Population dynamics in *Astrebla* grassland - implications for drought management.

D.M. Orr
Charleville Pastoral Laboratory
Queensland Dept. Primary Industries
P.O. Box 282
Charleville. 4470.

Abstract

The population dynamics of *Astrebla* spp. at two levels of grazing and exclosure are expressed in the form of age structure and used to project the likely changes due to drought. It is concluded that increasing pasture utilization during drought will increasingly delay pasture recovery following drought.

Introduction

Droughts of varying extent and duration occur frequently in *Astrebla* (Mitchell grass) grasslands. These grasslands are particularly susceptible to drought because of the paucity, or in many cases the complete lack, of edible trees and shrubs. The ground layer vegetation therefore becomes susceptible to very heavy utilization during drought where livestock numbers are not reduced. The threatened demise of these important grasslands during severe droughts, for example during the 1930's and late 1960's (see Everist 1935, Williams 1978) atests to the extent of heavy utilization suffered by the vegetation resource.

This discussion paper presents data from a current study into the population dynamics of *Astrebla* spp. under two levels of grazing and exclosure and discusses the implications for the maintenance of the pasture resource during periods of drought.

Population dynamics of *Astrebla* spp.

a. Methods

Population dynamics of *Astrebla* spp. are being studied at one location in each of two commercially grazed paddocks near Blackall, Central Western Queensland. One of these paddocks, designated as heavy grazing, has been grazed at a stocking rate heavier than 'district average' while the other, designated light grazing, has been stocked at about the Queensland Lands Dept. recommended rate of 0.8 sheep ha^{-1}. The study locations in the heavy and light grazing paddocks are 5 km apart and are areas known to be subject to heavy and light grazing respectively (See Orr 1980).

Each location consists of an exclosure containing 30 permanent, one metre square quadrats and surrounded by another 30 permanent one metre square quadrats which are subject to grazing. Charting of Astrebla spp. commenced in 1976 when plants were marked as either existing plants (i.e. present prior to the 1975-6 summer) or seedlings (i.e. new plants resulting from the 1975-6 summer rainfall). Charting has continued annually allowing the age structure of the pasture uder the four treatments to be determined.

The extent of grazing at each of the two grazed locations is assessed in each quadrat in April (end of 'wet' season) and again in October (end of 'dry' season) each year using photographic standards of different levels of A. lappacea utilization.

b. Results and Discussion

Average grazing utilization for the period 1975-1980 was 10% (range 0-15%) and 30% (range 0-50%) for the light and heavy grazing treatments respectively.

An analysis of the contribution of Astrebla spp. plants to each age group as at July 1980 reveals significant differences between the treatments (Table 1).

Significant differences between paddocks in the number of plants older than five years can be explained by a greater rate of death of this age group under heavy grazing (Figure 1).

Significantly more plants in the 3-4 year age group in the heavy grazing paddock is due to greater establishment opportunities than in the light grazing paddock during the 1976-7 summer. The heavy grazing paddock had 3 separate growth periods compared to only 1 in the light grazing paddock. Similarly, the absence of plants in the 2-3 year age group is due to the complete failure of rainfall during the 1977-8 summer.

There are significantly more plants in the 1-2 and <1 year age groups under grazing than under exclosure. The reason for this effect in the 1-2 year age group was not clear, however the substantial contribution in 1980 of plants <1 year old in the grazed treatment, heavy paddock prompted sampling for seed reserves.

An analysis of Astrebla seed reserves in the top 2.5 cm at these sites at December 1980 suggests that the significant grazing effect on age structure in the 1-2 and <1 year age groups resulted from greater seed reserves in the soil (Table 2). From this, it would appear that grazing promotes seed

Table 1. Age structure (years) of *Astrebla* spp. in 30 m^2 at July 1980 under two levels of grazing and exclosure in *Astrebla* grassland

Paddock	Ungrazed/Grazed	Age (years) > 5	4-5 (1975-6 seedlings)	3-4 (1976-7 seedlings)	2-3 (1977-8 seedlings)	1-2 (1978-9 seedlings)	< 1 1979-80 seedlings
Light	Ungrazed	93^{apy}	1^{apy}	0^{apy}	$0^{\#}$	1^{apy}	1^{apy}
	Grazed	75^{apy}	23^{apy}	4^{apy}	0	7^{aqy}	5^{aqy}
Heavy	Ungrazed	63^{bpy}	5^{apy}	14^{bpy}	0	2^{apy}	7^{bpy}
	Grazed	62^{bpy}	9^{apy}	22^{bpy}	0	15^{aqy}	183^{bqz}

