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HABITAT ASSESSMENT AND MONITORING

of

DANGGALI CONSERVATION PARK

A student report in fulfilment of the unit Habitat Assessment under the supervision of staff in Wildlife and Park Management, SACAE, Salisbury.

1989

CWL 251 HABITAT ASSESSMENT

FIELD STUDY AT DANGGALI C.P.

25th April to May 1989

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GLOSSARY

habitat - the place where an organism lives which is defined by all the biotic and abiotic factors of its surrounding environment; a "suitable" habitat meets the basic requirements for survival, i.e. food, water and shelter, as well as other requirements for species interaction, reproduction and safety from hazards. The term is commonly used in wildlife management.

habitat type - a land unit or map unit with a particular combination of features, especially vegetation and landform, which can be recognised as a distinct and definable unit; it is often synonymous with vegetation type because wildlife is usually distributed by vegetation types.

microhabitat - a term used to describe small-scale habitat study areas within a larger unit, eg. litter, bark, tree hollows.

site - a general location, usually named for some nearby landmark, eg. Canopus, Three-Mile Dam, Faraway Bore, etc.

quadrat - in S.A. a study tract with defined boundaries, covering an area large enough to typify and represent a larger area, usually 1km^2 or less.

study area - a smaller size plot, established for some specialised purpose, eg. vegetation study area (VSA).

transect - a sample line or strip for quantitative measurements.

patch - a subunit of a habitat type which is distinctly different from its surroundings; a vegetation type may be made up of several patches.

wildlife - the indigenous biotic component of a landscape.

indicator species - plant or animal species which can be observed to reflect changes in the environment; they may show definite signs of response to environmental changes, such as past weather events or trends in populations.

species diversity - the number of species in an area.

species richness - the feature of wildlife in an area which includes species diversity, abundance and evenness of distribution (equability).

landform - any one of the various features that make up the surface of the earth (eg. slope, aspect, etc.).

topography - the shape of the ground surface, as indicated by hills, mountains and plains.

qualitative survey - a comprehensive study of a tract of land, using written descriptions of observations and subjective assessment.

quantitative survey - a comprehensive study of an area using measurements for analysing and interpreting the landscape in an unbiased, objective way.

monitoring - measuring change over time by observing study areas on successive occasions.

baseline study - the first study in a series of samples designed to monitor changes over time; a basis for comparison.

assessment - the process of gathering information on the condition of land based on surveys and description, to estimate the value of an area for a particular purpose.

evaluation - making judgements about the information collected.

habitat value - the importance of habitats to wildlife.

conservation value - the worth of the natural landscape to humans for purposes of preservation, study or perpetuation of whole systems.

conservation status - the rank or classification of a species or an area with respect to conservation values, eg. size, naturalness, rarity, location, etc., from this the significance, or importance can be established.

photopoints - photographic monitoring points where colour slides are taken twice yearly (April and September), according to a standard layout prescribed by N.P.W.S.

ACKNOWLEDGEMENTS

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- Janice White developed a new bird census method and supervised students in all habitat studies

- Marg Blaber typed and arranged the written report;

- and numberous individuals have contributed over the years toward the ongoing Danggali studies.

1.0 INTRODUCTION

This report contains the results of the fourth year of habitat assessment field studies at Danggali Conservation Park, conducted by staff and students of Wildlife and Park Management at the South Australian College of Advanced Education. The original purpose of these studies, begun in 1986, was to monitor the recovery of a mallee ecosystem after disturbances such as grazing, fire, mechanical grading and erosion.

Monitoring changes over time requires some baseline description of flora and fauna such as the establishment of permanent study quadrats. Eighteen study quadrats were described in the first three years, in carefully selected habitat types. The quadrats (Fig. 1.1) were placed either in areas which had been subjected to severe impacts such as near dams, homesteads or bores or in reference areas which may represent the least damaged parts of the park. Another rationale for placement of quadrats was to describe type sites representing the major habitat types of this mallee land system.

The studies have purposely been aimed at the macro and microhabitat scale of flora and fauna, which would complement the broader scale of mapping and aerial survey, in order to pinpoint species or populations that serve as useful indicators of recovery or degradation. An understanding of not only what species occur there, but also the intricate interrelationships between plants, animals and abiotic factors, would enable park managers to take an ecosystem approach to conservation management at Danggali C.P.

The 1989 study was the first year quadrats from previous years' studies were revisited; three quadrats were re-measured, MV1, established in 1986 after fire, LB1 and TO1 (Fig. 1.1) both established in 1987. Only vegetation was resampled intensively, general observations and comparisons were made with previous reports, and invertebrates were sampled for the first time and added to the data bank of these early quadrats.

Three new quadrats were established in 1989 as the first reference areas in the Danggali studies. They were located in the northeast section of the park, along the eastern border, which was thought to be the least grazed area in the past (Osborn, pers. comm.). The placement of these three quadrats was made to cover a mosaic of habitat types as well as to include species not encountered before.

1.1 Goals and Objectives

The main goal of the 1989 study is to monitor changes in previously established quadrats and to establish new quadrats in the best preserved section of the park. Specific objectives required to achieve this goal include the following:

- reassess the vegetation in the intensive Vegetation Sample Areas (VSAs) of MV1, LB1 and TO1, and compare the current assessments with previous ones;
- initiate invertebrate studies, which were not previously done, in these old quadrats;
- make observations on the general condition of the quadrats and comment on changes since the last sample;

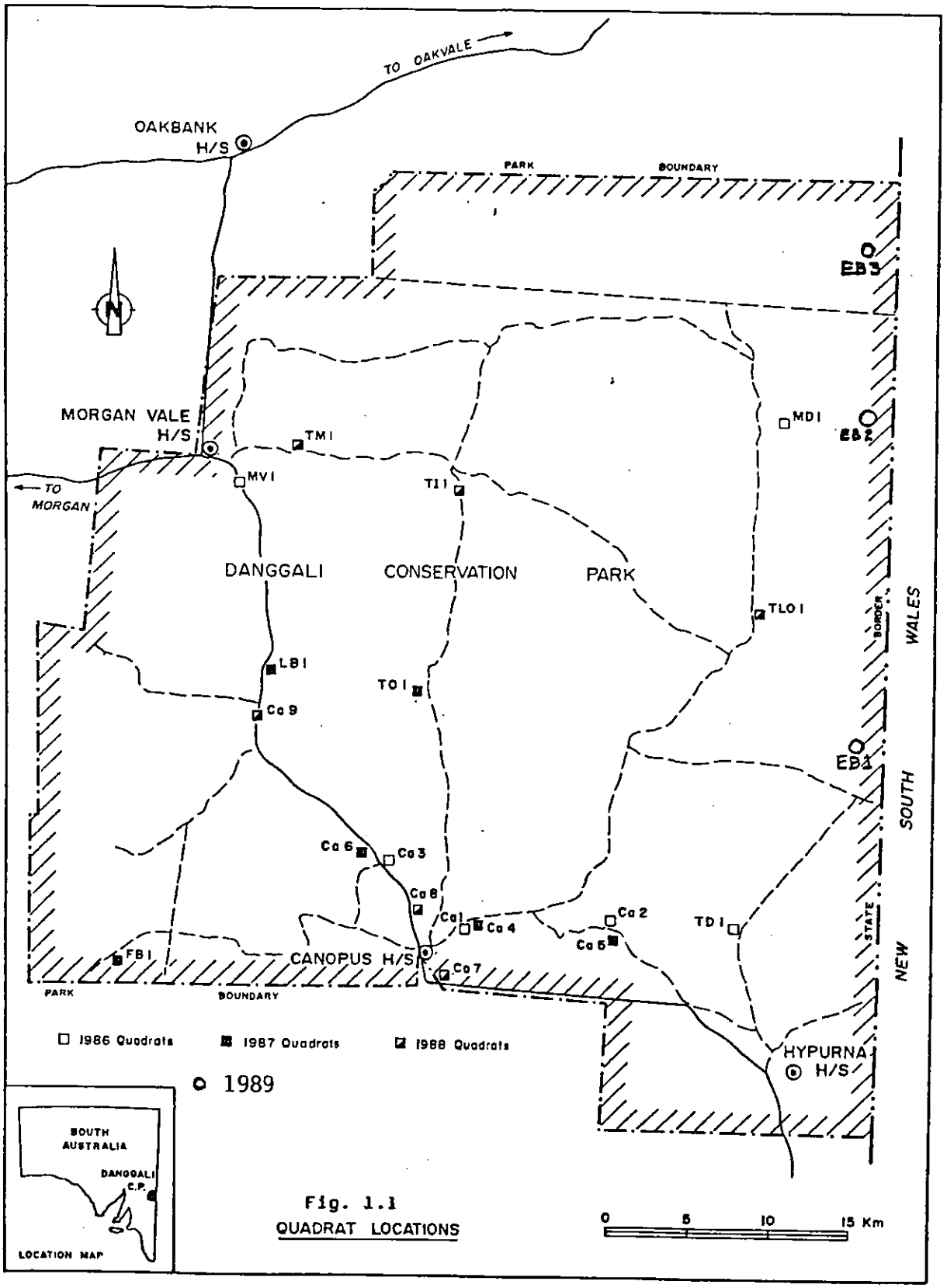


Fig. 1.1
QUADRAT LOCATIONS

- establish new quadrats to look at sand pine, Callitris verrucosa, desert poplar, Codonocarpus cotinifolius, and mosaics of several habitat types;

- test a new bird census technique and refine other sample techniques;

- comment on management implications of the findings;

- recommend future directions for field studies and identify special projects for further investigations.

1.2 Limitations of the Study

Without a comprehensive knowledge of flora and fauna distribution in the park, it was difficult to find pristine areas to represent undisturbed natural habitats. The quadrats chosen on the eastern border were partly chosen for ease of access and safety, at the sacrifice of finding the most well-preserved reference area for this park. Nevertheless, the quadrats are probably representative of the least grazed areas of the park.

Relocating previous sample areas was questionable because of confusing or inadequate directions on their precise location. It was valuable experience to learn how important is exact communication for relocating and remeasuring vegetation. It is hoped that in the future, error in locating and plotting of individual plants will be minimised.

With only ten days in the field per year, we see only the flora and fauna at one point in time, autumn, a fairly inactive time for flowering and breeding. Variability between habitats of the same habitat type is another problem in comparing quadrats.

1.3 Rainfall Records

The mean annual rainfall at Canopus Homestead is 200mm (Laut, 1977), a fairly dry mallee site. The records from Canopus Homestead are as follows (Osborn, pers. comm.).

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Total
1988	14.6	1.0	6.0	24.0	44.4	58.4	29.2	5.4	23.8	2.0	55.3	36.9	298.6
1989	7.2	0	124.0	25.0	23.0								

Rainfall in the seasons prior to this study was unusually high and well above average. Rainfall is unpredictable and variable, but the 124mm in March of this year is unusual and comes at an unexpected season. It may or may not have an influence on the biota.

1.4 Habitat Studies at Danggali C.P.

Broad habitat types are largely distributed according to landform and soils. Danggali can be described as an undulating calcrete plain with superimposed, low sand dunes and alluvial flats with low spots of clay-pans. Generally, mallee shrublands occur on the calcrete plains, Triodia

on the dunes and blackoak on the flats. Bluebush is characteristic of the claypans and may extend into the blackoak flats. The transitions between definable habitat types may be quite variable and contain elements of either type. Pockets of unusual species may have limited distributions, but in the absence of a vegetation map of the park, their extent is unknown. The unusual occurrences studied this year are sandpine and desert poplar. The northern half of the park has been affected by extensive fires at Christmas 1984 and 1985.

The 1988 report summarises the quadrats and habitat types studied to date. This report presents the 1989 results of habitat assessment at the following quadrats:

1989

1 - Re-sampled quadrats

Morgan Vale, MV1	Mallee-*Triodia* burned and unburned quadrats.
Little Bunyip, LB1	Mallee-*Triodia* burned and unburned transition.
Tomahawk, TO1	Mallee-*Triodia* patchy burns.

2 - New quadrats in least-disturbed portion of the park

Eastern Border 1, EB1	Blackoak/Mallee mosaic.
Eastern Border 2, EB2	Mallee Dunes with sandpine pockets.
Eastern Border 3, EB3	Mallee Dunes with desert poplar pockets.

New techniques for surveying invertebrates and birds have been employed here, improving upon previous methods and studies. Time-efficiency of methods may be seen in the 1988 report. Also, background information on climate, rationale and management can be found in previous reports.

2.0 METHODS AND TECHNIQUES

2.1 Description of Methods and Techniques

The methods in this study were chosen because they are relatively simple, standard and can be easily repeated.

Techniques are defined here as refinements of commonly used methods which have been acquired from field experience and past Danggali habitat assessments.

Most of the methods and techniques used in 1989 with the exception of bird transects, invertebrate micropitfalls and pitfall lines, were the same as those used in 1988. A detailed description of the methods and techniques listed below is given in section 2.1 of the 1988 Danggali report.

Soils - soil pits, soil profiles
Vegetation - qualitative transects, species lists, vegetation sample areas (VSA), point quarter
Mist netting
Sweep netting
Elliot traps
Destructive sampling
Opportunistic observations

2.1.1 Bird census

The method used this year for the recording of birds was different from the "Kilometre-hour" method used in 1988. In 1989 each quadrat had four transects, each 500 metres long. With an observer and recorder on each transect, the four transects were surveyed over a two-hour period within two hours of sunrise. All birds, species and numbers, within 50 metres on each side of the transect (Fig. 2.1) were identified and recorded. Counts were repeated on three consecutive mornings unless it was raining. Density was estimated using the mean number of birds of each species counted in three successive censuses.

The stratum and macro-/micro habitat was recorded for each observation. Any bird should not be counted more than once. Birds foraging in the air above the transects were counted; birds flying over the area were noted but not included in the census. By increasing the observation time and decreasing the length of transect, a more realistic bird count could be made of the fairly dispersed bird population in this mallee habitat.

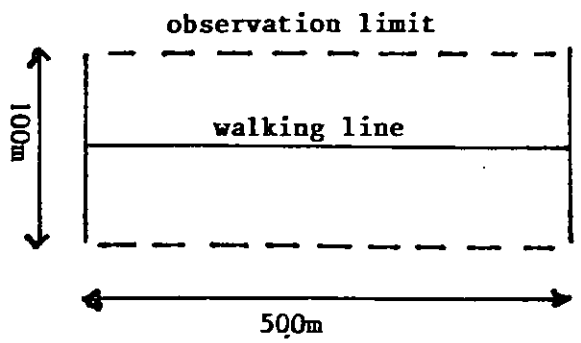


FIGURE 2.1 Bird transect

2.1.2 Invertebrate micropitfalls

As in 1988, small vials were sunk into the ground to act as invertebrate traps; however, in 1989 the traps were established in a different manner. Two rows of twenty traps, situated five metres apart, were established parallel to, and twenty metres from each side of the long axis of the VSA (Fig. 2.2). Seventy percent methylated spirits was placed in traps to kill and preserve the animals.

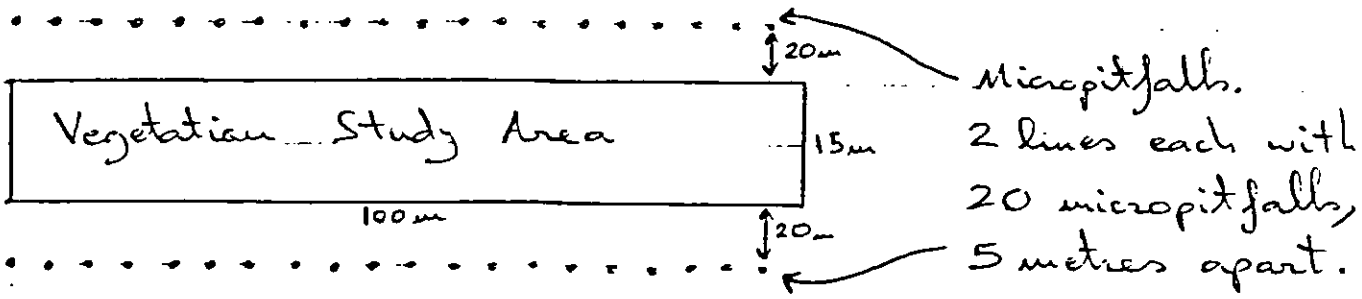


FIGURE 2.2 Distribution of micropitfalls

2.1.3 Pitfall lines

Each group had 20 (large) pitfall traps and drift fencing, mainly for the capture of small mammals, reptiles and frogs. These were positioned near the Elliot traps in an area thought to have the most potential. The pitfalls were established in two ways:

- One group of ten was placed in a row with a single drift fence crossing all the traps. The individual pitfalls were approximately 8 metres apart (Fig. 2.3).

