The response to season, exclosure and distance from water of three central Australian pasture types grazed by cattle.

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ABSTRACT

In two Mulga pasture types and in a Sandy Open Woodland, the effect of exclosure from grazing cattle during seven years,and distance from water were studied. Standing biomass levels fluctuated more in response to season and wildfire than to the treatments of exclosure and distance from water, and grazing pressures did not produce any marked deleterious effects. However, it is likely that in an extended period of low rainfall when cattle are making greater use of this country, exclosure may change species composition and benefit landscape stability. Due to the lack of change to date, grazing could continue at present stocking levels and under similar management.

INTRODUCTION

Exclosure is a recognised technique for partitioning the effects of season and the impact of livestock. Grazing pressure around a permanent watering point produces zones of influence which are dynamic rather than static. When a long exclosure radial to a watering point is erected, the effects of exclosure can be compared to the zones of grazing influence around the watering point.

Three extensive pasture types widely used by the grazing industry were studied. In the Mulga (*Acacia aneura*) lands, mixed pasture types of Mulga with an understorey of perennial grasses (Mulga Perennial), and annual and biennial grasses (Mulga Annual), occur. The Sandy Open Woodland pasture type is characterized by widely scattered trees and shrubs over biennial grasses on deep sandy soils at the base of ranges. Exclosures 3.2km long and 0.8km wide were erected adjacent to permanent watering points in Mulga country on Central Mount Wedge Station and in a Sandy Open Woodland on Mount Riddock Station in 1968. In addition to the effects of exclosure and season, wildfires burnt through the Mulga study area in 1975 and 1976 and through the Sandy Open Woodland site in late 1976. Standing biomass levels collected over the period 1972 to 1979 are presented in this paper.

RESULTS

1. Rainfall

The average annual rainfall at the Mulga site over the period 1968 to 1979 was 411mm, with a range between 181mm and 964mm while average rainfall over the same period at the Sandy Open Woodland study area was 422mm with a range between 72mm and 1,035mm.

The lowest annual rainfall measured is comparable with the driest year recorded at Alice Springs in 100 years (to 1973) while the January 1974 rainfall of 669mm in the Sandy Open Woodland nearly equalled the "wettest" year on record (to 1973) at Alice Springs. This period then has seen the extremes of precipitation for which an arid climate is known.

2. Standing Biomass

Standing biomass of the herbage layer in the Mulga Annual and Mulga Perennial varied from 217 kg ha^{-1} in 1973 to 2,377 kg ha^{-1} in 1976 (Fig. 1) in response to rainfall prior to each harvest. Total biomass in Mulga Annual did not vary appreciably from levels in Mulga Perennial in each year. Fires in February, 1975 and August, 1976 may have been responsible for the reduced standing biomass levels at the next harvest. No consistent significant effects were measured for either exclosure or distance from water.

Standing biomass in the Sandy Open Woodland varied from 551 kg ha^{-1} in 1973 to 1,870 kg ha^{-1} in 1975. The fire in late 1976 may have contributed to the significantly lower total yield in 1977, but this is also a period of lower rainfall in comparison with the previous three years. *Aristida browniana* was the dominant component in the wetter years between 1974 and 1978 comprising up to 86% of total standing biomass. In an analysis combining all years, forbs yielded less in the exclosed treatment (Exclosed: 147 kg^{-1}; Not Exclosed: 200 kg ha^{-1}). A higher biomass level of *Aristida browniana* at 3.2 kms was the only consistent effect shown with distance from water.

DISCUSSION

Exclosure and distance from water produced very few consistent significant trends in standing biomass in the seven years of data collection apart from less forb in the exclosed area and greater *Aristida browniana* at 3.2 km in the Sandy Open Woodland. In comparison with the main treatments, season produced very large fluctuations in all pasture types, e.g. there was a tenfold difference in standing biomass due to season over the period, while in any one year exclosure and distance from water produced less than two-fold differences. Better forb growth under grazing in the Sandy Open Woodland offers a marked nutritional advantage as forbs consistently had higher digestibilities and nitrogen contents than the dominant grass, *Aristida browniana* (Foran, unpublished data). Siebert, Squires and Hunter (1978) have shown a direct relationship between liveweight gain and dietary nitrogen in central Australia and a higher forb component in the diet should produce better liveweight gain. However, there must be a balance between landscape stability afforded by the grass component, and better animal nutrition from forbs on the Sandy Open Woodland pasture type.

The lack of treatment effects may not be unexpected as exclosure experiments in both Australia and the United States often report the effect of thirty or more years retirement (e.g. Hall, Specht and Eardley, 1964: Robertson, 1971). In addition, the middle nineteen seventies produced a flux in vegetation growth that masked grazing effects. Animal behaviour studies during this period showed that cattle spent a large proportion of their time on smaller, highly preferred land units such as floodplains and foothill fans (Hodder and Low, 1978: Low, Muller and Dudzinski, 1980). The grazing pressure expected during periods of average and lower rainfall was not experienced at either study site during these high rainfall years.

The resultant high fuel loads carried wildfires, the effects of which were difficult to differentiate from season and treatment effects.

Future studies should be located on more preferred pasture types where grazing pressure is high and controlled. The study of presumed gradients of grazing intensity with distance from water is possible with a range of grazing pressure treatments or with a number of exclosures in a paddock where animal numbers are monitored.

