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Drought, forage utilization, and their effects on the survival and recruitment of grasses of the mulga (Acacia aneura) woodlands.

by

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Abstract

In a mulga (Acacia aneura) woodland pasture, the survival of mature grasses and their seedlings was more strongly influenced by seasonal conditions than by grazing, although heavily grazed pastures fared worst. After two years of very dry weather, very few of the plants initially present were still alive. Subsequent pasture regeneration was heavily dependent on seedlings, apparently recruited at the end of the dry period. Undesirable grasses re-established more readily than the principal desirable ones. The implications of this for pasture management are discussed.

Introduction

A major question facing everyone associated with native pastures is whether the species compositions of such pastures have altered as a result of European settlement, and if so, in what ways.

One way of answering the question is to consider the fates of established plants and their seedlings. If the rates of mortality of mature plants and establishment of seedlings are similar, the species would be expected to maintain its position in the ecosystem. If an imbalance exists, the species will either increase or decrease as a fraction of the total pasture, depending on the direction of the imbalance. A long term perspective of such relationships must be adopted as significant changes may occur over decades rather than years. The effects of different seasons and levels of pasture utilization may be major confounding factors, especially in the short term.

Accepted local wisdom in the mulga woodland pastures of S.W. Qld is that wiregrasses (Aristida spp.) are increasing at the expense of more valuable grasses. If true, this is cause for great concern as wiregrasses provide inferior forage and the seeds are a costly contaminant of fleeces. However, such observations are based on anecdotal evidence with all the pitfalls that that implies.

This paper presents preliminary findings of a grazing experiment, part of whose purpose was to examine the extent to which pasture utilization alters the species composition of mulga woodland pasture.

Materials and Methods

The experiment site was located in mulga woodlands on 'Arabella' station, approximately 30 km east of Charleville. The paddocks within the site are referred to hereafter as the 80% paddock (22 ha), the 50% paddock (55 ha), the 35% paddock (46 ha), the 20% paddock (110 ha), and the 0% paddock (two ungrazed exclosures, both of 2 ha). The percentages refer to the level of utilization of forage and was estimated as follows. In most years, 10% or less of annual forage production occurs during the 6 winter months (Christie 1978). Hence, the forage at the end of March of each year is that available to support livestock until the following summer, if not later, so stock numbers should be adjusted accordingly. On the first of April every year, each paddock was sampled to estimate the available forage, including mulga leaf within browsing range. Assuming that each sheep has an annual requirement of 400 kg of dry matter, the number of sheep in each paddock is adjusted each April so as to consume 80% of the available forage in the 80% paddock, 50% in the 50% paddock, and so on. Hence, the stocking policy is directed towards the consumption of a known fraction of forage each year, rather than the maintenance of constant numbers of livestock.

An initial survey of the site, using a line transect technique indicated that the four perennial grasses, Aristida spp., Thyridolepis mitchelliana, Monachather paradoxa, and Digitaria ammophila, comprised more than 90% of all grasses in all paddocks. Twenty-six permanent quadrats (1 m x 1 m) were established in each paddock and the location of each individual plant of the four preceding species in each quadrat of each paddock was recorded in January 1979. Subsequent recording was limited to occasions preceded by sufficient rain to allow a distinction to be made between live and dead plants and species. Such occasions occurred in May 1979, September 1979, November 1980, and April 1981. Rainfall over this period is shown in Table 1. Comparing current with previous records on the second and subsequent occasions allowed plants to be classified as seedlings, live plants, or dead plants. Seedlings embraced all new plants with three or more leaves. Younger seedlings could not be identified accurately and were excluded. Adjustments were made for apparently dead plants which subsequently resprouted.

Table 1. Summer and winter rainfalls at 'Arabella' between 1/4/1978 and 31/3/1981 both as absolute amounts and as a fraction of the long term average.

Period	Rainfall (mm)	% of long term average
1/4/78 to 31/9/78	323	214%
1/10/78 to 31/3/79	151	42%
1/4/79 to 31/9/79	82	54%
1/10/79 to 31/3/80	78	22%
1/4/80 to 31/9/80	99	66%
1/10/80 to 31/3/81	332	93%

Results and Discussion

The number of individuals of both species groups in each paddock in January 1979 is presented as a base of 100 and changes in their numbers are expressed relative to this base (Figure 1). The initial frequencies of both groups of species are shown on the January base. The four grasses occur with different frequencies in each paddock. It seems likely that a major part of the variation was caused by a wildfire which burnt through parts of the 20% and 35% paddocks between the pilot survey and the first detailed recording in January 1979. However, this does not affect the interpretation of the data. The method used in this investigation examines a known population of individual plants each of which can be re-examined as long as the plant lives.

