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EFFECT OF GRAZING ON AN AREA OF SEMI-ARID LAND AT MORKALLA IN THE NORTH-WEST VICTORIAN MALLEE

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Abstract

The effect of sheep and rabbits grazing on the vegetation and its regeneration measured in the 275 mm annual rainfall zone on three overgrazed sites between 1968 and 1980.

It was found that where the grazing pressure was reduced the natural revegetation slowly developed with the healing of the bare surface in enclosures. In areas where grazing continued the regeneration of herbs and forbs was insignificant or did not occur at all.

The vegetation growth is governed by rainfall, consequently the best management for both animal production and vegetation maintenance is a stocking rate that never completely defoliates the groundcover.

Introduction

Morkalla is situated in the semi-arid north-west section of the Mallee region of Victoria, near the South Australian border. The area is part of the Raak land-system where the land was taken up for grazing long before wheat-growing on the surrounding land-systems (Rowan and Downes, 1963). Here, interference with the native vegetation by introduced sheep and rabbit grazing resulted in changes and deterioration of the plant communities.

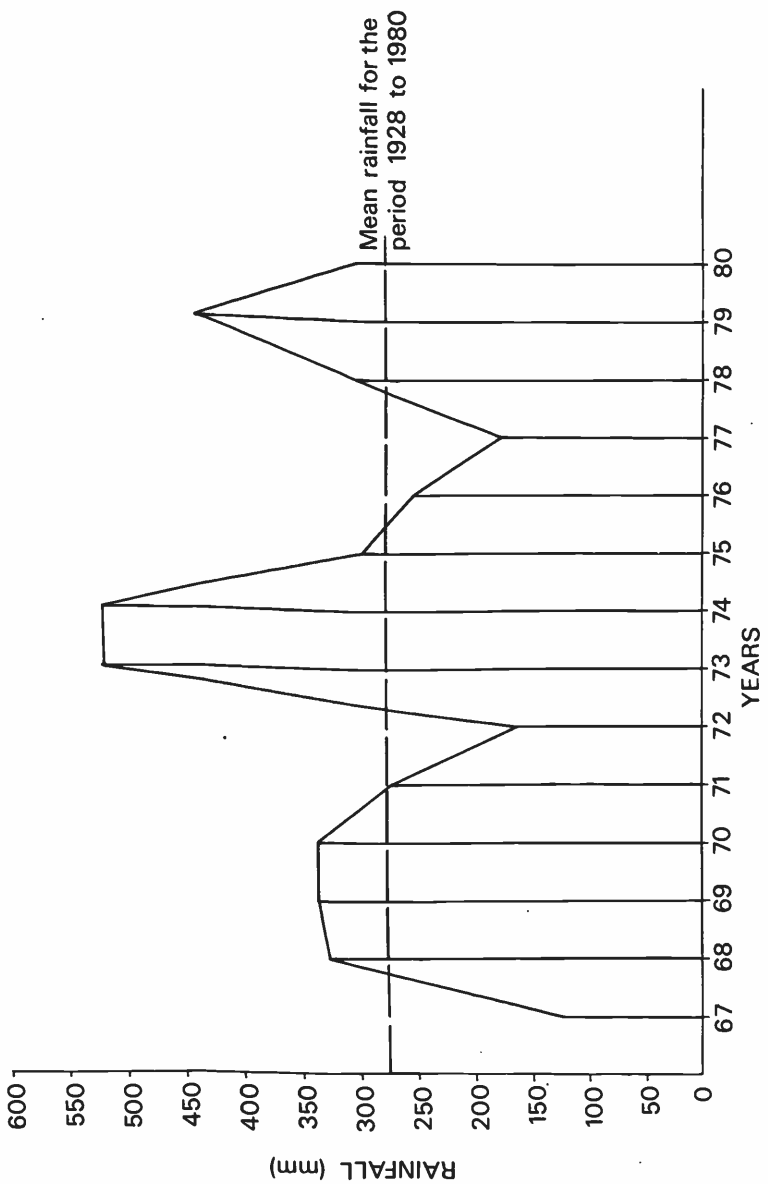


FIG. 1 MORKALLA NORTH AVERAGE YEARLY RAINFALL BETWEEN 1967 AND 1980

Most of the soil parent materials are unconsolidated aeolian strata which range in texture from sand to clay (Butler 1956, 1959, Rowan and Downes, 1963). The mean annual rainfall is 275 mm. The temperature frequently exceeds 33°C and above 38°C temperatures are common during summer. Winter is mild. Potential evaporation is approximately 152 cm per annum. Monthly potential evaporation in summer is 25.4 cm and in winter, 3.8 cm (Central Planning Authority, 1952). Growing season is normally restricted to the three winter months; however, because of the unreliability of the rainfall (percentage variability is about 26 per cent) flash regrowth can occur in late spring or summer as a result of heavy rain.

