VEGETATION IN THE MUSGRAVE RANGES, SOUTH AUSTRALIA

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SUMMARY

An account is given of a traverse through ungrazed vegetation within the Reserve for Aborigines in the far north-west of South Australia, visited in 1963 after rains and in 1965 during drought. A map of the traverse is presented together with general information on the landscape and soils, and details of the plant cover, its floristics and organization. Particular attention is given to features of vegetation which outside the Reserve might be attributed to the effect of cattle grazing. Catastrophic destruction of mulga woodland is found to be a periodic happening under natural conditions.

THE LOCALITY

The area observed was the belt of country east of Mount Caroline between Musgrave Park Station in the north and Mount Harriet in the south (Fig. 1). Precambrian high-grade metamorphic bedrock protrudes through the mantle in the north as the rugged Musgrave Ranges, and to the south as spectacular inselbergs separated by deep alluvium covered with various desert soils and superficial dunes. A characteristic feature of the locality is the abrupt way the inselbergs and ranges rise from the plains. The southern inselbergs border on vast dunefields, and to some extent long dunes flow about them in a north-west, south-east orientation. Attention was confined to vegetation on the alluvial and aeolian soils, since the inselbergs and their vegetation are largely inaccessible to cattle. Recently comprehensive geological, geomorphological and soil studies have been published on areas abutting the study area, but not in it. The South Australian Geological Survey has published the Mann 4-mile sheet, while the C.S.I.R.O. Land Research and Regional Survey Division has produced Land Research Series No. 6, incorporating land form, vegetation and soil maps south to the Northern Territory-South Australian border just north of the study area. Useful bibliographies of early work in the area are provided by Wilson (1947) and Mirams (1964).

Relative altitudes were measured with an aneroid barometer at distances checked against a vehicle odometer reading in tenths of a mile and the following features are evident:

(1) There is a total altitudinal variation of about 250 feet in the 32-mile (51·5 km.) traverse.

(2) There is an overall trend for loss of altitude with progress southwards.

(3) Superimposed on this trend is a second one for local increase in altitude in the vicinity of protruding bedrock.

The local pattern is for slopes down from the bases of inselbergs out to intervening plains. Soils on the immediate slopes are typically very coarse