Means in columns with different superscripts are significantly different ($P \leqslant 0.05$)

a,b for paddock effect

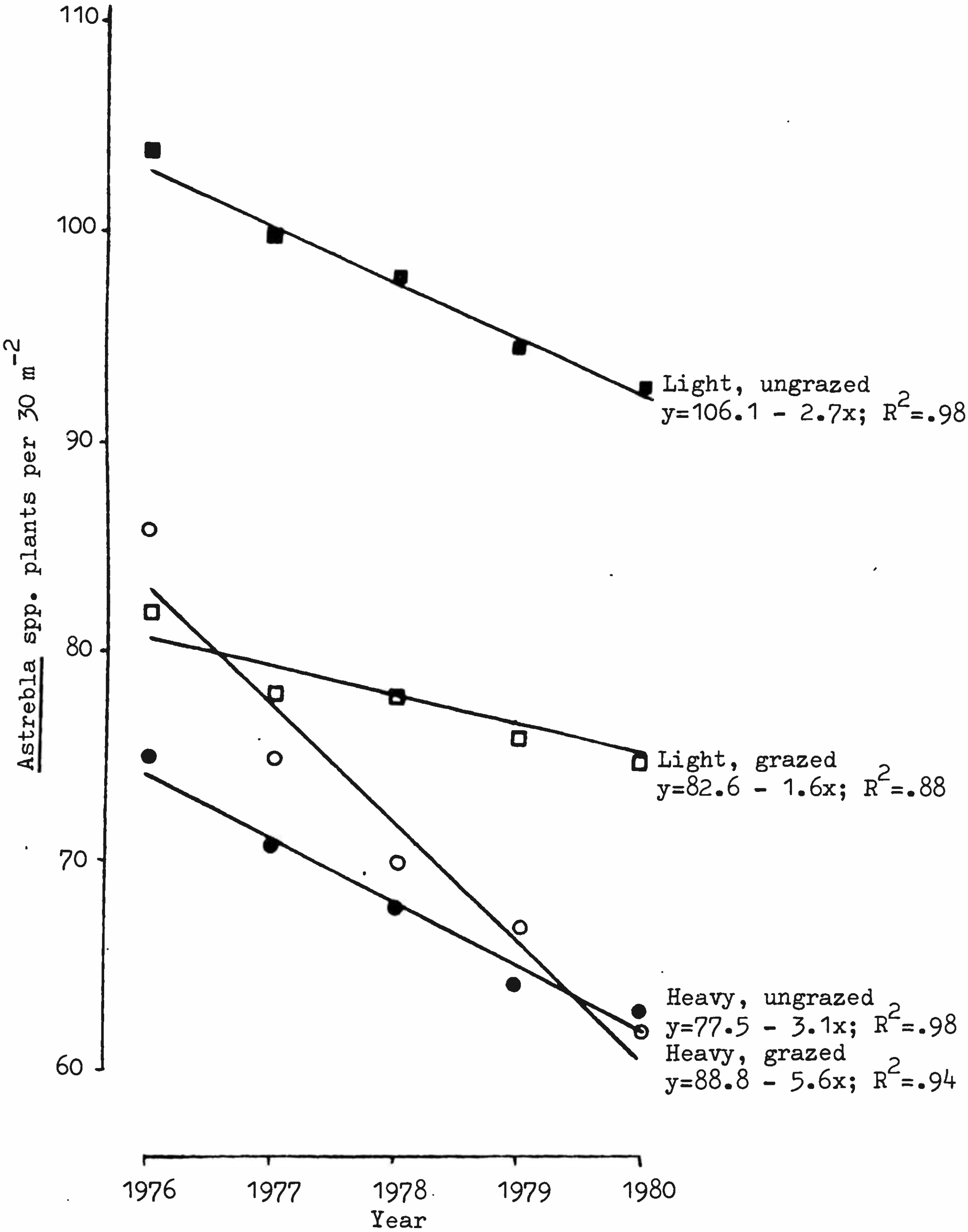
p,q for grazing effect

y,z for paddock x grazing interaction

Analysis performed on square root transformed data.