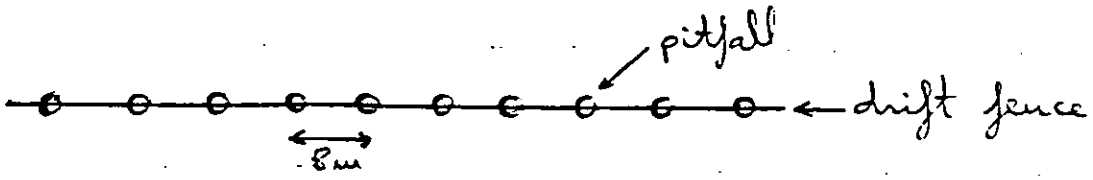


FIGURE 2.3 Distribution of pitfalls with single drift fence.

- The other ten were set out in two rows of five and each pitfall had its own 10 metre drift fence (Fig. 2.4).

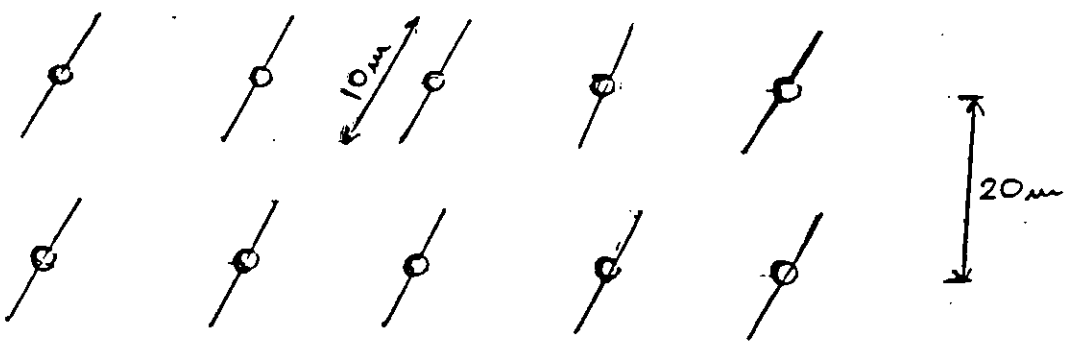


FIGURE 2.4 Distribution of individual pitfalls

2.1.4 Other methods

Other methods of fauna data collection included spotlighting at night, sightings and hand captures of reptiles, invertebrates and frogs. Important also was the evidence provided by tracks, burrows, bones, feathers, scats and scratchings left by various animals.

2.2 Equipment and Resources

The equipment and resources used in this year's Danggali habitat assessment were similar to those used in 1988. A detailed description of these is given in section 2.2 of the 1988 report.

3.0 MORGAN VALE 1 (MV1) RESAMPLED QUADRATS UNBURNED/BURNED MALLEE DUNE 1986-1989

3.1 Introduction

The study quadrat near Morgan Vale homestead was resampled on 25-28 April 1989. The aims of this study were to observe and note fire succession and distribution patterns of the vegetation since the original study carried out three years previously (after the 1985 fire) and to study the diversity of invertebrates using micropitfall traps. This method was not used in the 1986 study.

Both burned and unburned sections were studied and, where possible, in the same manner as in the 1986 investigation. The study quadrats were relocated from the description in the previous study, with one quadrat of 200 metres North/South and 500 metres East/West in both sections.

The following sections are details of the results from the inventory of the flora and invertebrates.

3.2 Quadrat Details

Dimensions of the study areas are similar to those of the 1986 study (see Fig. 3.1) with the exception of the ground cover VSA in the burned section.

Two micropitfall lines were placed in a systematic pattern in each section of the quadrat. The pitfall lines in the burned section were placed in an area dominated by Eucalyptus dumosa shrubs. Low shrubs and a ground-cover of Triodia irritans formed the understorey. In the unburned section the pitfall lines were in an area of Eucalyptus dumosa upperstorey. The understorey consisted of shrubs sparsely placed and a groundcover of large circles of Triodia irritans. Sketches of the micropitfall lines are shown in Figure 3.1.

There were not any bird transects carried out, nor were any Elliot traps placed. Casual observations were made of both birds and reptiles in both sections of the site.

As in 1986 the rangefinder method was used in the burned VSA to determine the distances between the shrub species (refer to Plate 3.1). It was also used to determine height of individual shrubs. In the unburned VSA observer estimations were made of tree and shrub heights and distances between individual plants.

3.3 Landforms

The unburned and burned quadrats in the Morgan Vale 1 quadrat occur in the same landform types. Both quadrats are situated on top of an old, relict dune, accounting for the undulations and depressions observed in each quadrat.

The unburned quadrat has a gentle slope running to the north-west corner, with undulations and depressions located between the quadrat boundaries. Two dune ridges lie parallel along the northern perimeter, and a natural drainage depression runs along the southern perimeter.

The landform of the burned quadrat is more prominent compared to the unburned quadrat. The absence of well established vegetation for wind barriers subjects the sandy surface soils to increased erosion, resulting in the pronounced channels and hollows in the soil.

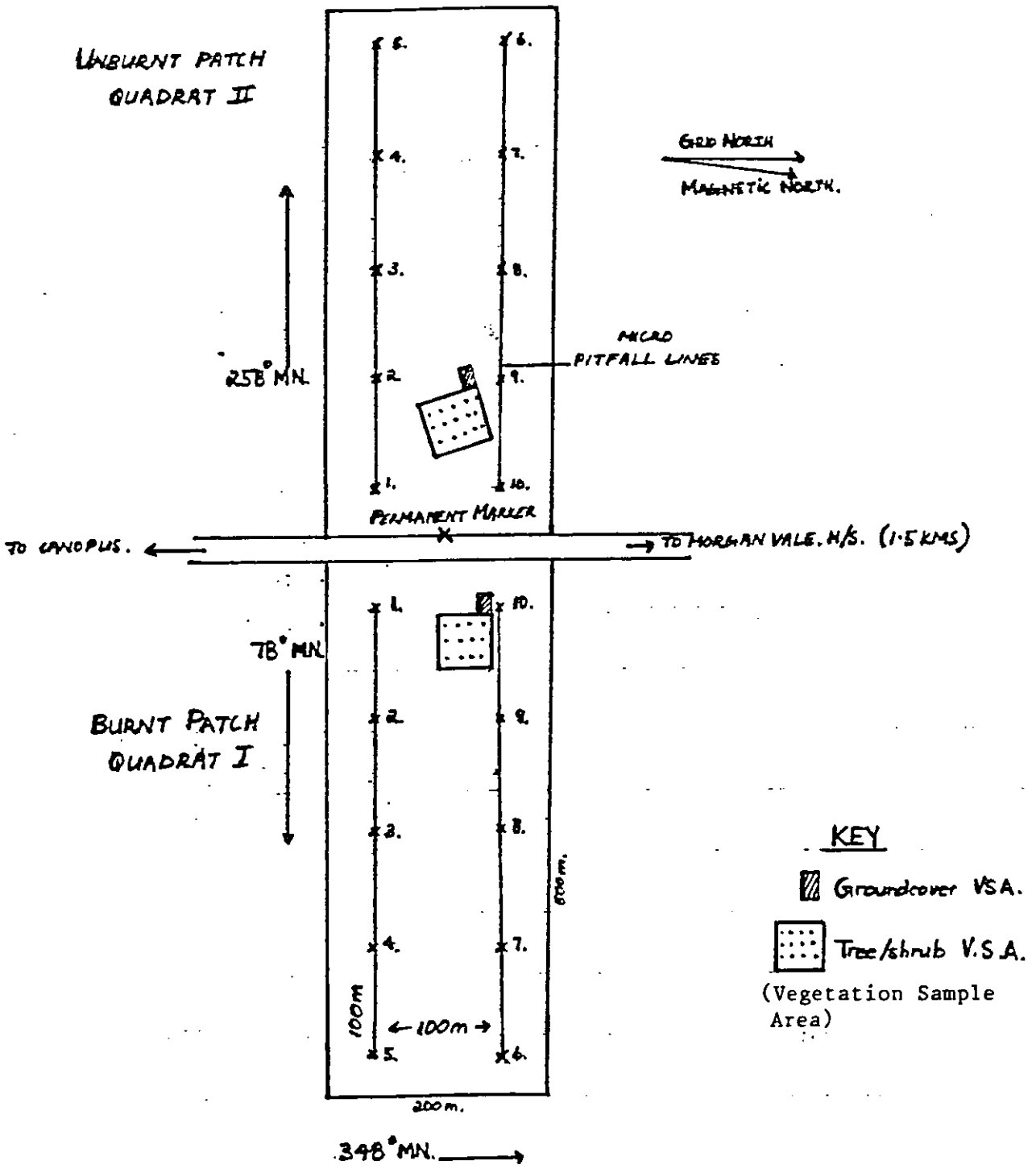


FIGURE 3.1 Location of Quadrat Details

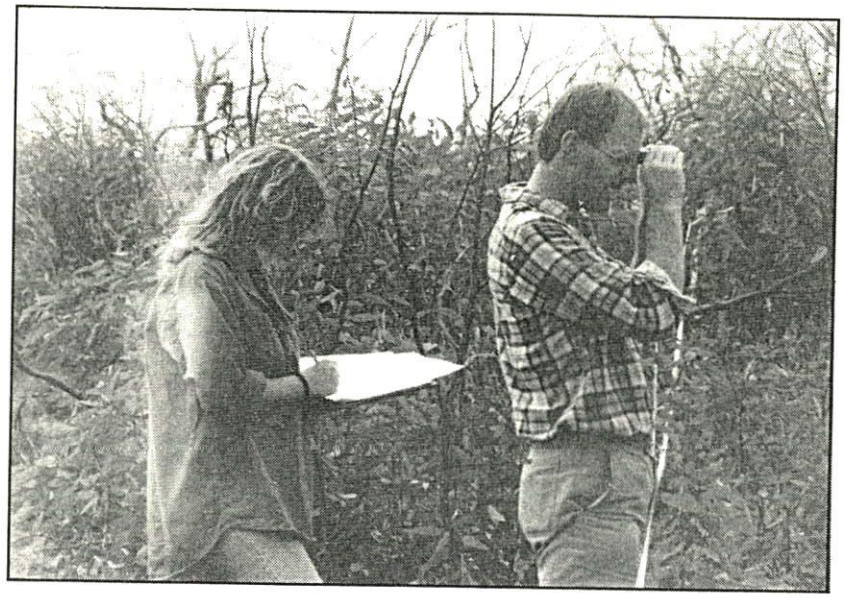


PLATE 3.1 Use of a rangefinder to determine shrub distance

3.4 Vegetation

Two quantitative methods were used in Morgan Vale 1 to re-monitor the vegetation in the unburned and burned quadrats. The use of Vegetation Sample Areas (VSA) and vegetation transects/nodes enabled information of the same type as 1986 to be obtained and compared.

The two quadrats in the unburned and burned areas were re-monitored in 1989 in order to record changes in vegetation and continue to assess regrowth after fire.

Only numerous or widespread species that were recorded are treated in the text; full species lists are presented in Appendix 3.1 and 3.2.

3.4.1 Description of vegetation

3.4.1.1 Unburned Quadrat

The dominant vegetation type in the quadrat is Eucalyptus dumosa, with an understorey of Beyeria opaca and Acacia burkittii shrubs. There were a total of 74 plants mapped in the VSA, 57% of these recorded species being Mallees. The Mallee species mapped were Eucalyptus dumosa, Eucalyptus socialis and Eucalyptus gracilis. These mallees, and the number of stems on each tree are plotted on the map in Figure 3.2. Ten different shrub species were recorded in the understorey and were Eremophila glabra, Acacia burkitti, Acacia colletioides, Eremophila sturtii, Beyeria opaca, Cassia nemophila var nemophila, Cassia nemophila var zygophylla, Rhagodia spinescens and Maireana sclerolaenoides (Fig. 3.2). There were 12 individuals of A. burkittii and 9 individuals of B. opaca, these being the two dominant understorey species (refer to Table 3.1).

1989 Monitoring of VSA
MV1-A (unburned)
Mallee-Triodia dune

D - dumosa)
S - socialis) Eucalyptus
G - gracilis)
Eg - Eremophila glabra
Ab - Acacia burkitti
Ac - Acacia colletioides
Es - Eremophila sturtii
V1 - Voucher 1
Ba - Beyeria apaca
Cnn - C ssia nemophila var. nemophila
Cnz - Cassia nemophila var zygophylla
Rh - Rhagodia spinescens
Ms - Mairena scelerolaenoides

→ number after Eucalypt species is the number of stems on the actual plant

→ (Ac) circle around node means it is a shrub

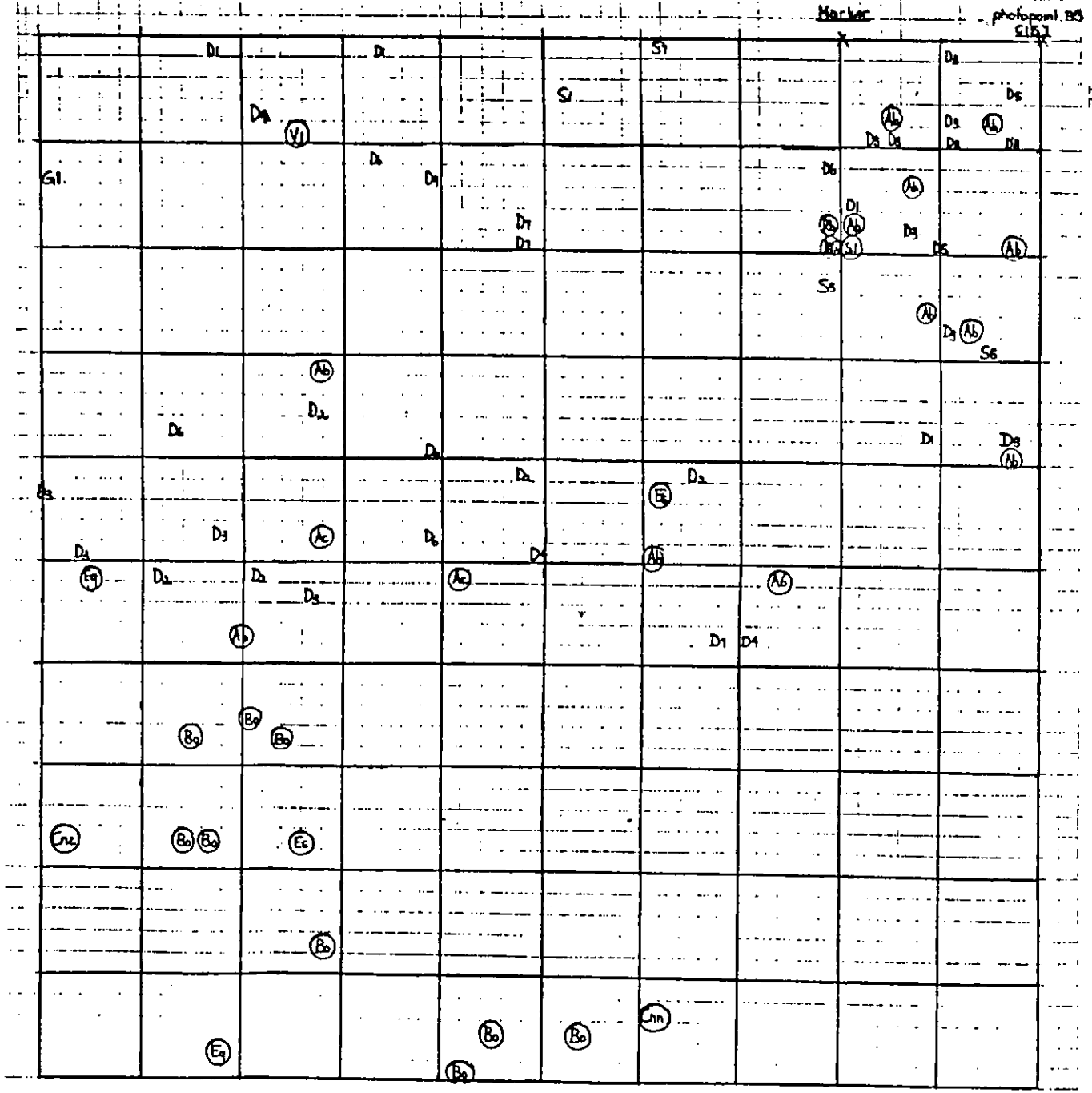


FIGURE 3.2 VSA map for tree/shrub species in unburned area April 1989

TABLE 3.1 The number and percentage of shrubs mapped in unburned area

Species	Number mapped	% of allshrubs
Eucalyptus dumosa	36	49%
Eucalyptus socialis	5	7%
Eucalyptus gracilis	1	1%
Eremophila glabra	2	3%
Acacia burkittii	12	16%
Acacia colletioides	2	3%
Eremophila sturtii	2	3%
Voucher 1	1	1%
Bayeria opaca	9	13%
Cassia nem. var nem	1	1%
Cassia nem. var zygp		
Rhagodia spinescens	1	1%
Maireana sclerolaenoides	1	1%
Total	74	100%

3.4.1.2 Burned Quadrat

A Vegetation Sampling Area (VSA) was set out in the burned area of the Morgan Vale study site so that the vegetation could be mapped and compared to the burned area results of 1986, to monitor the growth of species after fire. The VSA was based on a permanent photopoint described in the 1986 report - in this way we hoped to locate and map the 50m x 50m VSA that was mapped in 1986 (Fig. 3.3).