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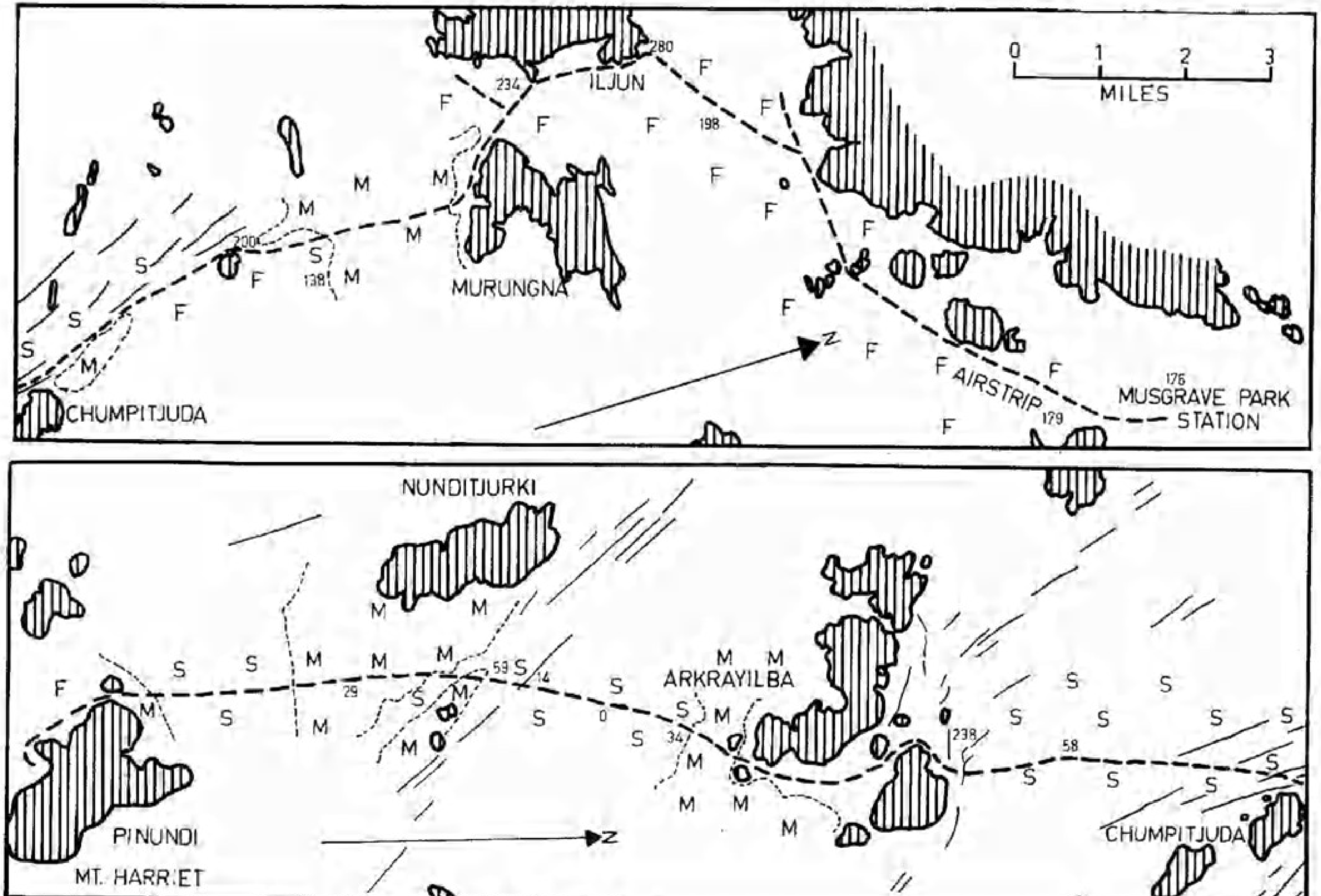

Fig. 1. The Musgrave Park-Mount Harriet Traverse. Hatched areas represent ranges and inselbergs. Figures are of relative height in feet. F = forbfield and forbfield scattered mixed woodland, plus isolated monospecific groves and colonies. S = spinifex perennial hummock grassland with areas of spinifex shrubland, spinifex-scattered mixed woodland and isolated monospecific groves and colonies. M = dense pure mulga woodland.

outwash gravels while those of the plains are deep sands and sandy loams. Some of the northern soil profiles under scattered *Hakea ivoryi* woodland are alkaline throughout, up to pH 8·5 but most are neutral to acid throughout the profile, ranging from pH 7 down to pH 5·5 under dense *Acacia aneura* woodland. Many of the profiles, particularly in the south, show a shift in hue towards red with depth, a typical case having a Munsell notation of 5YR 4/6 at 1 foot (30 cm.) and 2·5 YR 3/6 at 3 feet (91 cm.) depths. Drainage channels do not persist far beyond the ranges where they originate, but deposit their load as alluvium on flood plains at the foot of the slope. The larger watercourses exhibit braided channel patterns. Long red dunes are superimposed on this landscape, particularly in the south. Some are mobile in patches, but most are stabilized and parallel at intervals of about a quarter mile. Occasional gypseous pans occur, surfaced with cracking clay.

Rainfall records have been taken at Musgrave Park Station since 1962. Some monthly totals are shown in Table 1.

THE VEGETATION

About 40 species of perennial plants occur along the Musgrave Park-Mount Harriet traverse. Thirty-three of the common ones are listed in Table 2 with a record of their incidence in successive 1-mile (1·6 km.) intervals along the traverse. There is nothing very zonal about this pattern of species incidence except perhaps the restriction of *Triodia basedowii* to the south. However, species densities vary enormously along the traverse in such a way as to produce a variety of structurally and floristically distinct kinds of vegetation. Structurally, the big differences are between (1) the forbfields and forbfield-sparse mixed woodlands; (2) the spinifex perennial hummock grasslands, spinifex-shrublands and spinifex-scattered mixed woodlands; (3) the dense monospecific mulga belt woodlands, and (4) the dense monospecific local groves and colonies scattered throughout (1) and (2).