No analysis performed

Figure 1. Survival of *Astrebla* spp. (plants 30 m^{-2}) between 1976 and 1980 under two grazed and ungrazed treatments in *Astrebla* grassland



production of Astrebla spp., at least in the range of utilization experienced to date in this study.

Tentative results from this study indicate that increased utilization in Astrebla grassland results in an increased rate of Astrebla spp. plant turnover.

Table 2. Seed reserves of Astrebla spp. (seeds m^{-2}) at December 1980 under two levels of grazing and exclosure in Astrebla grassland.

Paddock	Ungrazed/Grazed	Seed Reserves
Light	Ungrazed	57^{apy}
	Grazed	124^{aqy}
Heavy	Ungrazed	102^{bpy}
	Grazed	1124^{bqz}

Means with different superscripts are significantly different ($P \leq 0.05$).

a,b for paddock effect;

p,q for grazing effect;

y,z for paddock x grazing interaction.

Analysis performed or square root transformed data.

This flux operates via a greater death rate in older plants which is compensated, under normal seasonal conditions, by increased seedling establishment. Increased seedling establishment operates via a stimulation in seed production of existing Astrebla spp. plants (at least in the range of utilization experienced in this study).

Implications for drought management

The dynamics of Astrebla spp. populations described above has occurred during a period of favourable rainfall. (Seedling recruitment of Astrebla spp. has occurred in four out of five years of recording). It is probable that drought will interfere with this cycle.

The onset of drought results in increased utilization of Astrebla spp., particularly where livestock numbers are not reduced in line with seasonal rainfall. Increased utilization can be expected to accelerate the death of existing tussocks due to increased defoliation under conditions of soil moisture stress. Thus, the maintenance of Astrebla spp. density relies largely on seedling recruitment which cannot be expected during drought. The result of increased utilization of Astrebla spp. during drought therefore, is a reduction in Astrebla spp. plant density.

A reduction in livestock numbers would appear to be the best drought management based on resource stability. Reduced livestock numbers would minimise the death of established plants through reduced defoliation. These plants can then serve as the seed source for seedling establishment under favourable conditions. Such a drought policy based on resource stability is consistent with results of an economic survey in Astrebla grassland conducted during the drought years 1966-8 to 1969-70 (Childs 1974). This survey showed that higher economic returns were associated with lower stocking rates and a rapid reduction of livestock numbers as pasture conditions deteriorated.

Recovery of Astrebla grassland following drought will be dependent on the establishment of new Astrebla spp. plants from seed reserves in the soil. Plants subject to light grazing during drought can be expected to replenish soil seed reserves rapidly. This is consistent with the results of Everist's (1935) survey which concluded that Astrebla grassland suffered no apparent damage where they had not been overstocked during drought. The build-up of seed reserves in the soil following heavy grazing, however, can be expected to take a longer period because fewer Astrebla spp. plants would survive the drought than under light grazing. Thus, recovery from drought will be influenced by the rate of increase of seed reserves and subsequent plant establishment and this will be governed by the seasonal rainfall following drought. A rapid recovery in Astrebla grassland under the influence of three consecutive years of above average rainfall has been recorded (Orr 1981).

The implication for drought management of Astrebla grassland can be summarised - increasing utilization during drought will require increasing recovery time following drought. Financial incentives should, therefore, be offered to graziers to reduce stocking rates early during drought. Such incentives will be recovered through an earlier return to pasture productivity following drought.

Acknowledgement

The continued co-operation of the land holders involved in this study is gratefully appreciated.

Thanks are due to colleagues at the Charleville Pastoral Laboratory for comments on the manuscript.

This work was supported by a grant from the Wool Research Trust Fund on the recommendation of the Australian Wool Corporation. This support is gratefully acknowledged.

References

Childs, J.C. (1974). Qd Dep. Prim. Ind. Tech. Bull. No. 1.

Everist, S.L. (1935). Qd Agric. J. 43, 374-87.

Orr, D.M. (1980). Aust. J. Agric. Res. 31, 797-820.

Orr, D.M. (1981). Aust. J. Bot. 29(5) (in press).

Williams, O.B. (1978). Proc. 1st Int. Rangel. Cong., Denver, pp. 185-6.