

PROCEEDINGS OF THE AUSTRALIAN RANGELAND SOCIETY BIENNIAL CONFERENCE
Official publication of The Australian Rangeland Society

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The reference for this article should be in this general form;

Author family name, initials (year). Title. *In*: Proceedings of the nth Australian Rangeland Society Biennial Conference. Pages. (Australian Rangeland Society: Australia).

For example:

Anderson, L., van Klinken, R. D., and Shepherd, D. (2008). Aerially surveying Mesquite (*Prosopis* spp.) in the Pilbara. *In*: 'A Climate of Change in the Rangelands. Proceedings of the 15th Australian Rangeland Society Biennial Conference'. (Ed. D. Orr) 4 pages. (Australian Rangeland Society: Australia).

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THE EFFECT OF CLIMATE AND GRAZING BY RABBITS ON SURVIVAL AND GROWTH
OF BLACK BLUEBUSH *MAIREANA PYRAMIDATA* SEEDLINGS AT MENINDEE IN
WESTERN NEW SOUTH WALES

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Abstract

The effect of climate and grazing by rabbits on black bluebush *Maireana pyramidata* seedlings growing on sand dunes and scalded loam flats was studied over a four-year period near Menindee, N.S.W.

Drought conditions which prevailed in the initial six months of the study greatly reduced seedling numbers irrespective of grazing. Subsequent drought periods had little effect on the survival of seedlings growing in ungrazed plots.

A flash flood devastated almost the entire seedling population of one plot.

Despite severe grazing by rabbits during three dry periods some seedlings, although completely defoliated, showed a remarkable ability to recover.

During the second dry period rabbits greatly reduced the shrub population on the dunes by scratching out plants, but had little effect on plants growing on the scalded loam flats.

Rabbits showed a preference for the woody parts of the bush, which affected size, growth rate and fruiting of plants.

Results show that post germination climatic conditions are important for plant establishment but that rabbits can also significantly reduce establishment of black bluebush seedlings, particularly on areas with coarse-textured soils. Black bluebush which covers extensive areas of this soil type in western New South Wales, offers protection to the soil from wind erosion.

Introduction

Black bluebush (*Maireana pyramidata* Benth) is the largest of the Australian *Maireana* species (Leigh, 1972), growing to a height of almost 2m and to a diameter of almost 3m on sandy soils (S.C.S. unpublished data).

It is a long-living, drought resistant native perennial shrub common over much of western New South Wales, and in South Australia. It grows as almost monospecific shrub communities, or in association with other bluebushes, or perennial saltbush (*Atriplex vesicaria*). It is also a common shrub component of mallee, belah-rosewood and mulga communities (Leigh, op. cit.).

Although black bluebush is one of the least palatable bluebushes it does provide some stock feed during drought. However, heavy grazing and ringbarking by sheep and rabbits in dry times have removed black bluebush from large tracts of country on the Riverine Plain (Leigh and Mulham, 1965).

Beadle (1948) records that rabbits are particularly fond of bluebush areas because digging is easy and succulent green feed is readily available. He suggests that rabbits rather than sheep may be responsible for the disappearance of *Maireana* spp. in areas of western New South Wales.

Because black bluebush is a long-living, drought-resistant plant which grows on coarse-textured soils susceptible to wind erosion, it is extremely valuable for soil protection (Beadle, op. cit; Leigh and Mulham, op. cit.).

Results of studies conducted on the establishment and growth of black bluebush at Menindee (Milthorpe, unpublished) showed a need for more data regarding the impact of climate and rabbit grazing on seedling establishment. In 1972 a trial was commenced to isolate the effects of climate from rabbit grazing on bluebush seedling survival.

The Study Area

The study site is located 16 km north-west of Menindee on land immediately behind the Lake Menindee lunette. This land consists of alternating sandy rises or dunes, with alkaline sandy soils, and scalded flats, with compact calcareous loam soils.

In 1953, a regeneration area was established on part of a stock route to study the effect of grazing on the natural vegetation. In this study plots were established both inside and outside the regeneration area.

The area is treeless with the dune crests being dominated by clumps of sandhill canegrass (*Zygochloa paradoxa*) and the flats by black bluebush (*Maireana pyramidata*). The lower, stable slopes of the dunes support both sandhill canegrass and black bluebush.

Average annual rainfall for the area is about 225 mm and rainfall is highly variable with no seasonal pattern of distribution.