Between January 1979 and September 1979, a small proportion of both *Aristida* spp and the other grasses died. Less than 10% of the plants alive in January died before May and up to 21% of those alive in May failed to survive until September. Offsetting this was seedling recruitment over the same period resulting in a net increase in the numbers of live plants ranging between 16% and 51% (*Aristida* spp.) and 12% and 39% (other grasses). Differences between treatments were not marked although the net increases were lower in the 80%, 20% and 35% paddocks, possibly as a result of heavy grazing in the first paddock and fire in the other two.

The increase in plant numbers occurred despite the low rainfall received during the summer of 1978/79 and winter of 1979 (Table 1). However, the winter of 1978 was comparatively wet with more than twice the long-term average being received. Some residual benefit may have been derived from

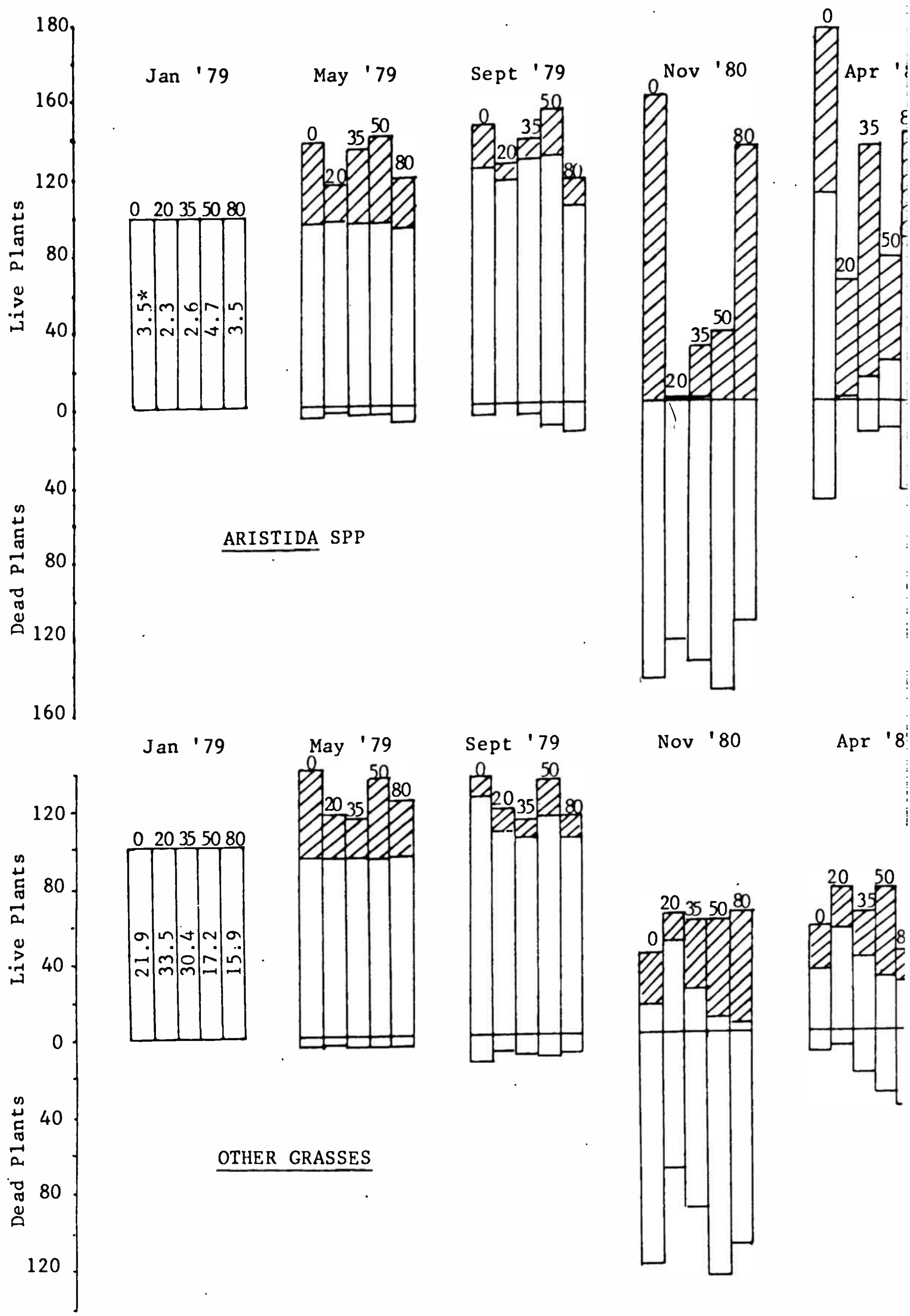

Figure 1. The effects of 0%, 20%, 35%, 50% and 80% total forage utilization on the survival of plants and recruitment of seedlings (crosshatched) of Aristida spp and other perennial grasses in mulga (Acacia aneura) woodland pasture between January 1979 and April 198 Data is shown relative to January 1979 expressed as a base of 100. (* Initial frequency of individuals per square metre.)

this over the following 12 months. The winter of 1979/80 and summer of 1980 continued the trend of very low rainfall.