Forbfields occupy the northernmost 10 miles of the traverse. During droughts they are bare, windswept plains, the surface of which is wind-sculptured about the persistent bases of dead ephemerals. After heavy rains, the appearance of these areas is transformed by the growth of a dense and colourful stratum of forbs from a few centimetres to about 30 cm. high. In terms of species composition and spacial patterns of association, this forbfield is much too complicated to summarize simply and warrants detailed study. It is not misleading, however, to report as common densities of about 20 to 30 plants per square metre and as typical plants species of *Erodium*, *Helichrysum*, *Helipterum*, *Brachyscome*, *Calocephalus* and *Calotis*.

Much of the forbfield has a scatter of such species as *Eucalyptus terminalis*, *Hakea suberea*, *Hakea ivoryi*, *Acacia estrophiolata* and *Pittosporum phylliraeoides*. The most characteristic feature of this meagre cover is an occasional concentration into an open corkbark woodland of *Hakea ivoryi*.

The mulga belts, in contrast, occur in the southern 20 miles of the traverse. They only occupy situations sloping north to south and do not occur on equivalent south to north slopes in the study area, for no clear reason. The belts are pure *Acacia aneura* and no other plants except forbs and grass occur within them. The trees form a dense woodland of forest-like aspect, almost impene-

TABLE 1

Monthly rainfalls in millimetres at Musgrave Park Station, April 1962-December 1964

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1962	NR	NR	NR	—	13·5	—	16·5	21·8	—	57·9	3·8	3·8	
1963	24·6	—	6·6	9·1	49·3	38·1	1·8	—	0·8	7·1	—	39·9	177·3
1964	23·1	—	—	57·7	6·6	0·5	—	5·8	20·8	0·5	9·4	7·6	132·0