Methods

The trial examined the effects of climate in the presence and absence of grazing on the growth of black bluebush seedlings on two soil types, loamy sands and calcareous loams.

Inside the regeneration area ungrazed plots were located on the slope of a low dune and on an adjacent scalded flat. Each plot was fenced with rabbit-proof netting.

Unfenced replicate plots were established outside the regeneration area and were open to grazing by rabbits and domestic stock.

Each plot measured 8.23 m² (27 feet) by 4.57 m (15 feet) and was divided into 45 x 0.914 m² (1 square yard) quadrats.

Seedlings in the original population were marked by wire pegs placed beside each plant. When plants died the pegs were removed.

Seedling counts were made 15 times between August 1972 and August 1976, at intervals of 2 to 6 months.

In August 1976 a random sample of 25 bushes from the original population in each plot (or all bushes when there were less than 25 plants remaining) was selected and the height and diameter of each bush measured. In addition all other plant species on each plot were harvested for determination of dry matter yield.

Results

Data on the survival of the original and later populations, and on average plant density, are presented in Table 1 and shown in Figures 1 and 2.

Between the second and third observations flooding of 80% of the flat killed most of the seedlings on the ungrazed plot but although partially flooded there was little effect on plants on the slightly higher grazed plot.

TABLE 1 - Black Bluebush Population and Density Data

	23.10.72	22.2.73	30.4.73	18.6.73	28.8.73	31.10.73	16.4.74	16.8.74	13.11.74	20.3.75	17.7.75	31.10.75	27.2.76	6.8.76	Total Average Plant Density (Pl/m ²)
<u>UNGRAZED DUNE</u>															
Original Population	459	335	210	200	184	177	173	172	172	172	172	172	172	172	172
Later Populations	-	17	10	21	29	29	38	32	27	33	37	40	40	39	12.20
% of Original															5.61
Population Remaining	100	73	46	44	40	39	38	38	38	38	38	38	38	38	38
<u>GRAZED DUNE</u>															
Original Population	540	398	206	189	162	158	157	140	132	130	87	76	75	75	75
Later Populations	-	97	32	43	43	40	39	21	19	16	11	6	11	9	14.35
% of Original															2.23
Population Remaining	100	74	38	35	30	29	29	26	24	24	16	14	14	14	14
<u>UNGRAZED FLAT</u>															
Original Population	294	129	*12	10	6	6	6	6	6	6	6	6	6	6	6
Later Populations	-	8	1	0	0	4	3	3	3	8	8	7	7	10	*80% flooded and plants lost
% of Original															7.82
Population Remaining	100	44	4	3	2	2	2	2	2	2	2	2	2	2	0.43
<u>GRAZED FLAT</u>															
Original Population	298	126	53	46	35	34	32	31	31	29	28	28	27	27	27
Later Populations	-	7	5	6	6	18	20	35	27	23	25	26	27	26	7.92
% of Original															1.41
Population Remaining	100	42	18	15	12	11	11	10	10	10	9	9	9	9	9

Figure 1 :- Survival of Grazed and Ungrazed Black Bluebush with Time.
Original Population

