reversibility of pasture condition by stock management alone within an appropriate management time frame. We can specify when more interventionist measures must be made to rehabilitate the soil resource and give pasture species a chance to establish.

Geomorphic Unit	Site 1	Site 2	Site 3
Run-off Slope	51% very unstable	75% moderately stable	51% stable
Sandy Colluvial Sheet	36% very unstable	zero	zero
Sandy Banks	13% unstable	15% moderately stable	zero
Sandy Hummocks	zero	10% moderately stable	26% Moderately stable
Depositional Zone	zero	zero	23% very stable

Table 1. Relative proportions of geomorphic strata and soil stability on the three study transects.