The VSA was in a Mallee Triodia community, hence there were no trees to map. There were four species that were too numerous and small to include. These species were Beyeria opaca, Halgania cyanea, Chenopodium desertorum and Maireana pyramidata, and were included in the groundcover VSA. The seven species that were mapped were Eucalyptus dumosa, Duboisia hopwoodii, Acacia burkittii, Acacia ligulata, Eremophila glabra, Myoporum platycarpum and Santalum murrayanum. There were 212 individuals mapped and put into height classes. Six individuals were less than 0.5m in height and were all E. glabra, A. burkittii and A. ligulata. 186 individuals were between 0.5m and 2m and all species occurred in this class. There were 20 individuals that were over 2m and these were all E. dumosa and one E. burkittii (Figure 3.3). Eucalyptus dumosa dominated the VSA area as there were 147 of this species out of 212 plants, resulting in 69% of the shrubs recorded being E. dumosa (Table 3.2).

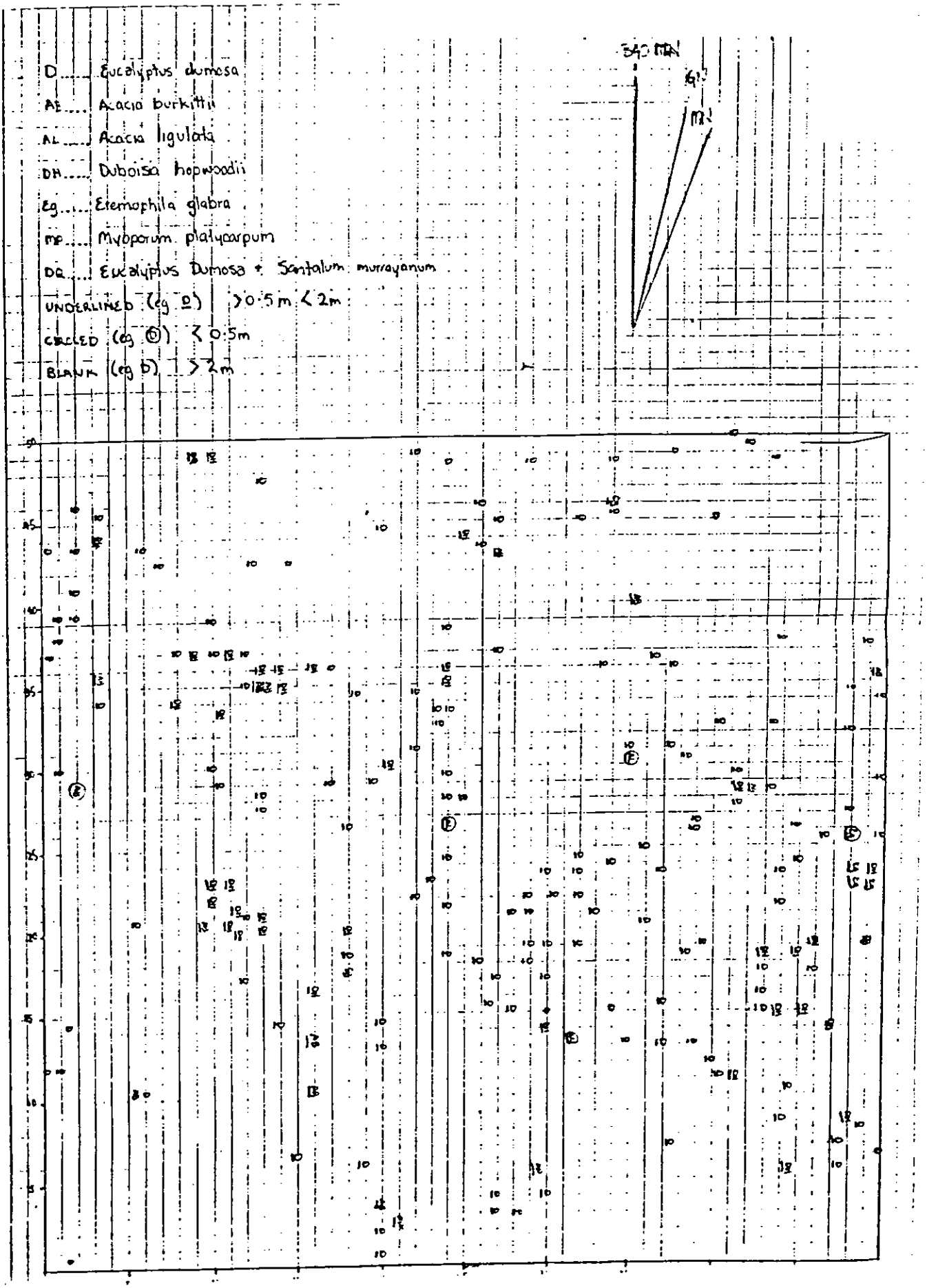


FIGURE 3.3 VSA Map for tree and shrub species in burned MV1-B

TABLE 3.2 The number and percentage of shrubs mapped in the burned area

Species	Number mapped	% of all shrubs
E. dumosa	147	69%
D. hopwoodii	39	19%
A. burkittii	13	6%
E. glabra	7	3%
A. ligulata	2	1%
M. platycarpum	2	1%
S. murrayanum	2	1%
Total	212	100%

3.4.1.3 Comparison with 1986 data

Eucalyptus dumosa remains the dominant mallee species in the VSA unburned quadrat, with the same trees recorded. Numbers of Acacia burkittii and Acacia colletioides were found to be very similar to 1986, the same individuals were identified. Six specimens of Eremophila scoparia were recorded in 1986, but none of these were found this year. Instead a number of Eremophila glabra and Cassia species were recorded. This fact could be the result of an identification error in the 1986 report or a mislocation of the sample boundaries.

However, the number of Beyeria opaca specimens decreased slightly, nine shrubs were recorded this year in comparison to twelve found in 1986.

3.4.2 Interpretation of data (tree and shrub VSA in burned and unburned MV1)

The vegetation sample area (VSA) in the unburned area contained more species than the VSA in the burned area (Fig. 3.2, Fig. 3.3). There were 13 species in the unburned VSA and six species in the burned VSA, but two species were recorded in the unburned VSA that were present in the burned VSA although not recorded. There was a greater number of individual plants in the burned VSA (212) than in the unburned VSA (102). Hence in the burned area there were more plants but fewer species. Three species occurred in both areas, these were Eucalyptus dumosa, Eremophila glabra and Acacia burkittii.

In both areas Eucalyptus dumosa was the most abundant species, but a greater percentage occurred in the burned area (refer to Fig. 3.4). It was noted that in the unburned area there were areas where no shrubs occurred, while in the burned area there was little space with no shrubs. It was also noted that shrubs were generally more mature and taller in the unburned area, due to the lack of disturbance by fire unlike the other quadrat.

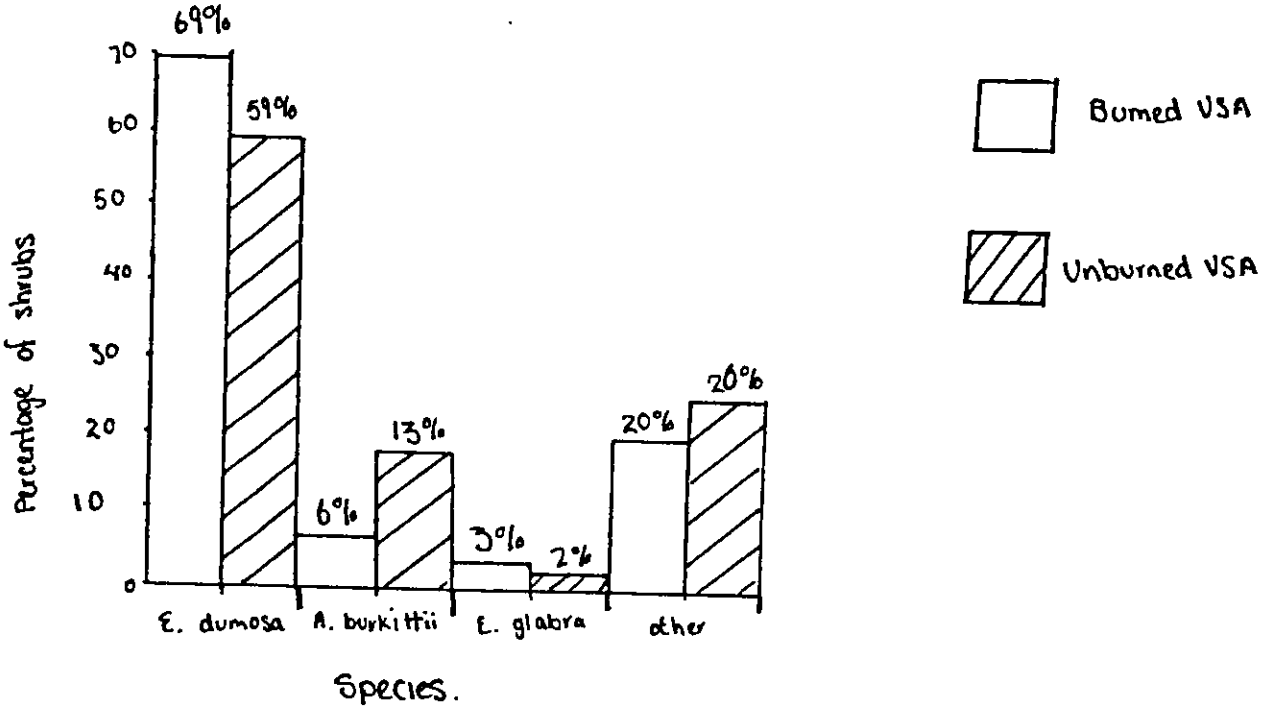


FIGURE 3.4 Percentage of shrubs common to both burned and unburned VSA

3.4.3 Description of Groundcover

3.4.3.1 Unburned section

The most frequently recorded and the most dominant groundcover species recorded in the unburned section of MV1 was Triodia irritans as shown by Fig. 3.5. Triodia irritans made up 86% of recorded species, and had a projected cover (FPC) of about 57% of the VSA.

Other species which made up the remainder of the vegetation were Enchylaena tomentosa, Maireana sclerolaenoides and Beyera opaca. These occurred in roughly the same numbers and had a projected cover of about 8% when combined.

Bunch grasses were also found to be evenly spread over all the VSA.

3.4.3.2 Burned section

As shown by Fig. 3.6, Triodia irritans was the most dominant plant with the greatest foliage projected cover of 36%. Beyeria opaca had a foliage projected cover of 4.5% while Halgania cyanea was 3.5%. Other commonly recorded plant species which provided groundcover were: Chenopodium desertorum 2% foliage projected cover, Maireana pyramidata 0.5%, and one plant of Cassia nemophila var. platypoda.

Solanum coactiliferum seedlings were also abundant throughout 50% of the quadrat in the northeast corner, however they were too small and numerous to map. Bunch grass was also common throughout the quadrat.