TABLE 2

Thirty-three perennial plant species and their patterns of incidence in 32 successive 1-mile (1·61 Km.) intervals on the traverse from Musgrave Park Station to Mount Harriet.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
Acacia ligulata A.Cunn. *ex* Benth.	+	+	−	+	−	−	−	−	+	+	+	−	−	−	−	+	+	+	−	−	−	+	−	−	+	+	+	+	−	−	−	+
Acacia aneura F.v.M. *ex* Benth.	+	+	−	−	−	−	−	+	−	−	+	+	+	+	+	+	+	−	+	−	−	+	+	−	+	+	+	+	+	+	+	+
Acacia estrophiolata F.v.M.	+	+	−	−	−	+	−	−	+	+	+	−	−	+	−	+	+	+	+	+	+	−	−	−	−	−	+	−	−	+	+	−
Acacia kempeana F.v.M.	+	+	−	+	+	+	+	−	−	+	+	−	+	−	−	+	−	+	−	−	+	+	+	+	−	+	−	+	−	−	+	−
Acacia victoriae Benth.	+	−	−	−	+	+	−	−	−	−	−	−	−	−	−	−	−	−	+	+	−	−	−	−	−	+	−	−	−	−	−	−
Acacia salicina Lindl.	+	+	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−
Acacia tetragonophylla F.v.M.	−	−	−	−	−	−	−	−	−	−	−	+	−	−	+	−	−	+	−	−	−	−	−	−	−	−	−	−	−	−	−	−
Casuarina decaisneana F.v.M.	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	+	−	−	−	−	−	−	−	−	−	−	−	−
Chenopodium nitrariaceum (F.v.M.) F.v.M. *ex* Benth.	−	−	−	−	+	+	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−
Codonocarpus cotinifolius (Desf.) F.v.M.	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	+	−
Dodonaea viscosa.	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	+	−	+	+	+	+	+	−	−	+	+	+	−	−	−	+	−
Enchylaena tomentosa R.Br.	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	+	−	−	−	−	−	+	+	−	−	−	−	−
Eremophila longifolia (*R.Br.*) F.v.M.	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	+	−	−	−	−	−	−	−	−	−	−	−	−
Eucalyptus camaldulensis Dehnh.	−	−	−	−	−	−	+	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−
Eucalyptus terminalis F.v.M.	−	+	+	+	+	+	−	−	+	+	+	+	−	−	+	−	−	−	−	−	+	−	−	−	−	−	−	+	−	−	−	+
Eucalyptus dichromophloia F.v.M.	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	+	−	−	−	−	−	−	−	−	−	−
Eucalyptus oxymitra Blakely	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	+	−	−	+	+	−	−	−	−	−	+	+	−	−	−	−	−
Eucalyptus transcontinentalis Maiden	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	+	−	−	−	−	−	+	−	−	−	−	−	−
Exocarpos sparteus R.Br.	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	+	−	−	−	−	−	−	−	−	−	−	−	−	−
Grevillea nematophylla F.v.M.	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	+	−	−	+	+	−	−	−	−	+	+	+	−	−	−	+	−
Grevillea stenobotrya F.v.M.	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	+	−	−	−	−	−	−	−	−	−	−
Hakea ivoryi Bailey	+	+	+	−	+	+	+	+	+	+	−	+	+	+	+	+	−	+	+	−	−	−	−	−	−	−	−	−	−	−	+	−
Hakea suberea J. Moore	+	+	+	−	+	−	+	+	+	+	−	+	−	−	+	−	−	−	−	−	−	+	+	+	−	−	+	−	−	−	−	+
Hakea sp. aff. multilineata Meisn.	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	+	+	+	+	+	−	−	−	−	−	+	−	−	−	+	−
Melaleuca glomerata F.v.M.	−	−	−	−	−	−	+	−	−	−	−	−	−	−	−	−	−	−	−	−	−	+	−	−	−	−	−	−	−	−	−	−
Muehlenbeckia cunninghamii (*Meisn.*) F.v.M.	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	+	−	−	−	−	−	−	−	−	−	−	−	−
Pittosporum phylliraeoides DC.	−	−	−	+	+	+	−	+	+	+	+	−	−	−	+	−	−	+	−	−	−	−	−	−	−	−	−	−	−	−	+	+
Santalum acuminatum (R.Br.) A.DC.	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	+	+	+	−	−	−	+	−	−	−	−	−	−
Santalum lanceolatum R.Br.	−	−	−	−	−	−	−	−	−	−	+	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−
Triodia basedowii Pritzel	−	−	−	−	−	−	−	−	−	+	−	−	+	−	−	+	+	+	+	+	+	+	+	−	+	+	+	+	−	+	+	−

trable to motor vehicles, and the canopies are of even height (about 8-10 metres) and very regular. The margins of these belts are typically very sharp.

The average density of trees is about 20 per square chain (60 sq. m.). The frequency distribution of butt girth shows an absence of seedlings, with most butts about 1 to 2 feet (30-60 cm.) and an occasional big, 4·5 ft. (80 cm.), butt. The trunks that are close together are the smaller ones, but small trunks are also as widely spaced as big ones.

Distinctly different growth habits and phyllode forms are exhibited in the mulga populations. The growth habits range from clean-boled tree through parachute-shaped semi-tree to straggly shrub. The phyllodes on any one plant are either acicular, or are flattened and expanded. Their ratio in 42 randomly chosen trees was 22 acicular : 20 expanded, and there was no apparent correlation between growth habit and phyllode form.

Perennial spinifex hummock grassland also occurs in the southern 20 miles (32 km.) of the traverse, between the mulga belts. These grasslands are *Triodia basedowii* hummocks at a density sufficient to give 35% true ground cover when estimated by random point quadrants. The intervening spaces of ground typically support parakeelya (*Calandrinia*) species for periods after rains. A common variation on these grasslands is spinifex shrubland, as in the case where *Hakea multilineata* forms a stratum above the hummocks. Like the forbfield, spinifex grassland often supports a sparse woodland, often of *Acacia estrophiolata* or *Acacia ligulata*.