Although these studies were not designed to compare the productivity of pasture types, basic models were developed for standing biomass and rainfall (Fig. 2). The relationships for the mulga pasture types in central Australia had steeper slopes than that developed from the data of Christie (1978) at Charleville. These differences may be related to soil fertility status, plant composition and previous grazing history. The relationship derived for the Sandy Open Woodland indicates a more productive biomass-rainfall relationship than that developed from the data of Lendon and Ross (1978) which may be due to greater soil moisture availability or to higher accumulated biomass levels which increases the standing biomass intercept. The relationships are unlikely to be linear throughout the full range of rainfalls as we would expect a rapid decline in standing biomass below 50mm and a plateau above 500 to 600mm. Simple growth models of this type can find wide application in rangeland management, particularly in the areas of stocking rate assessment and drought declaration policy.

On three pasture types in central Australia, grazing pressures have not produced any marked deleterious effects during the study period.

It is likely, that in an extended period of low rainfall when cattle are making greater use of this country, exclosure may change species composition and benefit landscape stability. However, due to the lack of change to date, grazing may as well continue at present stocking levels and under similar management.

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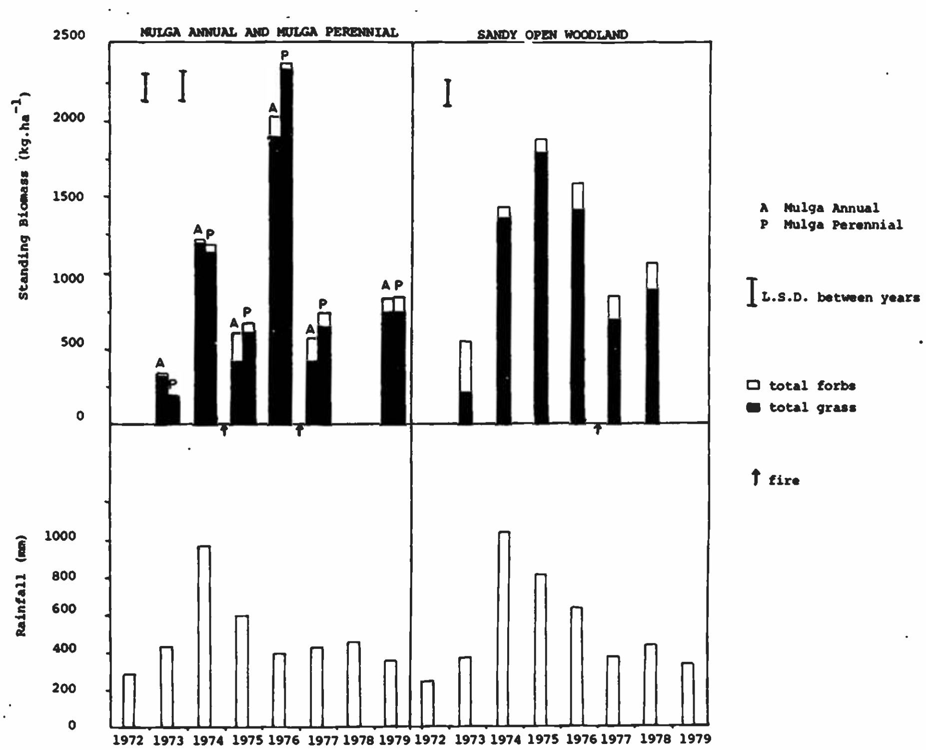

Fig. 1 Standing biomass levels (kg. ha^{-1}) and annual rainfall (mm).

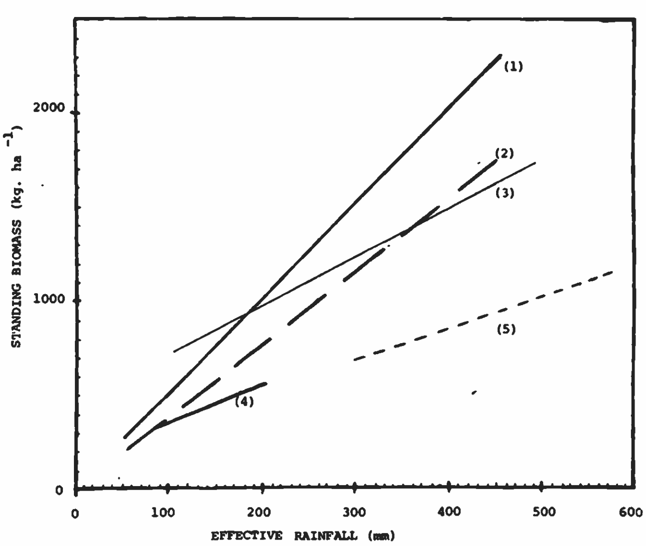

Fig. 2. Regression relationships between effective rainfall and dry matter production for four sites in Australian rangelands.

(1) Mulga Perennial, Central Mt. Wedge, central Australia, 1972-1979 $y = -4.0 + 5.1x$ (r^2.9)

(2) Mulga Annual, Central Mt. Wedge, central Australia, 1972-1979 $y = -1.4 + 3.9x$ (r^2.8)

(3) Sandy Open Woodland, Mt. Riddock, central Australia, 1972-1978 $y = 462.8 + 2.6x$ (r^2.8)

(4) Kunoth Paddock, central Australia, 1970-1972, (from Lendon and Ross, 1978) $y = 137.5 + 2.1x$ (r^2.9)

(5) Charleville, Queensland 1974-1977 (from Christie 1978). $y = 183.5 + 1.7x$ (r^2.9)