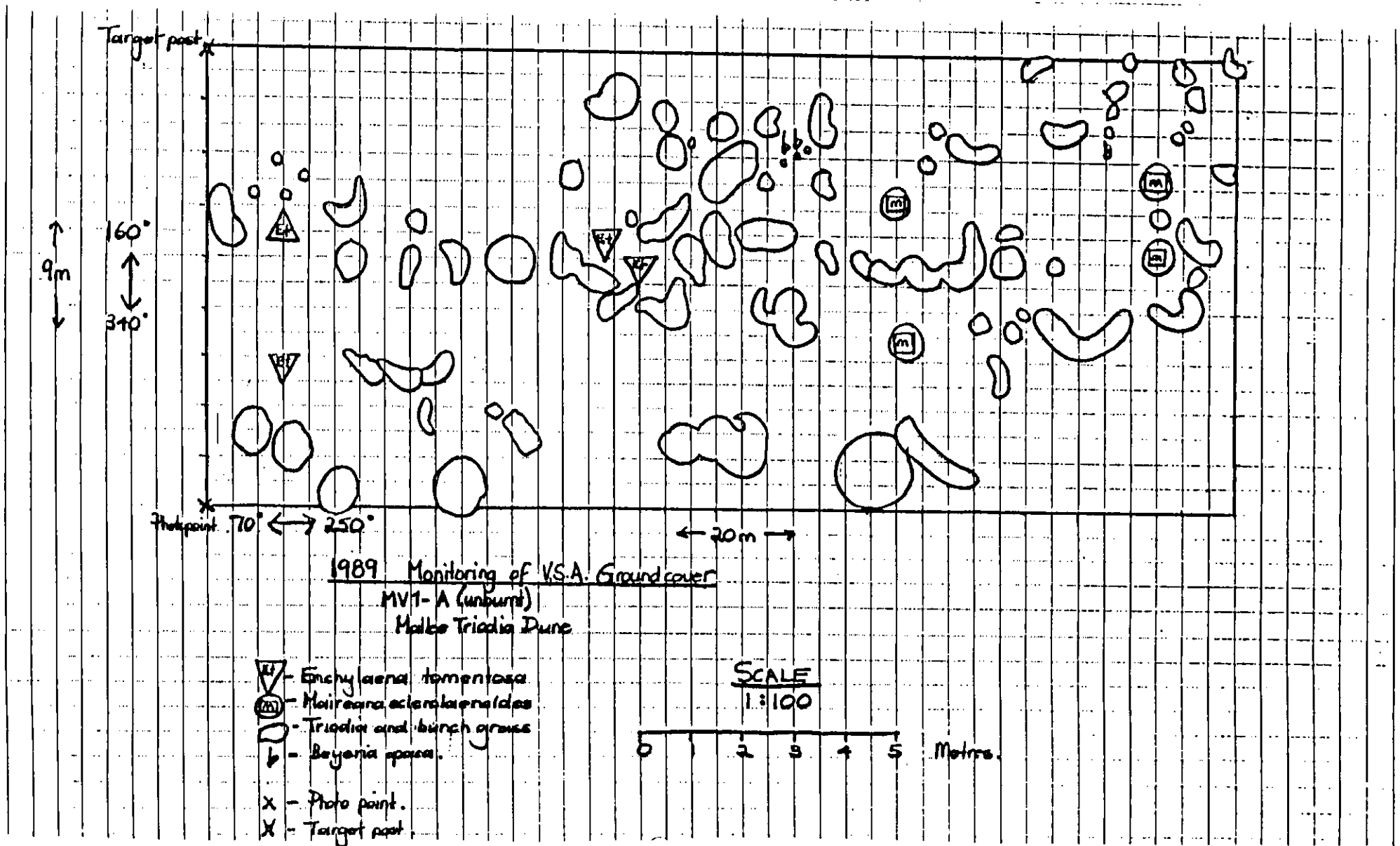


FIGURE 3.5 Map of groundcover species in unburned section of MV1-A

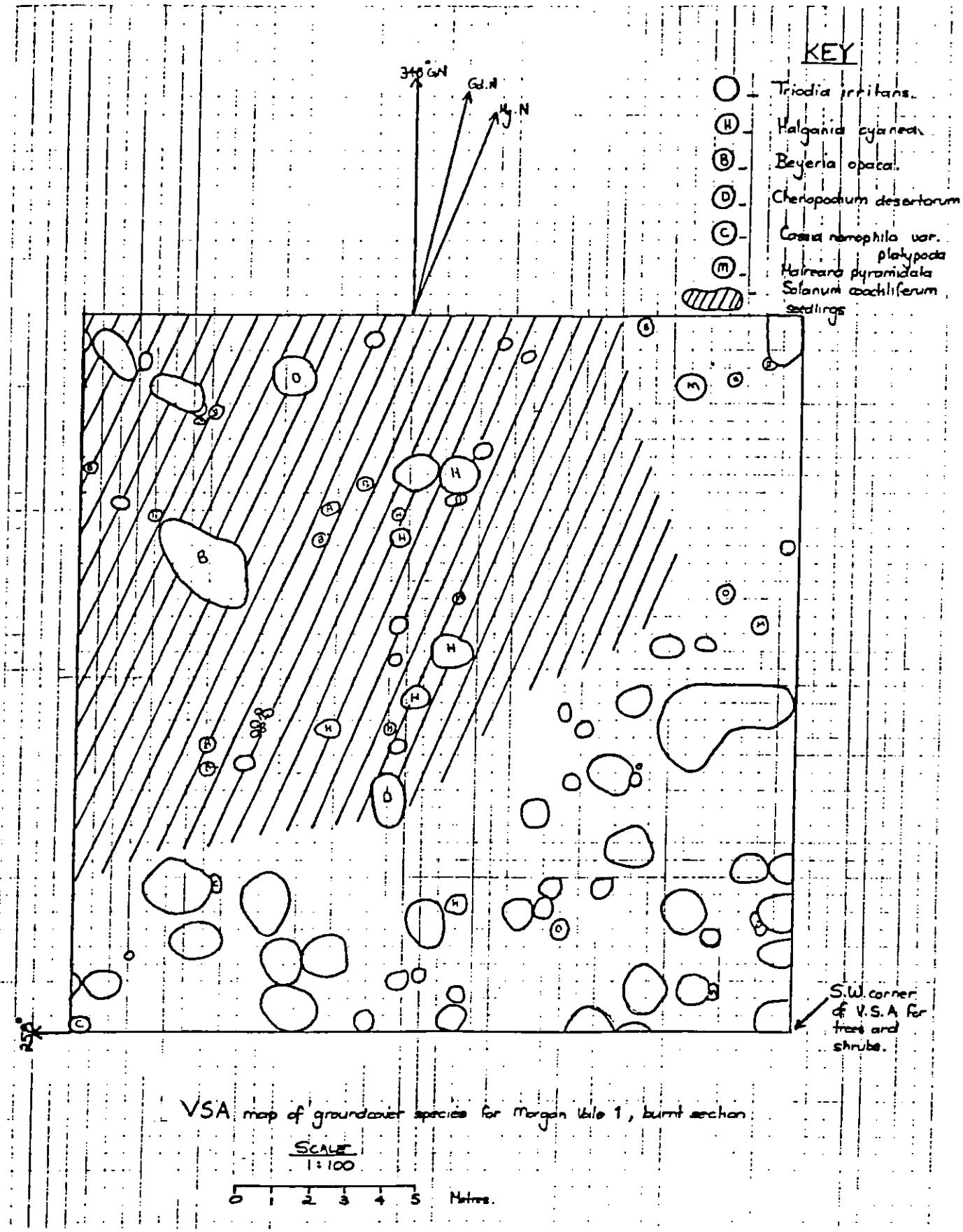


FIGURE 3.6 Map of groundcover species in burned section of MV1-B

3.4.4 Interpretation of Data

3.4.4.1 Comparison of groundcover - Burned vs Unburned, 1989

The density of plants in the burned section is greater than that of the unburned section of the quadrat, as shown in Table 3.3; however, the individual plants in the burned section are generally smaller in size than those in the unburned section.

TABLE 3.3 Density of plants in the burned/unburned areas

DENSITY (No. of plants/m^2)	BURNED	UNBURNED
	.99	.47

Bunch grass is abundant and evenly distributed in both sections. Podolepis capillaris is abundant and evenly distributed in the burned quadrat, but was not present in the unburned section. Solanum coactiliferum, Halgania cyanea, Chenopodium desertorum, Cassa nemophila var platypoda and Maireana pyramidata were also found in the burned section but not the unburned; while Enchylaena tomentosa and Maireana sclerolaenoides were only found in the unburned section. Triodia irritans was by far the most abundant species recorded in both sections.

3.4.4.2 Comparison of groundcover - Burned section 1986 vs 1989

In both years, Triodia irritans was found to be the dominant species with Halganea cyanea and Solanum coactiliferum being widespread. Beyeria opaca was the second most frequently occurring species in 1989, yet it was not considered significant in 1986. In 1989, Chenopodium desertorum, Maireana pyramidata and Cassia nemophila var. platypoda were found to be important species in the section, but were not present in 1986.

Eremophila sturtii, Rhagodia spinescens and Sclerolaena uniflora were present in 1986, but not in 1989. These differences could be due to errors in identification of species, or because new species are present and have replaced some species that occurred in 1986.

The density (number of plants/$metre^2$) in 1986 was $^{365}/_{20} \times 10 = 1.825$. In 1989 the density had decreased to almost half this, 0.99.

3.4.5 Dark turpentine, Beyeria opaca regeneration on Morgan Vale 1 burned area

On the 17th April 1986 a quadrat was pegged out to allow the fate of Beyeria opaca seedlings in the burned patch of Morgan Vale 1 to be followed. This 4 square metres (2m x 2m) quadrat was set out in the south-west corner of the VSA patch (152°G1), 5 metres from the photopoint marker, reference to 1986 report Appendix 5.5. Orientation is 152°GN from the north-west corner of the patch.

In 1986 the regeneration patch contained 115 Beyeria opaca seedlings which had an average height of 5cm, and an average density of 29 seedlings/$metre^2$. The total FPC of this species was 0.7% (refer to Table 3.4). The patch was resampled on 26/4/1989. The seedling numbers had decreased by 69 seedlings to a total of 36. This was to be expected, possibly due to the

grazing of these succulent seedlings by kangaroos, goats, rabbits and competition for space, nutrients and water. After a three year period the average height of the seedlings was 27cm, a growth of 22cm. The average density of these seedlings was 9 per metre^2, this reduction was directly related to the reduction of seedlings. The total FPC, however, has increased by 14.3%, from .7% to 15%. This increase was due to the growth of the seedlings in both height and diameter, which increases the foliage projection.

TABLE 3.4 Comparison of Beyeria opaca seedlings - 1986 vs 1989

	17/4/86	26/4/89
Number of seedlings	115	36
Average height	5cm	27cm
Average density	29/metre^2	9/metre^2
Total FPC	0.7%	15%

3.5 Fauna

3.5.1 Invertebrates

Invertebrates were sampled in the burned and unburned halves of the quadrat so comparisons could be made between the species present and between the abundance of individuals in the two environments. Unfortunately, in 1986 invertebrates were not sampled by this method, so data from the two years cannot be compared.

Micropitfalls were used as the capture method, and 40 were placed in each half of the quadrat (see section 2.1.2). The microhabitats in which the pitfalls were placed are summarized in Table 3.5, mallee litter, open area or Triodia.

TABLE 3.5 Percentage of pitfalls per microhabitat, MV1, 1989

	Unburned Section		Burned Section	
	No. Pitfalls Placed	% Pitfalls* Placed	No. Pitfalls Placed	% Pitfalls* Placed
Mallee litter	14	35	5	12.5
Open area	11	27.5	22	55
Triodia cover	15	37.5	13	32.5
Total	40	100%	40	100%

*% pitfalls placed in each microhabitat

Figure 3.7 shows significantly less pitfalls were placed in mallee litter in the burned section, and consequently many more were situated in open areas. This is because mallees in the burned area have not matured to the stage of producing abundant litter.

In the burned section seven micropits were pulled out of the soil from the one line by an unknown animal(s). This may have affected the diversity of species and number of individuals caught in this section.

The results in Figure 3.7 indicate that mallee litter is the preferred microhabitat of most invertebrate species in the unburned section. The result is different in the burned section, with bare ground and Triodia cover providing the larger numbers of species. This difference can be credited to the lower amount and quality of mallee litter here. The similar number and type of species represented (Table 3.6) indicates invertebrates are able to utilize prevailing landforms and vegetation to provide food and shelter requirements.

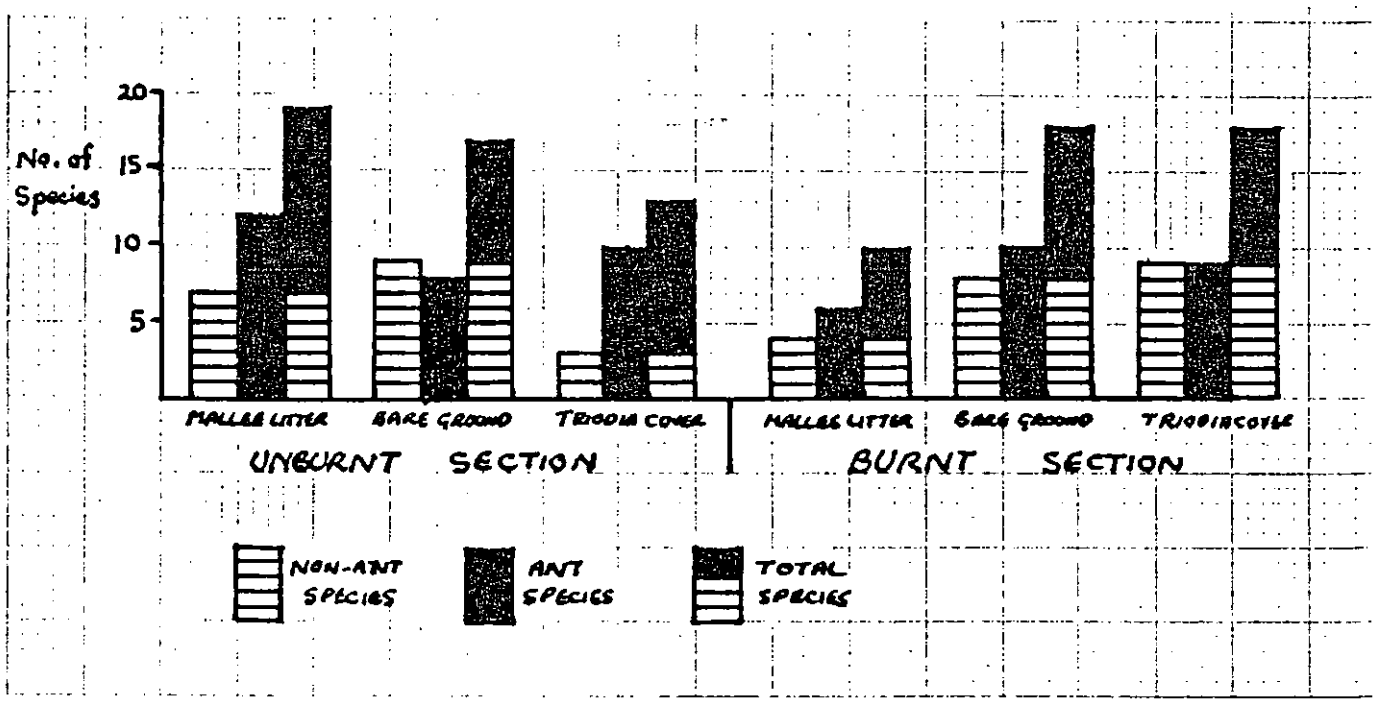


FIGURE 3.7 Number of ant and non-ant species recorded in MV1 pitfalls

TABLE 3.6 Summary of invertebrates recorded at MV1

ORDER	UNBURNED SECTION No. of Species	UNBURNED SECTION Total No. of Individs.	BURNED SECTION No. of Species	BURNED SECTION Total No. of Individs.
Araneae	1	4	6	9
Acarina	1	2	-	-
Coleoptera	1	1	5	6
Diptera	7	10	3	7
Hemiptera	2	2	2	2
Hymenoptera	1-18 [Ants] 19 [Wasps]	465	19 [Ants]	296
Isoptera	1	1	1	1
Lepidoptera	1	1	-	-
Orthoptera	-	-	1	1
Thysanoptera	1	1	-	-
Collembola	1	1	1	2
Total	35		38	

In both sections, ants are the most abundant of species and individuals caught. This may be partly due to the likelihood of their capture by the method used. The large numbers of individuals in the Order is also a dominant factor.

Results presented in Figure 3.8 indicate that invertebrates have re-established in the burned area since the fire of 1984/85, as the numbers of species trapped were nearly the same in both sections. However, numbers of individuals are lower in the burned section, indicating the process of regeneration is still occurring. Alternatively, this may be due to chance.

19 species of ants were caught at MV1 (Appendix 3.3). Of all genera, the most species caught were Iridomyrmex spp., and Melophorus spp. Iridomyrmex spp. were found in the most numbers (individuals) and in all microhabitats in both areas. This is consistent with Greenslade (1979) who asserts that Iridomyrmex spp. usually dominate ant associations. Species frequency of Iridomyrmex spp. in Fig. 3.8 supports this statement.

Appendix 3.3 shows Iridomyrmex species 5 as the most common in all micro-habitats in both sections of the quadrat, indicating a wide range of habitats provide suitable microniches.

Figure 3.8 and Appendix 3.4 also indicate that frequency of ant species is higher in the unburned area for all Greenslade's Functional Groups except for Opportunists (Rhytidoponera). This may be because they are poor competitors (Greenslade, 1979), preferring to colonize areas where there is less competition. A future study on succession of ant spp. after fire is recommended to determine whether there is a relationship.

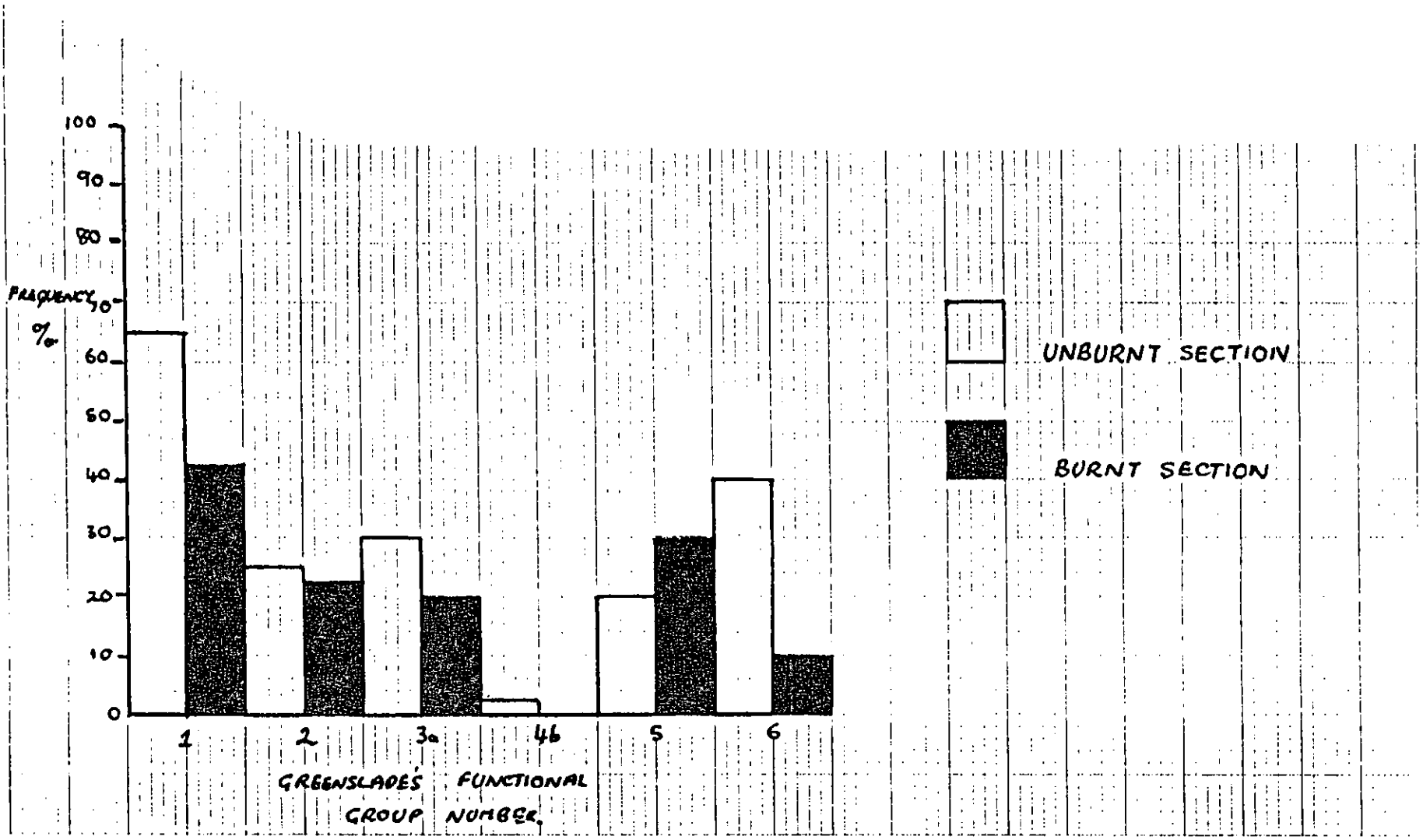


FIGURE 3.8 Frequency of Greenslade's Functional Groups (Ants) Micropitfall capture, MV1, 1989

3.6 Conclusions

3.6.1 Future studies

- continue with Dark Turpentine, Beyeria opaca, survey on growth patterns after fire.
- investigate soil erosion in both burned and unburned quadrats.
- determine why a large number of scorpion holes were found, but no scorpions were observed or captured.
- monitor the effects of feral goats and kangaroos in the quadrats.