The purpose of this study was to measure the regeneration of the vegetation between 1968 and 1980 with the excluding of grazing animals so that, in the future, the effect of livestock and rabbit-grazing on the vegetation and its regeneration could be evaluated.

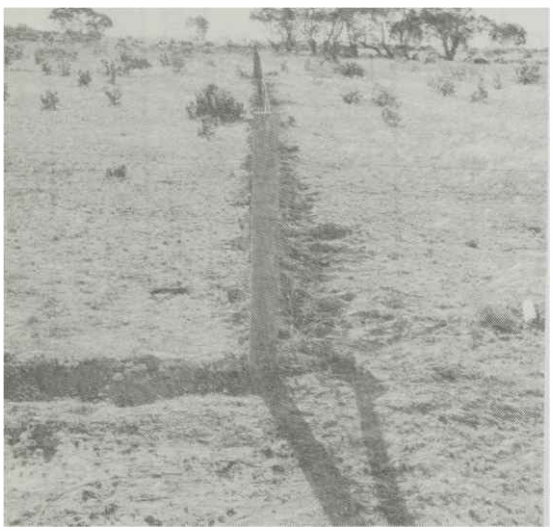
Study Area

In order to study regeneration, three sites were selected on a 7938 ha lease area grazed by 2600 sheep, rabbits and kangaroos (the number of rabbits and native fauna not known).

The original native vegetation of the area was savannah grassland containing pine, belar, buloke, mallees, rosewood, sandalwood, bluebush and saltbush. Stipa and Danthonia spp. were the main indigenous grasses.

The soils are sand and sandy clay with a low fertility level. The pH of sloping and sandy flats is 8.5 with a low chloride content (0.002 per cent in the upper 50 cm and 0.010 per cent in the lower 100 cm of sand). The soil pH of the flat sandy clay area carrying bluebush is 8.2 with a high chloride content (0.50 per cent in the upper 50 cm and 0.59 per cent in the lower 100 cm of sandy clay).

Result of more than average rainfall



Maireana (bluebush) spp. in 1968

Maireana (bluebush) spp. in 1980

Site 1 - Of 2 hectares situated on a gently-sloping area which has a cover of scattered mallee, pine and sandalwood. The groundcover mainly consisted of annual grasses and weeds.

Site 2 - Of 0.5 of a hectare on a flat area which had an original spear grass cover and the surface cover of which consisted of annual grasses and weeds. There was some scalding of the surface.

Site 3 - Of 0.5 of a hectare, had a scatter of heavily-grazed bluebush and a groundcover of predominantly weeds. The original vegetation was probably saltbush/bluebush with a groundcover of native annuals and Stipa. Where the bluebush had been eaten out, severe wind erosion had removed the sandy topsoil to varying depths, to expose a saline subsoil.

Methods

On each of the three sites plots were established, viz. control (grazed); rabbits and sheep excluded (not grazed); and sheep excluded (grazed only by rabbits). Each plot was divided into subplots and random groundcover samples were taken from each subplot yearly, using a quadrat of $\frac{1}{4}$ m^2 subdivided into 16 squares.