In mid-October 1980, a total of 102 mm of rain fell over a 13 day period, promoting sufficient growth to allow recording in November 1980. No *Aristidas* survived the protracted dry period in any of the 0%, 50%, or 80% paddocks, and less than 2% survived in the 20% and 35% paddocks. Of the other grasses, less than 20% of the plants alive the previous year survived except in the 20% paddock in which 40% survived. The great majority of plants present in November 1980 were recently recruited seedlings probably germinating after the October rain.

Seedling recruitment of other grasses by November 1980 was sufficient to lift the total numbers of individuals to between 42% and 63% of the levels of January 1979. Greater numbers of seedlings were recorded in the more heavily grazed paddocks. About half of the seedlings died before April 1981 but germination over the same period more than replaced losses except in the 80% paddock which declined to 43% of its population of January 1979.

In the 0% and 80% paddocks of November 1980, there were more *Aristida* plants than at any previous time and all were seedlings. Fewer seedlings were recorded in the 35% and 50% paddocks and none in the 20% paddock, although they were present but too small to be identified.

Between November 1980 and April 1981, *Aristida* seedlings were recruited at a higher relative rate than seedlings of the other grasses. While about half the seedlings recorded in November 1980 died before April 1981 all paddocks showed a net gain over that period. *Aristida* numbers in both 0% and 80% paddocks were greater than on any earlier occasion.

The data from the 20% paddock, and to a lesser extent the 35% paddock, must be interpreted with care. The effects of the fire mentioned earlier are confounded with those of grazing pressure and may be responsible for some of the apparently anomalous results. For instance, the greater survival of the three desirable grasses may be because the fire destroyed older, larger plants but not smaller ones with lesser amounts of fuel. The loss of large plants might decrease interplant competition and allow a greater survival rate during the ensuing dry period.

Drought conditons during the 1979/80 summer resulted in minor stock losses in the 20%, 35%, and 50% paddocks. Between November 1979 and February 1980, two thirds of the sheep in the 80% paddock were lost and the paddock was destocked for 12 months commencing in April 1980 as there was insufficient forage to support any livestock. The subsequent recovery of the 80% paddock needs to be viewed in the light of a pasture overgrazed to the point of collapse and allowed to recover subject to grazing only by native herbivores. A comparison with the ungrazed exclosures (0% paddock) (figure 1) shows that, except for a flush of germination by the three desirable grasses in November 1980, seedling recruitment and plant survival was poorer in the 80% paddock. This is probably due to heavy grazing diminishing both the seed pool and the surface litter necessary for successful establishment.

In assessing the implications of these data for management of rangeland pastures, it must be stressed that during the two year drought nearly all the original plants perished and were replaced by seedlings. This change was not apparent from the periodic visual appraisals of the pasture undertaken 6 or more times a year. Such discrepancies between data and subjective impressions underline the pitfalls of placing undue reliance on visual and anecdotal evidence in assessing pasture condition.

Management practices need to be adjusted to take into account the large contribution made to pasture recovery by seedlings and the relatively trivial contribution by established grasses. Seedlings need time to grow and establish. There is little reason to believe that grazing small seedlings enhances their survival.

Prior to european settlement, droughts were accompanied by attrition of the indigenous herbivores whose numbers increased through natural reproduction when good seasons returned. Thus, seedlings were subjected to only light grazing and probably had reasonable opportunity to establish. This contrasts strongly with modern pasture management. Once useful rain has fallen, a grazier is likely to do either or both of two things. Firstly, he will cease pushing mulga, and secondly, he may bring in stock from outside. The grazing pressure on seedlings must be much greater than before european settlement. It is difficult to be optimistic that under such a system pasture productivity can be maintained in the longer term with existing management.

The maintenance of plant numbers is important in these pastures but so too is the pasture composition. _Aristida_ spp. recovered more rapidly than the three desirable grasses, _Thyridolepis mitchelliana_, _Monachather paradoxa_, and _Digitaria ammophila_. Given the undesirable nature of _Aristida_ spp., the speed and extent of its recovery must cause apprehension.

It remains to be seen whether _Aristida_ spp. has gained a permanent advantage and whether the other species will return to their former levels. The rapid increase of _Aristida_ spp. in ungrazed paddocks suggests that the advantage may be more transient than real. Nevertheless, the reliance on seedlings for regeneration of all paddocks and the greater attrition rates in the more heavily grazed pastures underline the potential to destabilize the pasture. Excessive grazing at inopportune times may cause serious and, perhaps, permanent damage. Until a great more is known about the recovery potential of mulga pastures, prudent management indicates lenient grazing is desirable, especially immediately after a protracted dry period, to allow adequate seedling establishment.

Reference

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