3.6.2 Habitat value

The value of Morgan Vale 1 is in the opportunity to study and record the process of recovery after fire. By comparing data from consecutive years from the burned and unburned quadrats we can monitor regrowth and determine the effects of fire on the semi-arid region.

The quadrats are also rich in invertebrates which are good bio-indicators of recovery after fire and grazing.

3.6.3 Management implications

The data which has been compiled since the fire in December 1984 consists in the making of management decisions in regard to the stable unburned quadrat and the undisturbed vegetation of the burned quadrat.

It is important to monitor regrowth after fire in order to determine if the system is dependent on fire and is able to successfully regenerate and be of benefit as habitat.

4.0 TOMAHWAK DAM (T01) : Burned Mallee Dune 1987-1989

4.1 Introduction

The study carried out at Tomahawk 1 (T01) in 1989 was designed as a follow-up to a study carried out on the quadrat in 1987. As the area had been burned in 1985, the T01 quadrat offers good opportunities to study succession of fauna and flora after fire.

Standard sampling techniques (see section 2.0) were used to sample the vegetation of the quadrat, to map the VSA and to sample invertebrates.

4.2 Quadrat Details

The north-east corner of the T01 quadrat is located 150 metres magnetic north of a permanent photopoint marker (G.R. 471750 630900) which is on the southern bank of Tomahawk Dam. Fig. 4.1 illustrates the location of the quadrat in relation to Tomahawk Dam, the topography of the quadrat, the positions of the VSA and micropitfalls and some areas of atypical vegetation.

4.3 Landforms

The landform of this quadrat is a series of four somewhat parallel dunes trending toward the northeast (Fig. 4.1). The dune crests are roughly 200m apart, on average, with shallow swales between. The dune shapes in this area are rarely straight, often forked, curved and sometimes twisted. Some elements of the vegetation coincide with topography, e.g. the Callitris occurs on dune crests and chenopods in the swales, but generally the vegetation patterns are too complex to define consistent relationships.

4.4 Vegetation

4.4.1 Canopy

Due to the quadrat being heavily burned in 1985, the vegetation is relatively sparse regenerating mallee shrub (KS-Muir) (see Plate 4.1). The juvenile mallees were difficult to identify as they had not yet developed fruits and buds. Mallee shrubs were allocated to two groups on the basis of foliage colouring. The Yorrell Mallee (Eucalyptus gracilis) and the Ridge-fruited Mallee (Eucalyptus incrassata) were called Green-leaved Mallees while Red Mallees (Eucalyptus socialis) and White Mallees (Eucalyptus dumosa) were called Grey-leaved Mallees. The mallee shrub system is located on gently rolling sand dunes. Most topographic landforms had a Northcote soil classification of VC1.13 (Tamblyn and Holzner-1987). The quadrat possesses some emergent unburned KT (Muir) canopy, generally in the swales, and some Sand Pine (Callitris verrucosa) restricted to crests and upper slopes (see Appendix 4.1). Other than this atypical canopy, the vegetation canopy was relatively homogeneous.

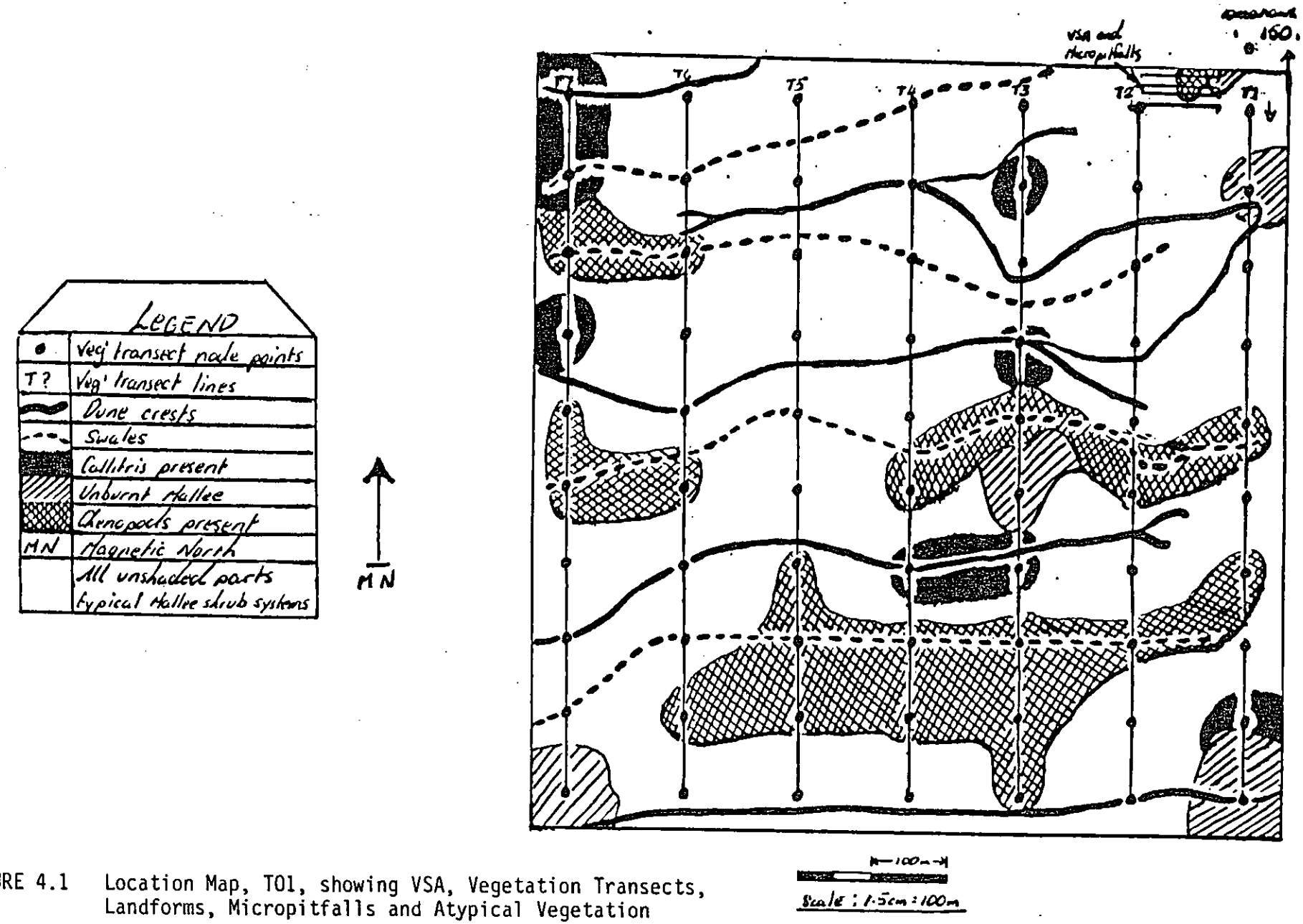


FIGURE 4.1 Location Map, T01, showing VSA, Vegetation Transects, Landforms, Micropitfalls and Atypical Vegetation

PLATE 4.1 Vegetation Structure of Tomahawk Dam Quadrat (TO1)

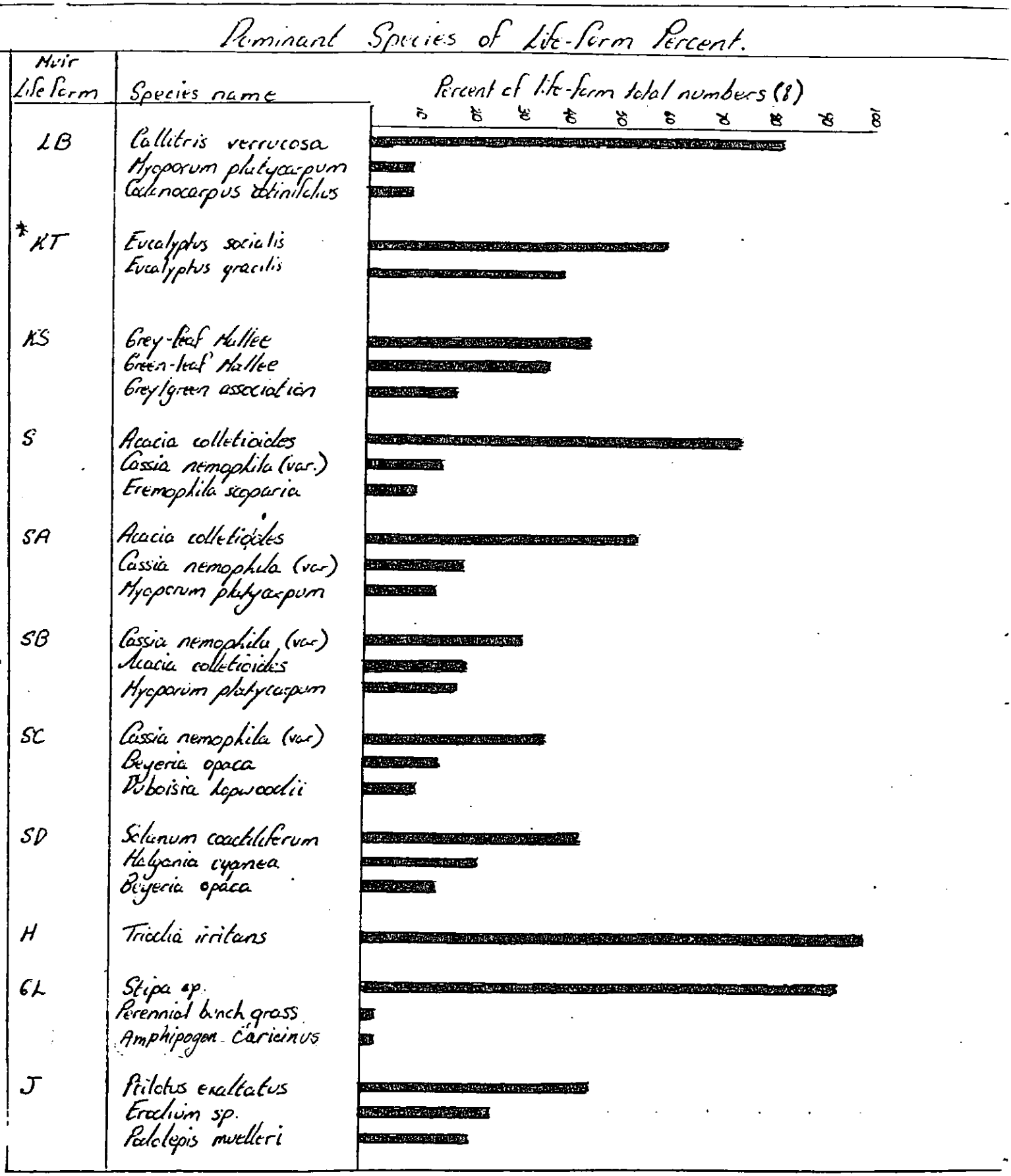
4.4.2 Understorey

As with the upperstorey strata, the understorey is variable but consistent throughout. Numbers of shrubs generally tended to be greater on swale areas than crests, although some species did favour the higher elevated areas (see Appendix 4.1). The shrub layers contained mature Wait-a-whiles (Acacia colletioides), various aged Cassias (Cassia nemophila vars), Dark Turpentines (Beyeria opaca), Black Fuchsias (Eremophila glabra), Kangaroo Apples (Solanum coactiliferum), Halganias (Halgania cyanea) and chenopods restricted to the swales.

Spear grasses (Stipa sp.), herbacecus groundplants and Porcupine Grass (Triodia irritans) were considered major contributors to the community in the lower vegetation strata (see Fig. 4.2) along with chenopods.

4.4.3 Vegetation and Topography

There was little variation in vegetation type throughout the quadrat and, with the exception of Callitris and chenopod populations, no distinct association between topography and vegetation type. Appendix 4.1 shows little association between plant species and topography or life form and topography. This made the development of a full vegetation association map irrelevant.



* Percent of only 5 recordings

FIGURE 4.2 Dominant Species of Life-form

4.4.4 Plant Species Present

Table 4.1 gives a full species list of plants found in the T01 quadrat.

TABLE 4.1 Plant Species observed at T01, 1989

Number	Species Name	Number	Species Name
1	Callitris verrucosa	34	Lomandra effusa
2	Codonocarpus cotinifolius	35	Vittadinia cunneata
3	Eucalyptus dumosa	36	Vittadinia triloba
4 (3A)	Eucalyptus socialis	37	Stip sp.
5	Eucalyptus gracilis	38	Leichhardtia australia
6	Acacia burkittii		
7	Acacia colletioides	40	Dittrichia graveolens
8	Acacia (ligulata) bivenosa	41	Triodia irritans
9	Eremophila glabra	42	Eremophila scoparia
10	Olearia pimeleoides	43	Myoporum platycarpum
11	Grevillea huegellii	44	Hakea leucoptera
12	Doboisia hopwoodii	45	Maireana triptera
13	Beyeria opaca	46	Templetonia egena
14	Westringia rigida	47	Zygophyllum apiculatum
15	Olearia subspicata	48	Eremophila sturtii
16	Dodonaea angustissima	49	Maireana georgii
17	Solanum coactiliferum	50	Sclerolaena obliquicuspis
18	Enchylaena tomentosa	51	Stipa sp.
19	Sclerolaena diacantha	52	Nicotiana goodspeedii
20	Podolepis muelleri		
21	Euphorbia drummondii	54	Eremophila desipiens
22	Halgania cyaena	55	Dissocarpus paradoxus
23	Ptilotus exaltatus	56	Ptilotus polystachyus
24	Erodium sp.	57	Ptilotus sp.
25	Chenopodium nitrariaceum	58	Perennial bunch-grass
26	Chenopodium desertorum	59	Zygophyllum iodocarpum
27	Rhagodia spinescens	60	Solanum sp.
28	Cassia nemophila (varieties)	61	Olearia decurrens
29	Baeckea crassifolia		
30	Sclerolaena parviflora	63	Eucalyptus porosa
31	Cryptandra tomentosa	64	Eucalyptus incrassata
32	Amphipogon caricinus	65	Rhagodia ulicina
33	Psilocaulon tenue		

Figure 4.3 shows mallee shrubs as the most recorded life-form in the quadrat. Lower strata shrubs (Muir) also recorded relatively high numbers. The densities generally ranged between sparse and very sparse (i/r - Muir).

Figure 4.3 shows the highest percent of species within each life-form. General indications are of a mixed mallee population, a large input by Wait-a-whiles and Cassisa in the shrub layer and a mixed Porcupine Grass/ Stipa Grass groundcover.

Figure 4.4 shows plants recorded in the VSA at T01. It shows a canopy primarily consisting of Grey-leafed juvenile mallees. Canopy cover varies at differing locations between mid-dense, sparse and very sparse (Muir). The most dense area of canopy cover (western section) was primarily a Mallee/Triodia association. Larger shrubs were observed at areas with sparse canopy cover (30 to 80 metres from west boundary). The eastern part of the VSA contained an atypical area with very little vegetation cover of any sort. The extreme eastern boundary contained two unvurned Yorrell Mallees associates with a sparse Bunchgrass groundcover. Only species above 50cm were recorded. Numbers of all species recorded are given in Table 4.2.