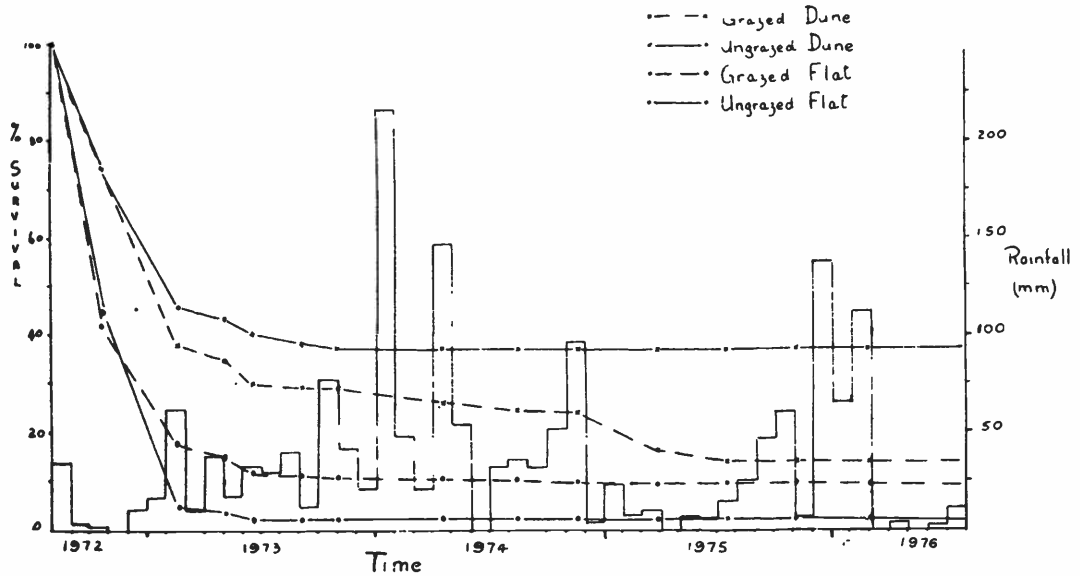
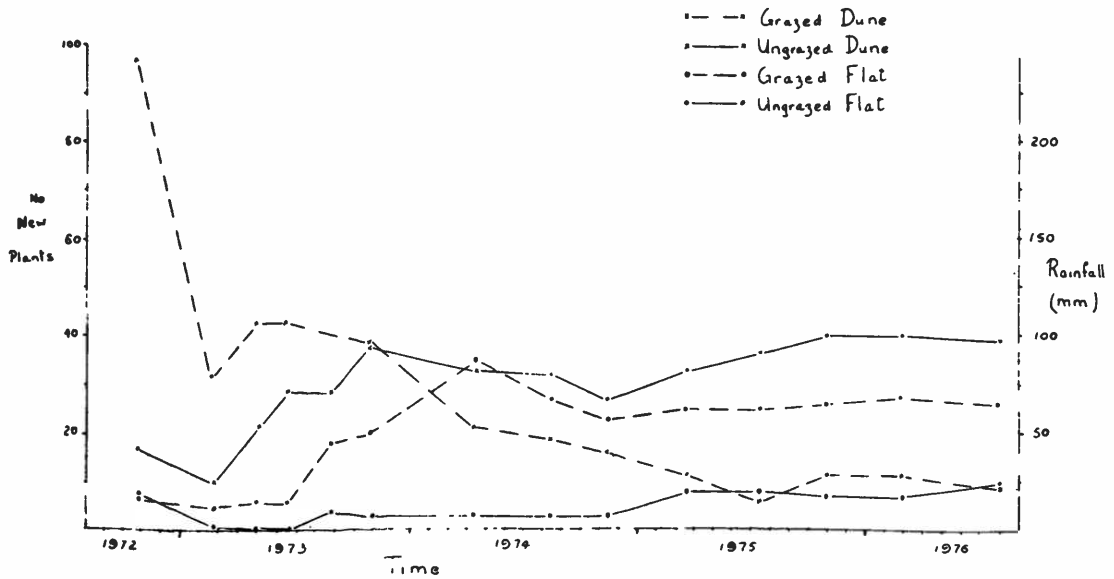


Figure 2 :- Survival of Grazed and Ungrazed Black Bluebush with Time.
Subsequent Populations



During the second and third dry periods bushes throughout the area were severely grazed. The following evidence indicates that rabbits were responsible for almost all the grazing on the outside plots.

- (i) Lack of evidence of grazing by domestic stock (sightings, tracks, dung) but evidence of rabbit activity in the area (sightings, warrens, scratchings, dung).
- (ii) Neatly chewed twigs and stems on all bushes, cut off at an angle of approximately 45° which is characteristic of rabbit browsing.
- (iii) The abundance of uneaten leaf discovered at the base of grazed bushes supports Graetz (1973) comment that rabbits prefer to nibble the stems rather than the foliage of black bluebush.
- (iv) Rabbits require green feed during dry periods and black bluebush and sandhill canegrass (*Zygochloa paradoxa*) provided the only green material during dry spells, while domestic stock prefer annuals and perennial grasses even when dry and these were abundant throughout the trial.

During the second dry period several plants on each of the grazed plots were completely defoliated and only short "stumps" remained. On the dune site some bushes were so heavily grazed that they could not be found. Comments on field sheets for many plants such as "heavily grazed, rabbits"; "eaten by rabbits"; "black bluebush scratched out" were made at the March and July 1975 observations.

At the end of July favourable rainfall conditions returned and in October 1975 many of the "stumps" on the flat, and some on the dune, had re-shot.

Table 2 shows average height and diameter of 25 randomly selected bluebushes, and the dry weight of other plant species on each plot.