TABLE 1. SPECIES LIST FOR REGENERATION PLOTS AND OPEN AREA

SPECIES	ENCLOSURE (Stock and Rabbits Excluded)		GRAZED BY RABBITS (Stock Excluded)		GRAZED OPEN AREA	
	FREQUENT	PRESENT	FREQUENT	PRESENT	FREQUENT	PRESENT
Aizoaceae						
* Gasoul crystallium		X				X
Amaranthaceae						
Ptilotus spathulatus	X			X		
Boraginaceae						
* Echium plantagineum		X	X		X	
Ompalolappula concava	X					X
Campanulaceae						
Wahlenbergia stricta	X					X
Caryophyllaceae						
* Spergularia diandra		X		X	X	X
* Herniaria hirsuta			X		X	
Cruciferae						
* Brassica tournefortii		X	X		X	
* Sisymbrium irio		X		X	X	
* Sisymbrium erysmoides		X	X		X	
Alyssum linifolium	X					
Compositae						
Angianthus strictus	X			X		
Angianthus tomentosus		X				
Brachycome ciliaris	X					
Calotis erinacea	X					
Craspedia chrysantha	X					X
Craspedia pleiocephala		X		X		X
* Centaruea melitensis		X	X		X	

TABLE 1. SPECIES LIST FOR REGENERATION PLOTS AND OPEN AREA (Cont'd.)

SPECIES	ENCLOSURE (Stock and Rabbits Excluded)		GRAZED BY RABBITS (Stock Excluded)		GRAZED OPEN AREA	
	FREQUENT	PRESENT	FREQUENT	PRESENT	FREQUENT	PRESENT
Compositae (cont'd)						
Gnephosis skirrophora	X					X
Helipterum pygmeaum	X					X
* Hypocheoris glabra		X	X		X	
* Onopordum acaulon		X	X		X	
* Sonchus oleraceus		X		X	X	
* Reichardia tingitana		X		X	X	
Vittodinia triloba	X					
Geraniaceae						
Erodium crinitum	X	X	X		X	
Gramineae						
Bromus rubens	X			X	X	
Danthonia caespitosa	X					X
Danthonia setacea	X					X
* Hordeum leporinum		X		X		X
* Koeleria phleoides		X			X	
Stipa variabilis	X			X	X	
Stipa eremophila	X					X
Schismus barbaratus		X				
* Trisetum pumilum		X				X
Goodenianceae						
Goodenia pusilliflora	X					
Goodenia pinnatifida	X					
Labiatae						
Ajuga australis		X			X	

TABLE 1. SPECIES LIST FOR REGENERATION PLOTS AND OPEN AREA (Cont'd.)

SPECIES	ENCLOSURE (Stock and Rabbits Excluded)		GRAZED BY RABBITS (Stock Excluded)		GRAZED OPEN AREA	
	FREQUENT	PRESENT	FREQUENT	PRESENT	FREQUENT	PRESENT
Liliaceae						
Angnillaria dioica		X				
Papaveraceae						
* Papaver sommiferum		X		X		X
* Papaver hybridum		X		X		X
Papilionaceae						
* Medicago minia		X				X
* Medicago polymorpha	X					X
Psoralea eriantha	X					
Psoralea tenax	X					
Swainsona microphylla	X					
Umbelliferae						
Daucus glochidiatus	X			X		X
Uaryophyllaceae						
Spergularia diandra		X				
Zygophllaceae						
Zygophyllum crenatum		X		X	X	
Zygophyllum ammophilum		X		X		X
Chenopodiaceae						
Bassia diacontha	X				X	
Maireana sedifolia	X		X		X	
Maireana pyramidata	X		X		X	
Malacocera tricornis	X			X	X	
Sapindaceae						
Heterodendron oleifolium		X				

* Exotic species

Five of these groundcover samples were selected for species counts and biomass measurements. All the standing biomass within each quadrat was cut off at ground level and collected. The samples were then sorted into grasses, forbs and herbs. The dry weight of each of these categories was determined after drying at 85°C for at least 24 hours. The halophytes yield was estimated.