TABLE 4.2 Number of species > 50cm, T01 VSA, 1989

Number	Species Name	life-form	Number found	Percent of recordings (%)
3/4	Grey-leaf mallee	KS	58	75.3
16	Dodonaea angustissima	SC	5	6.5
9	Eremophila glabra	SC	4	5.2
15	Olearia subspicata	SB	4	5.2
12	Duboisia hopwoodii	SC	3	3.9
* 5	Eucalyptus gracilis	KT	2	2.6
8	Acacia ligulata	SC	1	1.3

* Only mallee with fruit

Figure 4.5 shows the results of the groundcover plot used for surveying within the T01 VSA. Distribution of groundcover species tended to be scattered on bits of land unshaded by the mallee (primarily) canopy cover. Least number of individuals were recorded at the south-western section of the groundcover plot where larger shrub numbers were highest. The north-western section of the plot contained the largest of the mallees as canopy cover. This area produced the least number of species in the plot although numbers of individuals was relatively high. Chenopods were generally clumped in the north-eastern section of the plot where the canopy cover was almost non-existent (see Fig. 4.4). Kangaroo Apples, Dark Turpentines, chenopods and Halganias were most often recorded on the ground cover plots. Full details of species recorded in the plot are given in Table 4.3.

Appendix 4.2 shows guidelines for Muir classifications.

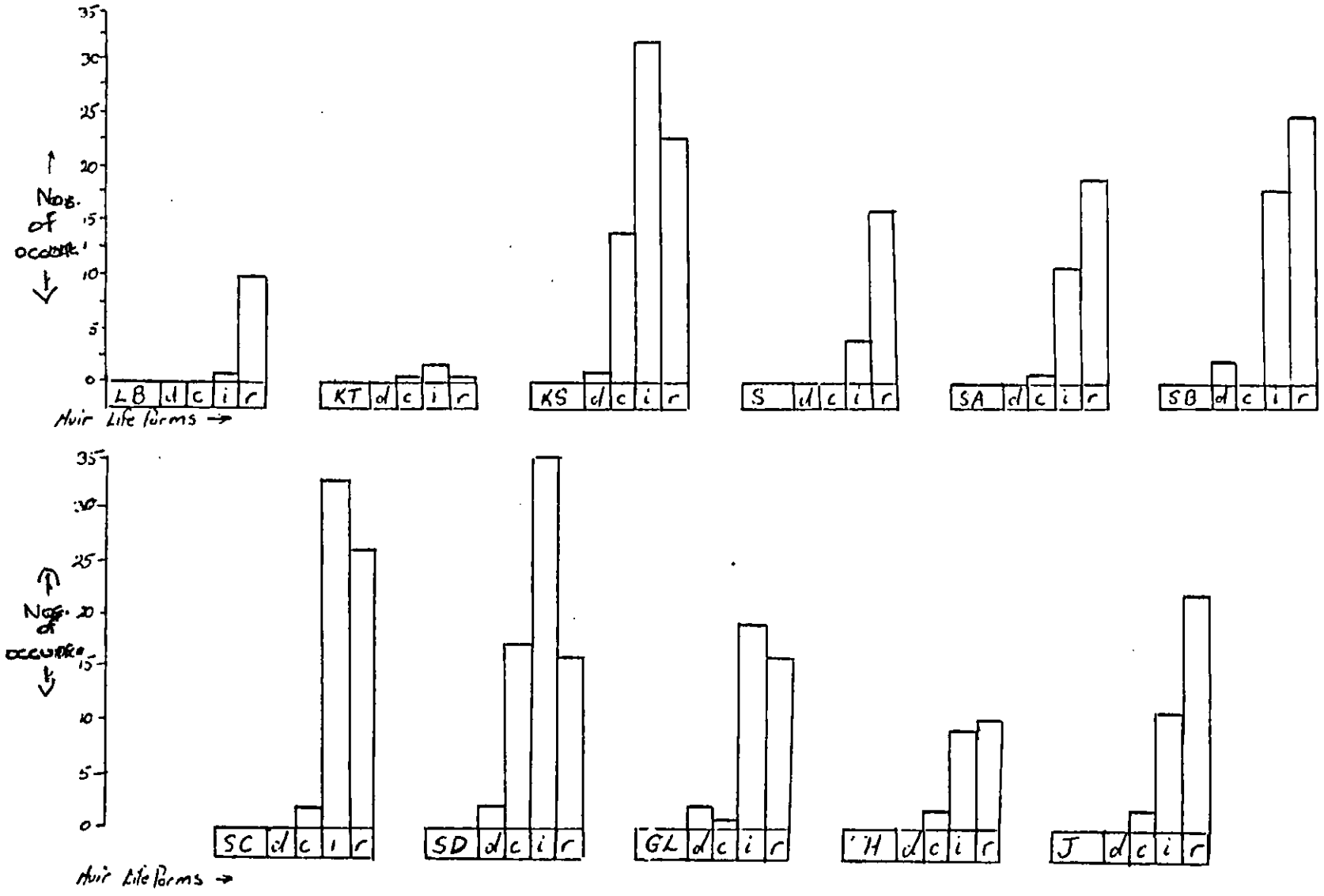


FIGURE 4.3 Life-form Frequencies. T01 Quadrat, 1989

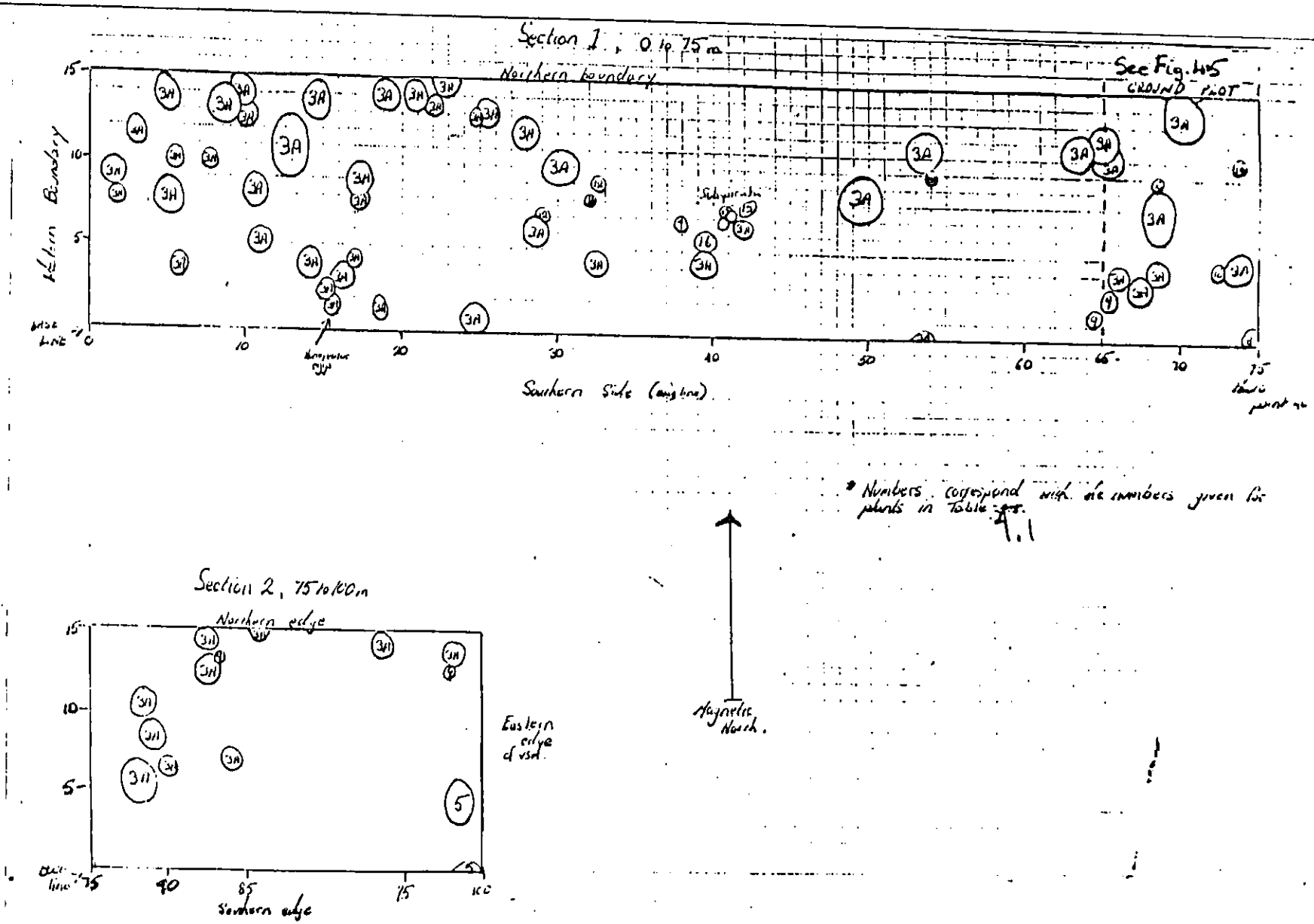


FIGURE 4.4 VSA T01 1989, 100m x 15m : Spatial plotting : range finding

Numbers correspond to species listed in Table 4.3.

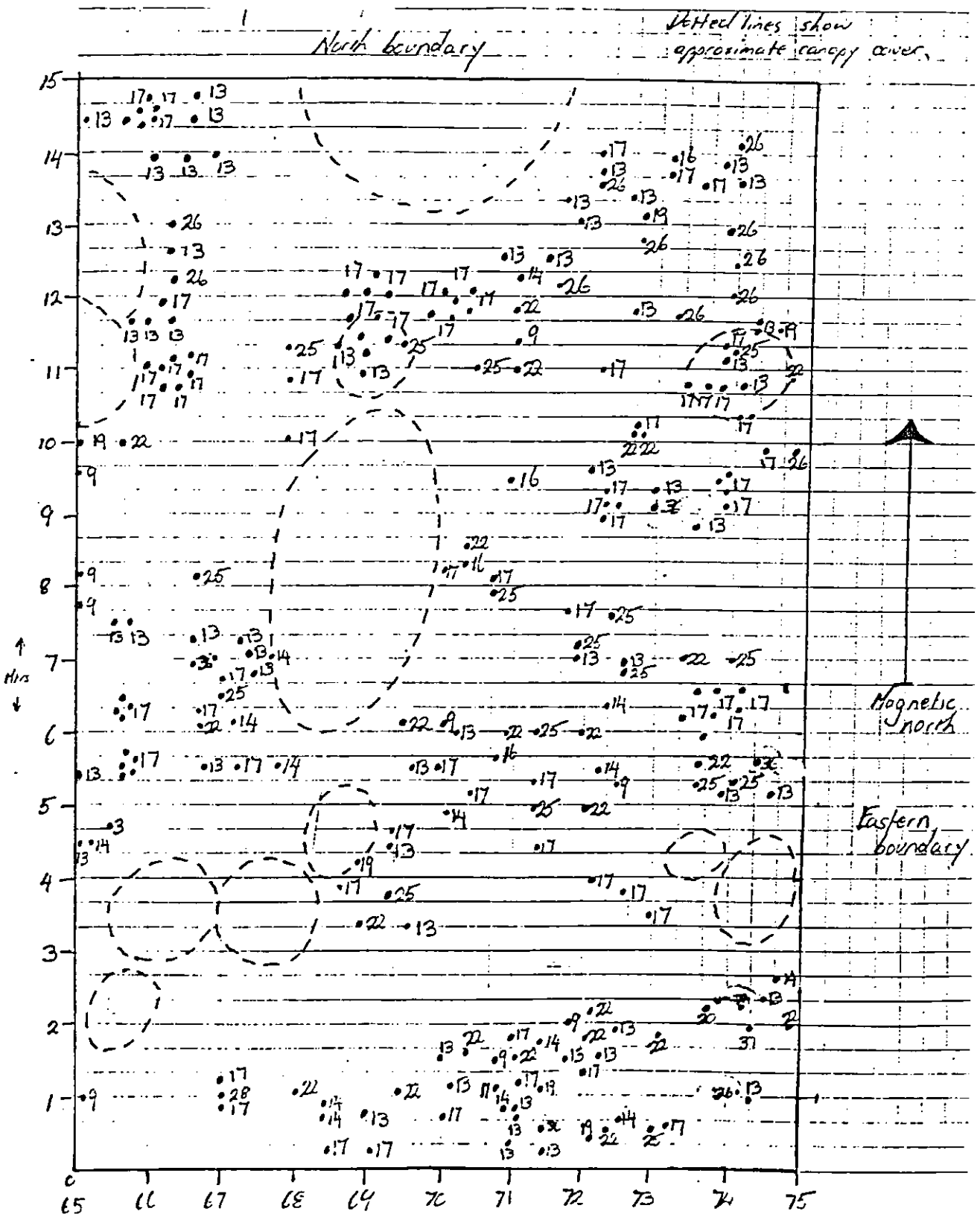


FIGURE 4.5 Groundcover - 10 x 15m section within VSA T01 1989

TABLE 4.3 Plant species > 50cm, Groundcover Plot, T01 VSA, 1989

Number	Species Name	Life-form	Number found	Percent of recordings (%)	
17	Solanum coactiliferum	SD	78	34.4	
13	Byeria opaca	SD	55	24.2	
22	Halgania cyanea	SD	24	10.6	
25	Chenopodium desertorum	SD	17	7.5	
14	Westringia rigida	SD	14	6.2	28 recordings
26	Chenopodium desertorum	SD	11	4.8	
9	Eremophila glabra	SD	9	4.0	
19	Sclerolaena diacantha	SD	6	2.6	
36	Vittadinia triloba	J	6	2.6	
16	Dodonaea angustissima	SD	4	1.8	
28	Cassia nemophila (varieties)	SD	1	.4	
20	Podolepis muelleri	J	1	.4	
24	Erodium sp.	J	1	.4	

4.4.5 Comparison with 1987 results

Comparisons with 1987 data gave the following indications:

General Comparisons

- The mallee canopy is continuing to grow. Although they are still yet to reach maturity, they are now large enough for some small nesting birds;
- Growth of lower storey shrubs has resulted in an increase in shrub life-form diversity, with individuals found in all Muir shrub classifications;
- Cassias, Wait-a-whiles, Dark Turpentines, Black Fuschias and other Acacias (Table 4.3) have all grown into larger life-forms;
- Cassias may be beginning to compete favourably with Wait-a-whiles, which were affected by fire;
- Species diversity has remained stable. A small increase in numbers of species was noted;
- Numbers of colonizing shrubs, eg. Turpentine Bush (Eremophila sturtii), Sticky Hopbush (Dodonaea viscosa), have decreased relative to other species, although these shrubs have also increased in size.
- Diversity of groundcover has increased;
- Stipa grasses have increased in numbers, this vegetation-type being suited by sparse groundcover;
- Bunchgrasses have decreased significantly in numbers, often being restricted to atypical areas of vegetation;

- Numbers and diversity of some introduced species, eg. Black Nightshade (Solanum nigrum) and Horehound (Marrubium vulgare) may have decreased or disappeared, although Ptilotus species were still prevalent;
- Herbaceous plants (J-Muir classification) have increased in numbers and diversity;
- Porcupine Grass is regenerating from seeds and rhizomes but is presently not dominant throughout the quadrat.

Comparisons of VSAs, 1987-1989

The locating of the 1989 VSA at T01 resulted in minimal overlap with the original VSA located in the 1987 survey. The only area of overlap occurred at the 75 to 100 metre area of the 1989 VSA (Fig. 4.6). Comparisons of this area gave the following indications:

- Mallee size has increased;
- Mallee numbers have remained stable;
- Two Black Fuschias have grown into larger life-forms;
- One individual, recorded in 1987, was not recorded in 1989. The individual, recorded as Hc (see comparison maps - Fig. 4.6), is at this point an unknown species.

The 1987 groundcover plots were not able to be relocated with confidence, so that 1989 groundcover does not correspond with 1987 groundcover.