TABLE 2 - Size of Black Bluebush and Dry Matter Yield of Other Plant Species, August 1976

	<u>Black Bluebush Dimensions (cm)</u>		<u>Dry Matter Yield (gm)</u>		
	<u>Average Height</u>	<u>Average Diameter</u>	<u>Sandhill Canegrass</u>	<u>Other Species</u>	<u>Total</u>
Ungrazed Dune	30.2	33.8	3290	4890	8180
Grazed Dune	15.0	20.8	140	4380	4520
Ungrazed Flat	78.7	147.3	570	1360	1930
Grazed Flat	23.1	27.9	-	1320	1320

The ungrazed plots each had a greater diversity of plant species than their respective grazed plots. Despite this difference in composition, production of species other than bluebush or sandhill canegrass was almost the same for each grazed and ungrazed site, however canegrass yield varied greatly due to grazing.

The first flowering and fruiting of bushes was recorded during August 1976. Six bushes were flowering or fruiting on the ungrazed dune, one on the grazed dune, but none on either the grazed or ungrazed flat.

Discussion

The Original Population

Death in all original populations showed a remarkably similar pattern during the first 15 months of the trial. In this period reductions in plant numbers were mainly due to the interaction of climate and competition.

The rapid rate of decline in all populations to February 1973 corresponded with the first dry period, and between February and October of 1973 there was a much slower death rate which corresponded with above average rainfall conditions.

This supports Milthorpe (unpublished), who suggested that survival of black bluebush seedlings may be markedly affected by the climatic conditions immediately following plant establishment.

The population numbers had stabilised after 15 months on all sites except the grazed dune. Unfortunately flooding prevented comparison between the grazed and ungrazed flats, but on the dune grazing appeared to have reduced the population during this initial period compared with the ungrazed site.

During the extremely wet period from October 1973 to November 1974 the population declined slightly on the grazed dune. In the dry period that followed large numbers of plants died at this site due to the effects of rabbits. However, on the flat rabbits were unable to dig at the roots of bushes and only one death was recorded.

During the dry period at the end of the trial there was no record of rabbits scratching at the roots of bushes, and no deaths occurred.

The percentage of the original plants surviving at the end of the trial on the grazed dune was about one third that surviving on the ungrazed dune, which strongly suggests that rabbits are an important factor in controlling black bluebush numbers on sandy soils.

Subsequent Populations

Later populations showed behaviour in response to climate and grazing similar to that of the original population: increases and decreases in population size were closely related to rainfall conditions; flooding again killed seedlings on the ungrazed flat; populations declined or were static during the record rains of 1974 but increased in the following dry period, except on the grazed dune where there was a large decrease due to the effect of rabbits; the heavily grazed stumps of "dead" plants again re-shot after effective rainfalls; and rabbits again had a greater influence on plant numbers on the dune than on the flat due to their ability to dig in the loose sandy soils.

Effects of Grazing on Bush Growth and Seeding

Grazing of black bluebush by rabbits resulted in a distinctively smaller densely bunched bush compared with ungrazed bushes which were relatively much larger and more open.

In the grazed plots bushes were larger on the flat than the dune, and in the ungrazed plots were much larger on the flat than the dune.

A black bluebush plant growing through the rabbit-proof netting at the ungrazed flat was grazed on one side but not the other. This bush had a heavy cover of immature fruit on the ungrazed half, and almost no fruit on the grazed half, suggesting that rabbits either inhibit fruiting or eat and dislodge the fruit when grazing. This explains the greater number of fruiting bushes recorded on the ungrazed dune.

Effects of Grazing on Other Plant Species

The results as shown in Table 2 suggest that after a 5 month dry period the rabbits are heavily reliant on perennial species for forage and appear to be largely dependent on sandhill canegrass and black bluebush for food despite abundant dead ephemeral forage. This was further endorsed by the abundant visual evidence of rabbit grazing of both perennial species.

Conclusion

For the successful establishment of black bluebush seedlings favourable climatic conditions for a period of at least 6 months is critical but grazing by rabbits during these dry periods can further markedly reduce seedling populations.

Plants establishing on compact loam soils stand a better chance of survival due to the inability of rabbits to dig out the roots. However, plants on sandy soils are extremely vulnerable to "rogueing" by rabbits.

As most of the extensive areas of bluebush country in western New South Wales is notoriously bad "rabbit country" it would be expected that at least 18 months of continuous favourable climatic conditions are required for the successful establishment of black bluebush.

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