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SEED BANKS AND SOIL LOSS IN GRAZED ARID GRASSLANDS - SOME PRELIMINARY RESULTS

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ABSTRACT

We investigated herbage dynamics, soil mobility and soil seed banks along a gradient of grazing in arid calcareous grasslands. Grazing-induced soil loss appeared to precede major compositional change in vegetation in these grasslands. Despite greater soil mobility closer to a watering point, particularly at the closest-in of five sites, herbage recovery after rain was indistinguishable amongst the three nearest sites. We have no evidence as yet of a grazing-induced gradient in the soil seed bank.

INTRODUCTION

When an area becomes degraded the breakdown in ecological processes can lead to a loss in its ability to respond to rainfall. Previous studies in calcareous grasslands in central Australia showed that water infiltration was not inhibited in degraded areas close to watering points nor were nutrient levels critically low. The failure of plants to germinate and establish may thus be due to a lack of propagules. Insufficient seed can in turn have two causes: one, that the amount of viable seed arriving at a site is too low, and the other, that the amount of viable seed arriving at the site is sufficient but the means to keep it there, and for it thus to become part of the soil seed bank, are inadequate.

Here we report part of a study to address these and related issues. We present two aspects: the dynamics of on-site herbage species (which will affect seed supply), and glasshouse germination trials of soils from the sites (as an index of the soil seed bank). We also present information, gained serendipitously from seed traps, on soil loss from the sites.

METHODS

The study was located 150 km to the south-east of Alice Springs in grazed calcareous grasslands. Five measurement sites were set up along a grazing gradient, with the most intensely grazed site being 500 m from the watering point and the least grazed 6 km from the watering point. Six-monthly vegetation surveys were undertaken post-winter and post-summer in which the frequency of all non-woody species at each site was assessed within an area of 150 × 150 m, subdivided into nine 50 × 50 m quadrats. Soil cores were taken from the same areas on each occasion for germination trials in the glasshouse, to give an estimate of the seed bank. Pit traps, 20 cm in diameter, were dug into the ground to catch the seed which blew or was washed along the ground. The traps were emptied every two months and the collected seed and soil were weighed.

RESULTS AND DISCUSSION

Vegetation

Three vegetation surveys have been completed to date. The first was post-winter 1994 after a long dry period, the second post-summer 1995 after good rains and the last post-winter 1995 after slightly below average rainfall. Classifying the data from all quadrats using the PATN package (Belbin 1987) produced three main groups corresponding to the three sampling occasions, indicating that seasonal differences were the most influential factor. Within the post-winter 1994 group, quadrats grouped according to sites, and sites were ordered from 1 to 5; sites 1 and 2 were most similar. Sites were less clearly distinguished within the other two seasonal groups, but sites 1, 2 and 3 were separated from sites 4 and 5 in both cases. Thus it appears that grazing utilisation in this particular area had established a gradient in herbage composition over an extended period without rain but, following rain, the more heavily grazed sites made at least a partial recovery.

Seed Bank

Glasshouse germination trials have been undertaken with post-summer 1995 soils, under both winter and summer conditions. Nearly all the dominant species present in the vegetation surveys germinated in the trials. For a few species, the mean number of germinants for each site was proportional to the frequency of that species in the vegetation surveys before and after the soil collections. For example *Chenopodium* spp. germinated in high numbers in soils taken from sites 3 and 4, and were most common in the vegetation surveys at those same sites. The winter germinant *Lepidium phlebopetalum* was most frequent at site 3 in both the vegetation surveys and the winter germination trial. The dominant grasses throughout were *Enneapogon avenaceus* and *E. cylindricus.* Problems with identification of these species in the glasshouse have meant the relationship between the seed bank of the individual species and the vegetation surveys cannot be determined. However *Enneapogon* spp. have germinated relatively consistently in soils from every site. More germinations will be required to understand the dynamic nature of the seed bank under different seasonal conditions but, thus far, we have no indication of a grazing-induced gradient in the seed bank.

Soil Loss

When we installed pit traps at each site to collect seed moving along the ground, we also inadvertently trapped mobile soil. High summer rainfall in January 1995, which occurred after a long dry period, was responsible for substantial amounts of soil being collected in traps in February 1995, the highest being at site 1 and least at site 5 (Table 1). The high plant cover on all sites after this rainfall and the lack of rain in February and March probably minimised subsequent soil movement by water. The absence of a gradient in April 1995 may indicate minor general soil movement by wind.

Table 1. Mean weight of soil (gm) collected from 20 cm diameter pit traps at two-monthly intervals, from sites 1-5 at increasing distance from a watering point. Mean rainfall at the sites for the preceding interval is given in brackets.

Site	Dec 94 (35.1 mm)	Feb 95 (128.2 mm)	Apr 95 (4.3 mm)	Jun 95 (24.1 mm)	Aug 95 (37.6 mm)	Oct 95 (9.6 mm)	Dec 95 (34.3 mm)
1	260.1	751.1	17.0	16.7	10.1	23.4	97.9
2	151.4	410.9	15.9	14.4	9.9	23.2	91.4
3	157.1	273.2	13.3	12.3	9.4	14.4	63.5
4	124.6	231.6	18.8	9.6	9.6	16.6	56.1
5	70.5	230.3	15.3	9.0	8.2	9.5	34.5

CONCLUSIONS

As soil loss proceeds, we speculate that seed will be resident in the soil for shorter periods and stable germination niches may become increasingly rare. Soil stability rather than seed supply may limit the seed bank in the first instance.

REFERENCE

Belbin, L. (1987). PATN Pattern analysis package - reference manual. CSIRO Division of Wildlife and Ecology, Canberra.