The occurrence of relatively small, very dense monospecific groves of various species is an outstanding and characteristic feature of all vegetation outside the mulga belts. Here and there, in striking contrast to their surroundings, will be found closely aggregated colonies of such species as *Acacia kempiana*, *A. estrophiolata*, *A. ligulata*, *A. aneura*, *Eremophila longifolia*, *Grevillea nematophylla*, *Pittosporum phylliraeoides*, *Eucalyptus oxymitra*, *E. transcontinentalis*, and *Dodonaea viscosa*. Densities of *Dodonaea viscosa* and *Hakea* sp. aff. *multilineata* in colonies averaged about 1 per 75 sq. metres and 1 per 50 sq. metres respectively. In many cases such a grove will be spacially delimited by a topographic site, such as the spine of a dune, or the rim of a pan, but there is little consistency of species-site relationships, except for *E. camaldulensis* on the major watercourses of the north. On the plains the colonial occurrences of species such as *Eremophila longifolia* seem haphazard.

Overall inspection of these various undisturbed vegetation types permitted a number of interesting conclusions. The first is that, in the complete absence of cattle, periodic catastrophic destruction appears to be a natural happening in this vegetation.

At sharp fronts within the mulga belts live trees give way to standing dead timber, and the transition across the front is complete in a distance of 20 m. On the one side the canopy is continuous and on the other, gone completely. The terminal effects of drought seem the most likely reason for this wholesale destruction, but the fronts do not follow the contour of the land. Further, there is no good evidence that fire was responsible, although fires occur in the area, since there is no trace of fire scars on the aerial photographs corresponding to the fronts. Fire scars occur elsewhere and are obvious.

Progress in the denudation of these devastated areas can be traced in examples along the traverse, through stages where all the timber has fallen, to a final stage of windblown sand and fragments of old wood. What is not to be found along the traverse is an example of regeneration in one of these areas, in fact, seedling mulgas are a rarity, which leads to a second conclusion.

The mulga woodlands on the traverse do not contain trees of all heights and girths from seedlings through saplings to mature trees. All the individuals in a section of mulga woodland carry their canopies at the same height, and although there is considerable variation in butt girth (10 cm. from the ground), there is an overall absence of very slender trees and a complete absence of seedlings, on the traverse. In a search for seedlings, areas beyond the traverse were inspected, and eventually seedlings were found west of the area on the Mt. Davies road. There were many of them, in a circular clump, and all were about 1 metre high. Individuals of other heights were absent.