4.4.6 Possible Further Studies - Vegetation at T01

The following studies are recommended on vegetation strategies at T01:

- Investigate the apparent decline of introduced vegetation at T01. Attempt to determine specific species disappearing and what they are being replaced by. Determine whether the position of the dam has any influence on their distribution.
- Further investigation into the growth strategies after fire by the shrubs found in the quadrat. Particular notice should be given to the Mallee shrubs to determine their species, to competing of Cassias and Wait-a-whiles in larger shrub stratas, to the success rate of Dark Turpentine and Pituri (Duboisia hopwoodii) and to the growth or decline of Halganias.
- The effect on areas of the increasing mallee size.
- Investigate specifics of areas of chenopod colonization, eg. soil test, amount of canopy cover, diversity and numbers of individuals of other species.
- Further monitoring of the growth strategies of Porcupine Grass.
- Investigations into specifics of areas of atypical vegetation, eg. effects on fauna populations of unburned areas and Callitris, soil and litter tests in Callitris and unburned areas, investigation of erosion areas and natural soaks.

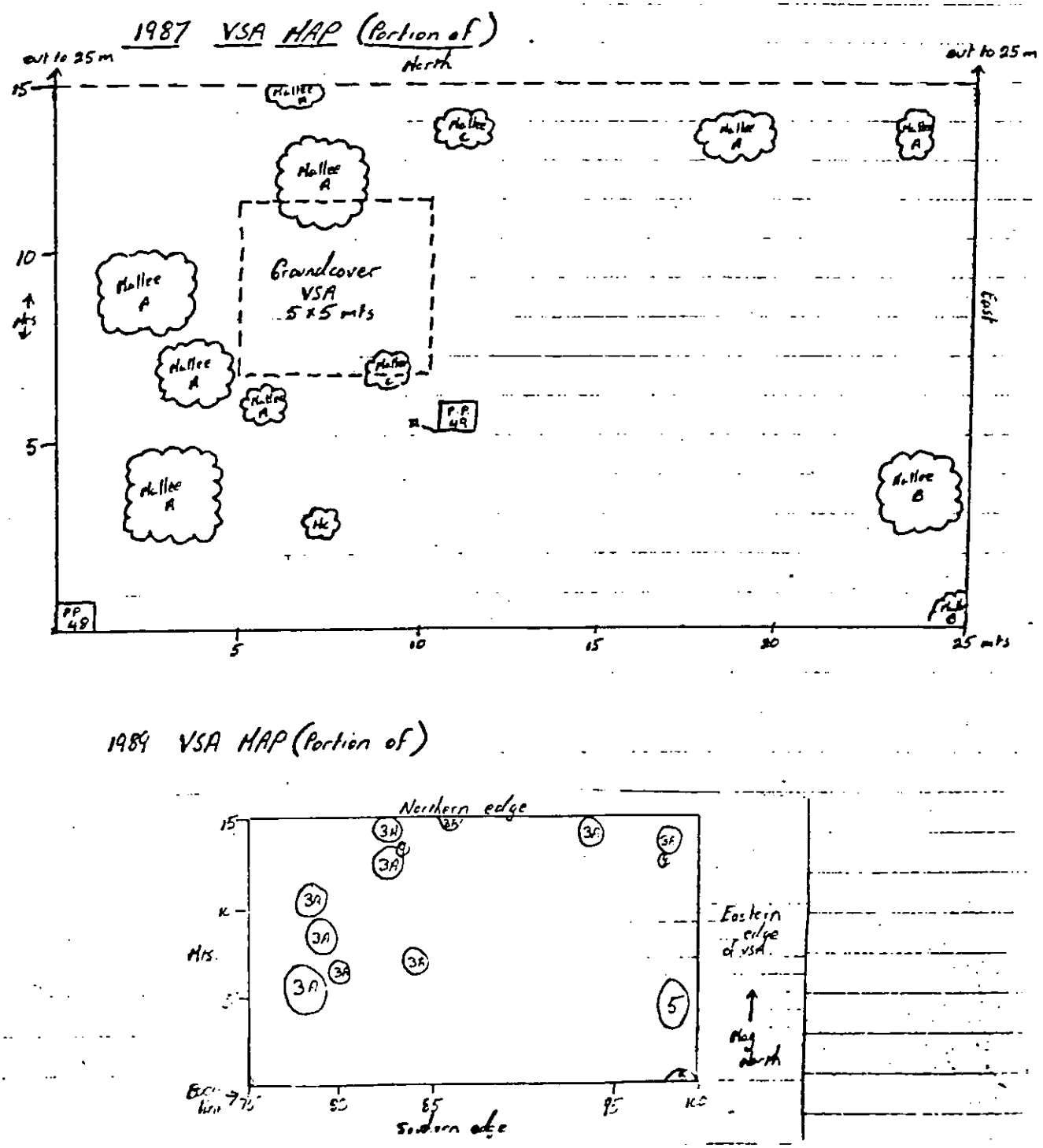


FIGURE 4.6 VSA Comparison Maps - Area of Overlap, VSA, TO1

4.5 Fauna

4.5.1 Introduction

Forty micropitfalls were laid down at 5 metre intervals along two lines, North and South of the T01 VSA. Half of these were pulled up during the sampling period, 25/4/89 to 28/4/89, by an animal suspected to be either a goanna or a crow. Some were resited and most still contained trapped invertebrates. Of the original 40 micropitfalls, 35 were viable enough to use in microhabitat and invertebrate capture rate comparisons which are shown in Appendix 4.3.

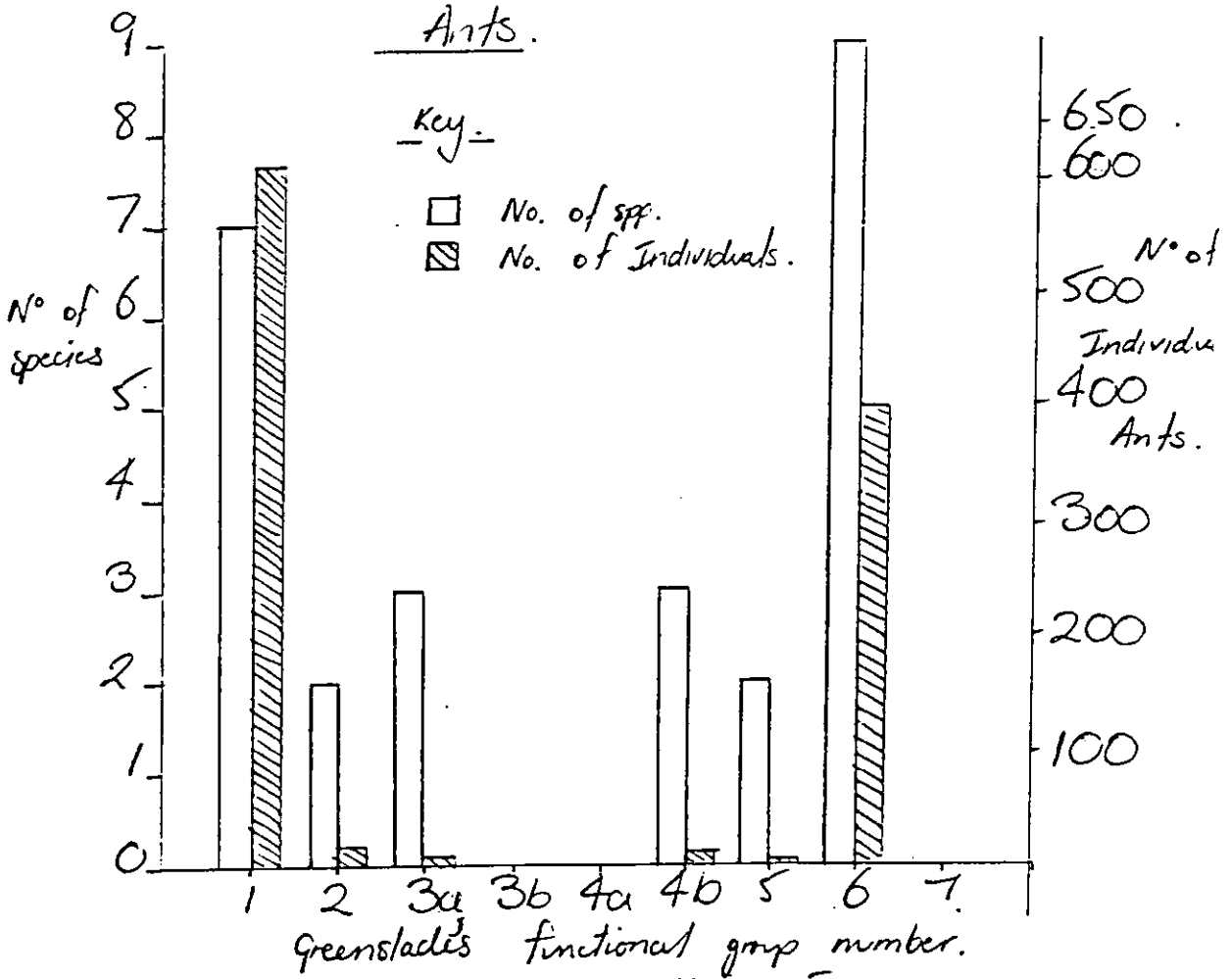
Of the 35 recorded microhabitats, 60% were open ground, 20% under mallee, and 20% under other vegetation. Forty percent had a sparse litter cover, 30% had a moderate litter cover and 30% had no litter at all. The sampling area in general contained a regenerating burned mallee habitat. A summary of invertebrates recorded in T01 can be seen in Table 4.4.

TABLE 4.4 Summary of Invertebrates recorded in T01

Order		No. of spp.	No. of individuals
1.	Acarina	3	5
2.	Aranaea	7	11
3.	Blattodea	1	1
4.	Coleoptera	8	22
5.	Collembola	(present but not analysed)	
6.	Diptera	11	56
7.	Heimptera	2	8
8.	Hymenoptera (non-ants)	1	1
	" (ants)	26	1055
9.	Isoptera	1	1
10.	Dermaptera	1	1
11.	Orthoptera	1	1
	Total	66	1162

4.5.2 Ants

Of the total 1055 ants caught, 60% were caught on open ground. This indicates little since it equates to the number of traps on open ground. However, 57% of all ants were caught in sparse litter, which is higher than the 40% of traps placed there. This may indicate ants generally prefer some litter to none or heavy litter, or that they are influencing litter accumulation in some way.



Group	Major Taxa
1. Dominant Species	Iridomyrmex.
2. Subordinate Species	Camponotus
3. (a) Hot climate specialists.	Melophorus, Meranoplus.
(b) Cold climate specialists	Prolasius, Notoncus
4. (a) Cryptic species	Small porerines and myrmicines
(b) Sub-Cryptic species	Stigmacross, Tapinoma
5. Opportunists	Rhytidoponera
6. Generalised myrmicines	Crematogaster, Pheidole, Chelaner, Tetramorium, Myrmicinea spp.
7. Large solitary foragers	Myrmecia

FIGURE 4.7 Greenslade's Functional Groups - TO1 micropitfalls

Most species of ants occurred in numbers too low to be able to draw reliable conclusions about them. The most notable exception to this were ants of the Iridomyrmex genus, as seen in Appendix 4.3. The Iridomyrmex genus represented 58% of the total catch of 1055 ants. They were the dominant ants in TO1, represented as functional group 1 in Fig. 4.7. They appears to be monopolising resources to the exclusion of some other groups, except group 6, which explains the low species and individual numbers for other functional groups seen in Fig. 4.7.

Iridomyrmex had the largest number of species per genus, the largest number of individuals caught per genus and functional group, and the highest frequency of capture per genus and functional group (see Fig. 4.7 and Appendix 4.3).

Iridomyrmex 5 in particular represented 65% of the Iridomyrmex genus, and 38% of the total number of ants combined. Their large numbers make them useful for microhabitat comparisons. Ninety-one percent of Idiromyrmex 5 were caught on open ground, possibly indicating a preference for this habitat. Also, 47% occurred with no litter, and 38% sparse. This large number of apparently open ground specialists may indicate the ant assemblage is still recovering from the effects of the 1985 fire.

Other indications that the habitat is still recovering can be seen by comparing the functional groups of TO1 with those of EB2 (see Table 7.9). The Iridomyrmex genus is not dominating the ant assemblage at TO1 to the same degree as at EB2 due to the relatively strong competition from the generalised myrmicines.

TO1 and EB2 are both mallee-dune type habitats. The main differences between the two are:-

1. EB2 has taller dunes which are more closely spaced, and
2. TO1 has had recent disturbance by fire.

One or both of these factors may be influencing the ant assemblages at both sites. However, it is more likely that the fire disturbance at TO1 for years previous has had the greater influence. As the habitat slowly recovers from fire over the seasons, some ants tend to recover more quickly than others, and can capitalise on the next growth and open nature of the habitat. It appears as though the generalised myrmicines are doing just that. The myrmicines have unspecialised behaviours, meaning they are not dependent on specific environmental conditions, and can therefore cope with the changes which occur in a habitat after fire better than other types of ants. The myrmicines have a rapid recruitment of individuals in their colonies, increasing their ranks quickly after fire disturbance. They also have very effective defences against the more aggressive Iridomyrmex and can therefore compete for resources better than other types of ants (Greenslade, P.J.M.)

The habitat of EB2 is relatively stable, since its last fire, much longer ago. In this stable community Iridomyrmex has been able to exert its dominance over the other ant genera, leaving relatively few myrmicines in the ant assemblage.

Ants of the Myrmicinae sub-family were well represented at TO1 by at least 5 genera, 9 species and 400 individual ants. They represented the second largest functional group, and appear to be the only functional group that is competing well with the Iridomyrmex genus, in terms of species diversity and individual numbers.

In fact the myrmicines had the highest species diversity of all functional groups and were most frequently caught: Crematogasters in 62% of traps and Chelaner 1 and Phedidole 1 in 37% of traps combined. Together Chelaner 1 and Pheidole 1 comprised 18% of all ants caught. Fifty-one percent of the Chelaners were caught on bare ground with sparse litter. Seventy-eight percent of Pheidole 1 were caught under vegetation cover, other than mallee and, significantly, none at all on bare ground. This may be an indication that these two very similar species of the Myrmicinae sub-family are avoiding competition by using different microhabitats.

4.5.3 Non-ant invertebrates

Non-ant invertebrates were represented by 10 orders, 37 species and 111 individuals, as shown in Table 4.4 and Appendix 4.3. Fifty percent of these were of the Diptera Order (flies), 20% were Coleoptera (beetles) and 10% were Aranaea (spiders).

As with ants, the 63% of invertebrates trapped on open ground could be related to the fact that 60% of the traps laid were on open ground and they occurred in very low numbers, making it difficult and unreliable to draw conclusions from the data shown in Appendix 3.3. Of possible significance is the fact that 90% of spiders caught were in traps on open ground.

4.6 Conclusions

In summary, the vegetation at T01 is regenerating. The mallees have increased in size and are now capable of housing small nesting birds.

Many shrub species have grown to maturity and can now be seen throughout all Muir shrub life-form stratas. Bunchgrasses have decreased in numbers as other groundcover species have begun to colonize the area with an increase in numbers and diversity.

The quadrat shows very little evidence of topographic influence on vegetation, which tends to be fairly uniform throughout.

The invertebrates showed evidence of continuing recovery despite the time since the fire. This is demonstrated by the large numbers of generalized ants which increase after disturbances due to their adaptability. They still dominate other ant communities such as the Iridomyrmex genus which prefer more stable habitats. This shows, therefore, that the ants' community hierarchy, usually seen in a stable habitat, has not yet been established.

5.0 LITTLE BUNYIP DAM 1 (LB1) : Burned/Unburned Mallee Dune, 1987-1989

5.1 Introduction

The quadrat at Little Bunyip Dam (LB1) (grid reference 6209) was established in 1987. The quadrat was placed at the edge of a burned patch which was backburned along a bulldozed track on 14th January 1985 during the fires of Christmas 1984-1985. Adjacent to this area lay an unburned patch which also formed part of the study quadrat (see Fig. 5.1). The main aim was to reassess the LB1 quadrat in order to monitor recovery after fire.

5.2 Quadrat Details

The measurements in Fig. 5.1 are used to locate the permanent quadrat marker post of LB1. The quadrat can then be marked out as indicated in Fig. 5.1. To locate the VSA photopoint C157/46 marker post in the burned area, travel 100m from the quadrat marker post in a direction of 8°M.N. In the unburned area the VSA photopoint C157/47 marker post is located 200m from the quadrat marker post in a direction of 188° M.N.

5.3 Landforms

The quadrat consists of undulating parallel dunes or sandy rises running east-west. There are more undulations in the burned section, whereas in the unburned there is a gradual slope to a dune crest at the southern edge of the quadrat.