Results and Discussion

A list of species on the sites and within the quadrats is presented in Table 1. Fifty-five different species excluding trees were found in the regeneration plots and 38 in the outside grazed area. Of the 38 species found on the open-grazed area, the 17 common ones were all exotics. The collected data and observation indicated that plants such as Calotis erinacea, Daucus glochidiatus, Goodenia pussilliflora, G. pinnatifida, Ompalolappula concava, Ptilotus spathulatus and Wahlenbergia stricta were growing vigorously in enclosure free from grazing pressure. Legumes such as Psoralea eriantha, P. tenax and Swainsona microphylla increased their number within the protected area, being free from heavy selective grazing by rabbits.

Members of the daisy family also responded to reduced grazing pressure and were present in higher numbers within the regeneration plots, principally Calotis erinacea, Craspedia chrysantha, Gnephosis skirrophora, Helipterum pygmeaum and Vittodinia triloba. Native grasses were plentiful and growing vigorously following enclosure.

However, in years when the rainfall was more than average (see Figs. 1, 2 and 3) the native grasses formed a dense surface cover (see photo) on the sandy open flats, especially Stipa variabilis.

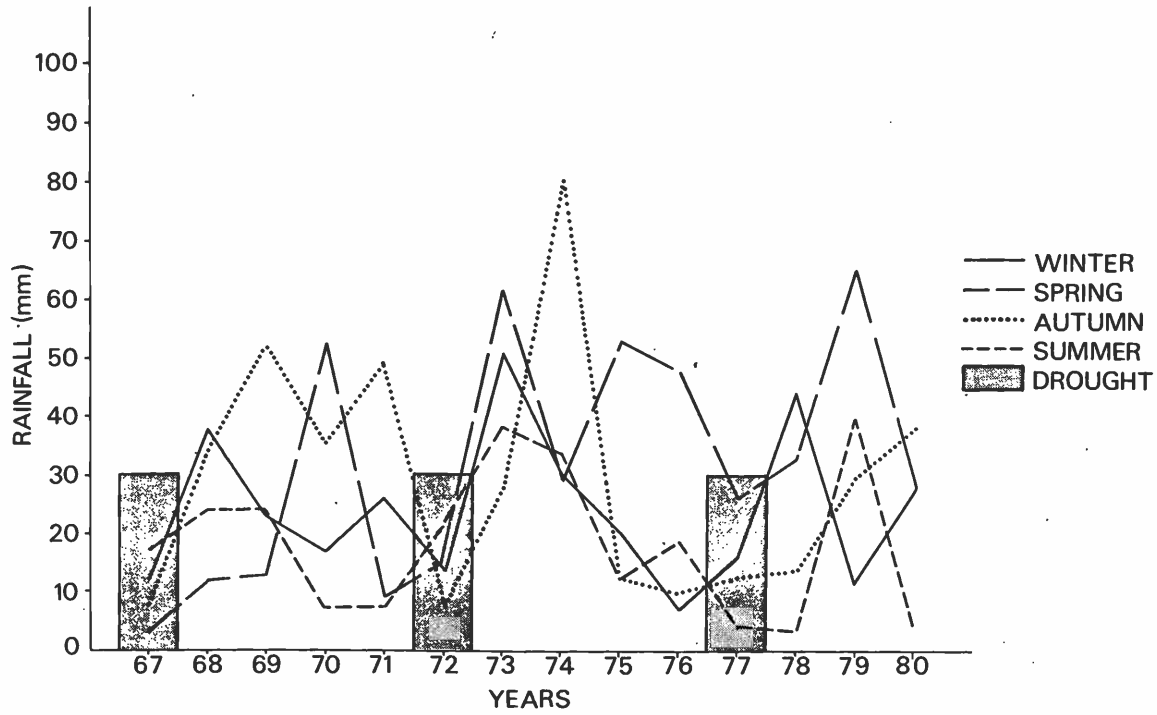


FIG. 2 SEASONAL RAINFALL DISTRIBUTION AND DROUGHT PERIODS BETWEEN 1967 AND 1980

Apart from Bromus grass within the regeneration plots and the open-grazed area a number of exotic weeds was found, the most common being Echium plantagineum, Brassica tournefortii, Sisymbrium spp., Onopordum acaulon, Hypocheoris glabra, Zygrophyllum spp. and Erodium crinitum.