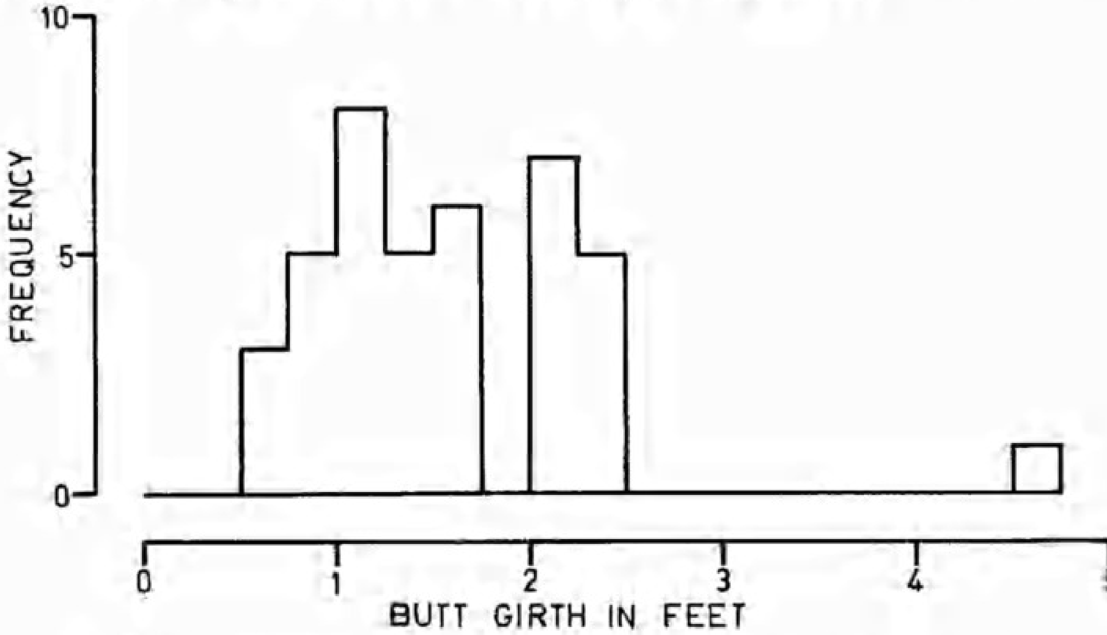

Fig. 2. A frequency distribution of butt girth (at 10 cm. from the ground) in a mulga belt.

These observations are consistent with the view that phenologically the mulga woodlands are made up of groups of contemporaries, rather than mixtures of individuals at all ages. A comparison of Fig. 2 with Fig. 1-2 in Smith (1962) amplifies this point. The mulga woodlands on the traverse would then be regarded as mature and stable, with evidence of destroyed sections but not, as yet, any new groups starting off, or any half-grown stands.

None of the mulga on the traverse is organized into the grove-inter-grove pattern referred to by Slatyer (1962). The nearest such mulga is about 30 miles south-east of Mount Harriet.

The possible importance of vegetative clonal reproduction in some perennial species is indicated by the marked colonial growth of some species along the traverse, for example, *Eremophila longifolia*. Some clumps of *Hakea ivoryi* trees are obviously clonal, since it is possible to observe stages from suckers about a decaying trunk through to a hollow ring of well-separated trunks.

The number of woody species per unit area along the traverse is very low, due partly to the very open nature of much of the vegetation but also to the fact that these species are typically grouped in floristically and structurally simple vegetation types usually of 1 to 3 species only. Of 26 samples each 1 acre (0·4 Hectare) in area at mile (1·61 km.) intervals, 1 had no perennial species, 8 had 1, 7 had 2, 6 had 3, 3 had 4, and 1 had 5.

General comparisons between this undisturbed vegetation and its apparent equivalents on the nearest cattle station, Mulga Park, showed that contrary to expectations, mulga woodlands on the station supported seedling mulga among the established trees, in distinct contrast to the traverse woodlands. After the heavy rains in 1963, the ephemeral forbfield was much sparser on the station than on the traverse. Lastly, the soil surface on the station was pulverised and worked up into a loose state devoid of litter and soft grasses in contrast to equivalent surfaces on the traverse, where fragmentary litter masked the red soil to a noticeable extent, and soft grasses were still apparent.

In order to evaluate the grazing impact of the cattle industry it is necessary to know the vegetation in the virgin state, in order to recognize and evaluate the extent of its change under grazing. On most stations the chance to gain a satisfactory picture has passed, since there simply are no ungrazed control plots left to inspect, and the observer is left with hearsay and inference from which to attempt a reconstruction. It is therefore important to remember this large tract of ungrazed vegetation within the Reserve for Aborigines, which includes much that would already be exploited as cattle-country were it not for the Act which sets it apart. This vegetation can never substitute for control areas within the station-lease country, but does at least afford the opportunity to see what some natural Central Australian vegetation looks like. Unfortunately, its further protection from cattle is uncertain – its Administrators introduced 120 in 1964 – but for some time to come much should remain undamaged.

ACKNOWLEDGMENTS

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Explanation of Plates

Plate 1

(a) A dense pure woodland of *Acacia aneura*. (b) Ephemeral forbfield. (c) Forbfield with a scatter of perennials. (d) A perennial hummock grassland of *Triodia basedowii*.

Plate 2

Example of stages in the decimation of mulga woodlands. Trees die and lose all foliage, then some fall entirely while others remain upright, progressively losing more twigs and limbs. Eventually only a few of the larger trunks remain standing. The last stage is a windswept area strewn with small fragments of wood.