One of the major components of the ground flora, Erodium crinitum, is a native species which was recorded by Zimmer (1946) (under the name E. Cygnorum) as being occasionally present in Tall and Small Mallee areas. Beadle (1948) reported it as becoming very common in Mallee areas in the south-west corner of NSW following clearing and grazing.

The weeds mostly occupy the otherwise bare areas where, after rains, the weed seed germination is rapid and usually short-lived.

The halophytic plant communities also responded to reduced grazing pressure. In the regeneration plots the Maireana spp. became larger and new plants were plentiful (see photos.). Average density of new plants was 1.4 per m^2 on the regeneration plot compared with only 0.2 on the open grazed land. The intervening space between the Maireana bushes was occupied by a sparse layer of herbaceous plants and grasses (Danthonia and Stipa). The density of these other plants is closely related to rainfall. In a year when the rainfall was good the yield was 150-450 kg/ha D.M. They are almost absent in drier years. In contrast the bluebush was quite stable (279-520 kg forage/ha).

TABLE 2. COMPOSITION OF GROUNDCOVER AND BARE GROUND

YEAR AND GROUP	NOT GRAZED (Stock and Rabbits Excluded)	GRAZED BY RABBITS ONLY (Stock Excluded)	GRAZED OPEN AREA
	PER CENT OF GROUNDCOVER		
1968			
GRASSES	11.6	10.9	10.6
FORBS AND HERBS	27.1	26.8	27.2
HALOPHYTIC spp.	1.1	1.2	2.3
BARE GROUND	60.2	61.1	59.9
1980			
GRASSES	33.1	21.5	19.9
FORBS AND HERBS	30.2	25.9	25.5
HALOPHYTIC spp.	7.2	2.0	3.1
BARE GROUND	29.5	50.6	52.5
DECREASE OF BARE GROUND BETWEEN 1968 AND 1980	-30.7	-10.5	- 7.4

Combined data of three Study Areas.

Table 2 summarises the changes which have occurred between 1968 and 1980 in the percentage of bare ground and groundcover and the composition of groundcover.

The analysis of the collected data showed that the highest decrease in bare ground occurred in the regeneration plots where the rabbits and sheep were excluded. The decrease was 30.7%. In plots where only sheep were excluded the bare ground decreased by 10.5%. The smallest decrease occurred in the control area (grazed open area) where the decrease in bare ground was 7.4%. The difference between the plots was significant ($P<0.01$).

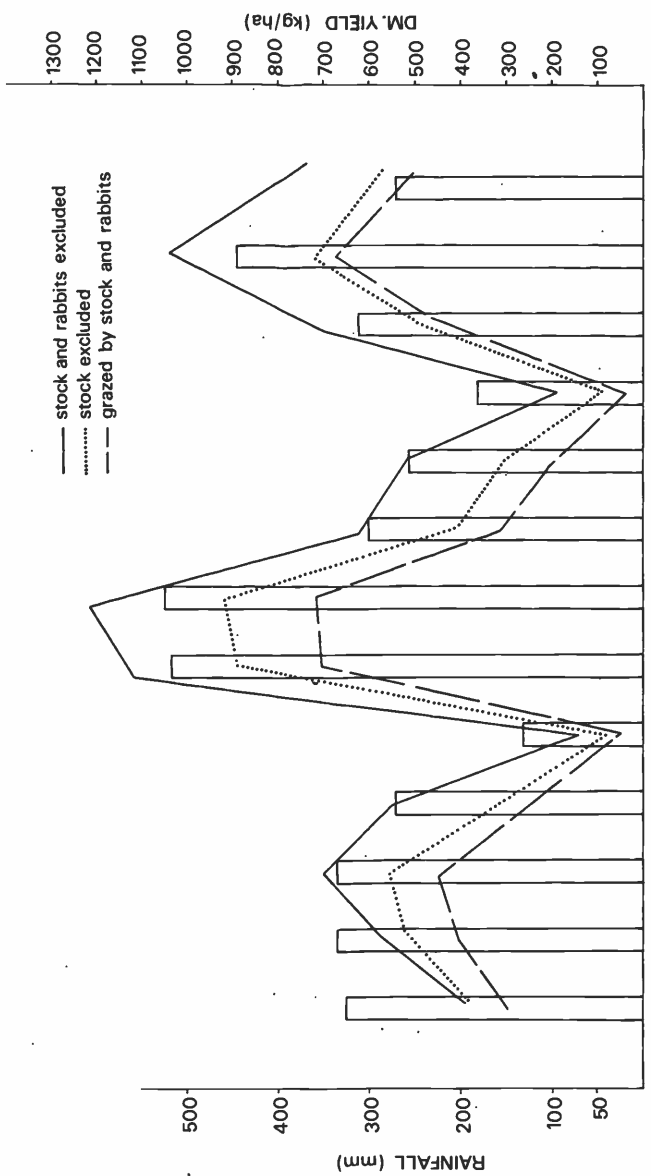


FIG. 3 FORAGE DRY-MATTER YIELD AND RAINFALL

The decrease in bare ground was manifested in the increase of total groundcover in the regeneration plots. Here the improvement in cover has been mainly from grasses, forbs and herbs.

Within these communities a few Callitris preisii seedlings had reappeared in the 12 years following exclusion of rabbits and stock. In the grazed area rabbits killed the young trees by stripping the bark.

The palatable forage yield is presented in Fig. 3. The quantity and quality of forage varied with the rainfall and contained a wide variety of species (Table 1). The dominant grasses (Stipa, Danthonia and Bromus) and Erodium provided approximately half of the forage yield each year. Other contributors were annual and perennial forbs, herbs and halophytic spp. The yield of these groups depended on the amount and season of rainfall (Fig. 3).

After the 1967 drought the groundcover recovered between 1968 and 1970. The D.M. yield was about 700 kg/ha in the enclosures. In 1971 the spring rainfall was very low which resulted in a declining yield for that year and a near nil D.M. forage production for 1972. Above average rainfall in 1973 and 1974 produced a high plant population which resulted in a peak forage D.M. yield of 1250 kg/ha in the enclosures. In 1975 and 1976 the rainfall and forage yield declined and was followed by drought conditions in 1977. A reasonably wet year in 1978 and 1979 produced a good forage D.M. yield of 1050 kg/ha in the enclosures. The analysis of data showed that the significantly higher forage yield occurred in enclosures where rabbits and sheep were excluded during the period of 12 years.

Conclusion

The stocking rate (0.33 sheep per ha) used in the 1960s and 1970s had a disastrous consequence for the area, although some grain feeding was practised at drought times.

At the beginning of the study, the sheet-eroded surface was bare of vegetation and most of the area was overgrazed.

In areas where grazing continued, the regeneration of herbs and forbs was very slow or did not occur at all although some improvement (Table 2) took place in the groundcover of the grazed area as a result of the erection of subdivisional fencing in 1976 and the provision of water by pipeline to the lease area. These factors proved advantageous to grazing management. Where the grazing pressure was reduced, however, a natural revegetation slowly developed with the healing of the bare surface in enclosures.

Rabbits are a problem even now, causing considerable damage to the ground flora. Over areas grazed by sheep, very marked differences are apparent between those parts where rabbits were excluded or where they were present. Their number must be reduced.

The vegetation growth and persistence is governed by rainfall. Consequently the best management for both animal production and vegetation maintenance is a stock rate that never completely defoliates the groundcover. With a 275 mm annual rainfall at Morkalla, this can be achieved by a fixed moderate stocking rate of about 0.13 sheep per ha or by a stocking rate which is adjusted around that figure from time to time to the seasons and rainfall.

Also, the Department of Crown Land and Management should give consideration to the fact that, in this rainfall zone, a stocking rate of 0.33 sheep per ha, apparently needed to

provide an acceptable income to the lessee, is beyond the capability of the land to sustain. For this reason, overgrazing will continue unless leases are enlarged sufficiently to allow a lower stocking rate.

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