The soil surface is generally exposed in the burned patch and being of a sandy texture with a sparse groundcover is susceptible to erosion, particularly on the sandy rises. The flat areas between rises are more stable and therefore less susceptible to erosion.

5.4 Flora, Vegetation and Habitat-types

5.4.1 Qualitative description

By establishing ten vegetation transects throughout the quadrat, the character of major plant species and vegetation habitats was recorded as thoroughly as possible. The results showed that the major vegetation habitat was Mallee-Triodia. According to Muir (1977) the habitat type within the burned patch was classified as a low open shrubland, with a low open groundcover. The habitat type within the unburned patch was a low open woodland with a low sparse groundcover.

The upperstorey of the quadrat was dominated by shrub mallees whose original canopies had been burned. Consequently, the regenerating mallee forms were of shrub height. For this reason mallees are referred to as shrub life forms. In addition, many of the shrub species were in the early stage of regeneration.

As part of the upperstorey within the burned patch, the tree species, Myoporum platycarpum was found to be present, but in very sparse, isolated stands. Instead, it was the mallee shrub species such as summer red mallee, Eucalyptus socialis, white mallee, Eucalyptus dumosa and yorrell, Eucalyptus gracilis which dominated this stratum. Other dominating shrub

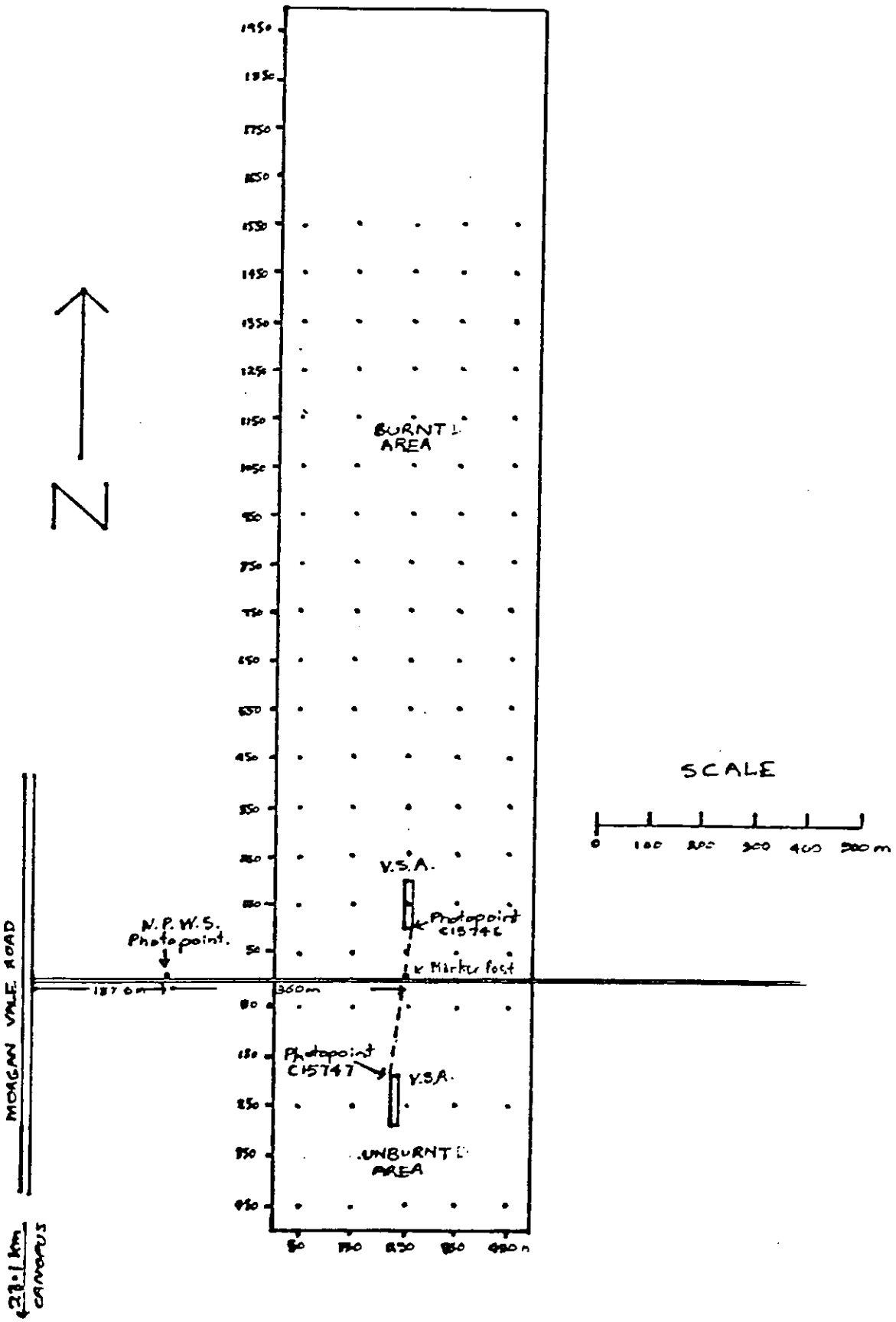


FIGURE 5.1 Location of Quadrat, VSA's, Nodes and Photopoints at LB!, 1989

species included sandhill wattle, Acacia burkittii, pituri, Duboisia hopwoodii and birdseye beanbush, Cassia nemophila var. zygophylla. The major subshrub species colonizing the patch were rough halgania, Halgania cyanea, Eremophila decipiens and dark turpentine bush, Beyeria opaca.

The groundcover was dominated by long greybeard grass, Amphipogon caricinus and porcupine grass, Triodia irritans which was occasionally growing in small clumps suggesting regeneration was from remnant rootstock. The herbaceous species, invisible plant, Podolepis capillaris and mulla mulla, Ptilotus exaltatus var. exaltatus were also found to be commonly growing within the patch. Sedges were recorded as being present, but not common. As a consequence of recent rain, lichens and mosses were forming a microphytic layer over the majority of the burned patch.

Within the unburned patch the dominant mallee shrub and tree species were similar to those of the burned patch. Whereas, the shrub species slightly differed with Acacia burkittii, turpentine bush, Eremophila sturtii, black fuchsia, Eremophila glabra, Cassia nemophila var. zygophylla and Beyeria opaca being common. The common subshrub species included juvenile Beyeria opaca, Cassia nemophila var. zygophylla and Zygophyllum eremaeum.

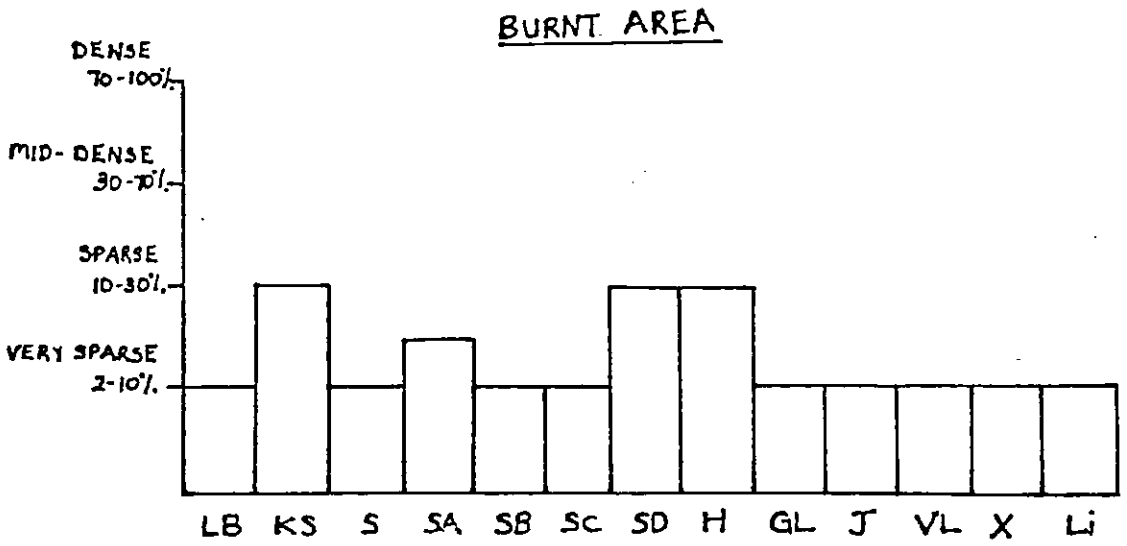
The groundcover was once again dominated by Triodia irritans and Amphipogon caricinus. The herbaceous species Podolepis capillaris and Ptilotus exaltatus var. exaltatus were present, but were not as common as in the burned patch. A complete species list is shown in Appendix 5.1.

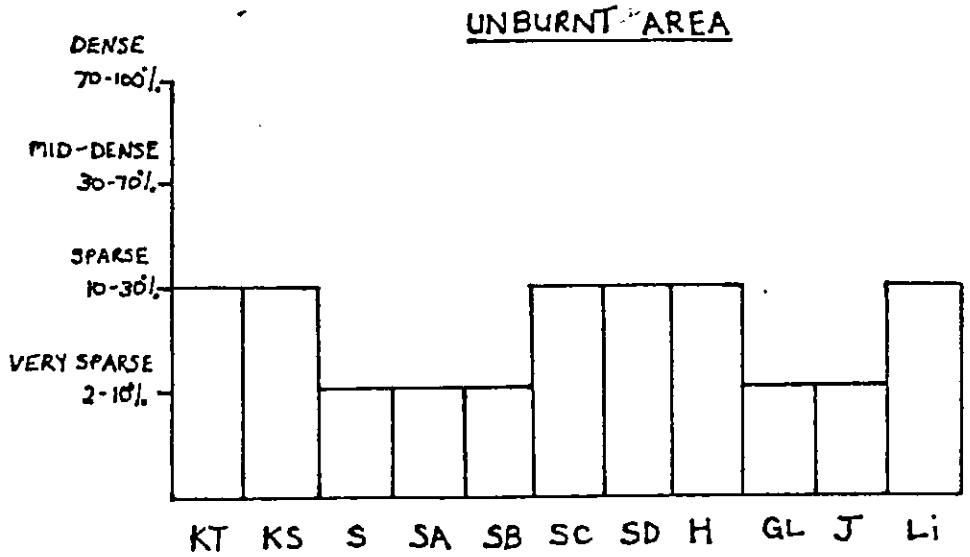
Fig. 5.2 shows the canopy cover of each life form in the burned and unburned patches or areas according to Muir (1977). This allows a comparison to be made between both patches, and thus, helps to discover the degree of difference between the major life forms.

From this data, signs of regeneration are recognized within the burned area through the upperstorey being dominated by mallees which were all less than 5 metres in height and classified as KS, Mallee Shrub form. Many of the mallees were seen sprouting from ligno tubers of the burned mallee trees. The life form LB, trees less than 5 metres, also showed signs of regeneration. The total estimated canopy cover was 2-10%. The understorey was dominated by subshrub species below 0.5 metres. However, the life form SA, shrubs 1-1.5 metres was also common in this stratum. This is due to the Acacia species showing evidence of rapid growth from seeds which germinated as a result of the fire. The ground cover was dominated by a sparse hummock grass life form with a very sparse microphytic layer.

In the unburned area a different set of major life forms was recorded. It was clearly seen that the upperstorey was dominated by the mallees, either in the tree form where they had reached maturity, or shrub form, showing new growth. The understorey mainly consisted of subshrub life forms ranging in height between 0.5-1 metre. However, due to the unburned patch being a great deal smaller sampling area than the burned patch, the taller shrub life forms ranging from 1-2 metres in height may have had a greater canopy cover than indicated by this study, and thus dominated the stratum. The sparse hummock grass was the dominant groundcover life form with a sparse microphytic layer.

The most common life forms of the whole quadrat are illustrated in Fig. 5.3. The mallee shrub life form had the highest number of individual occurrences and formed much of the upperstorey throughout the quadrat. At the majority of sampling points the estimated canopy cover of mallees was 10-30%. The least occurring upperstorey life forms were trees less than 5 metres (LB) and mallee trees (KT). This is due to species not reaching maturity since the fire.





KEY

LB	Trees <5m	SD	Shrubs 0.0-0.5m
KT	Mallee tree form	H	Hummock Grass
KS	Mallee shrub form	GL	Bunch grass <0.5m
S	Shrubs >2m	J	Herbaceous spp.
SA	Shrubs 1.5-2.0m	VL	Sedges <0.5m
SB	Shrubs 1.0-1.5m	X	Mosses
SC	Shrubs 0.5-1.0m	Li	Lichens

FIGURE 5.2 Life Form Spectrum for Each Area (Muir, 1977), 1989

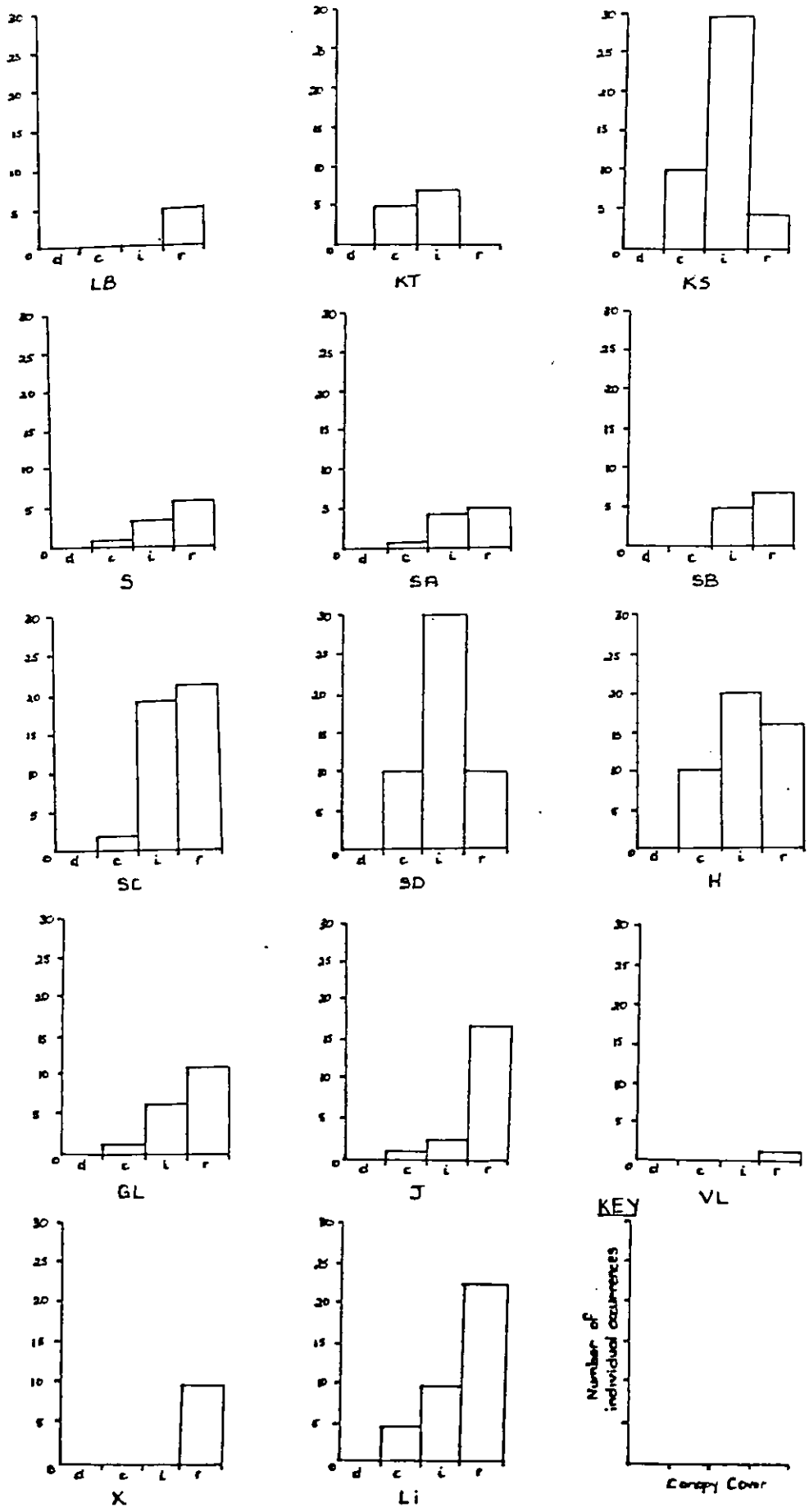


FIGURE 5.3 Number of Occurrences of Each Canopy Cover Within Each Life Form, 1989

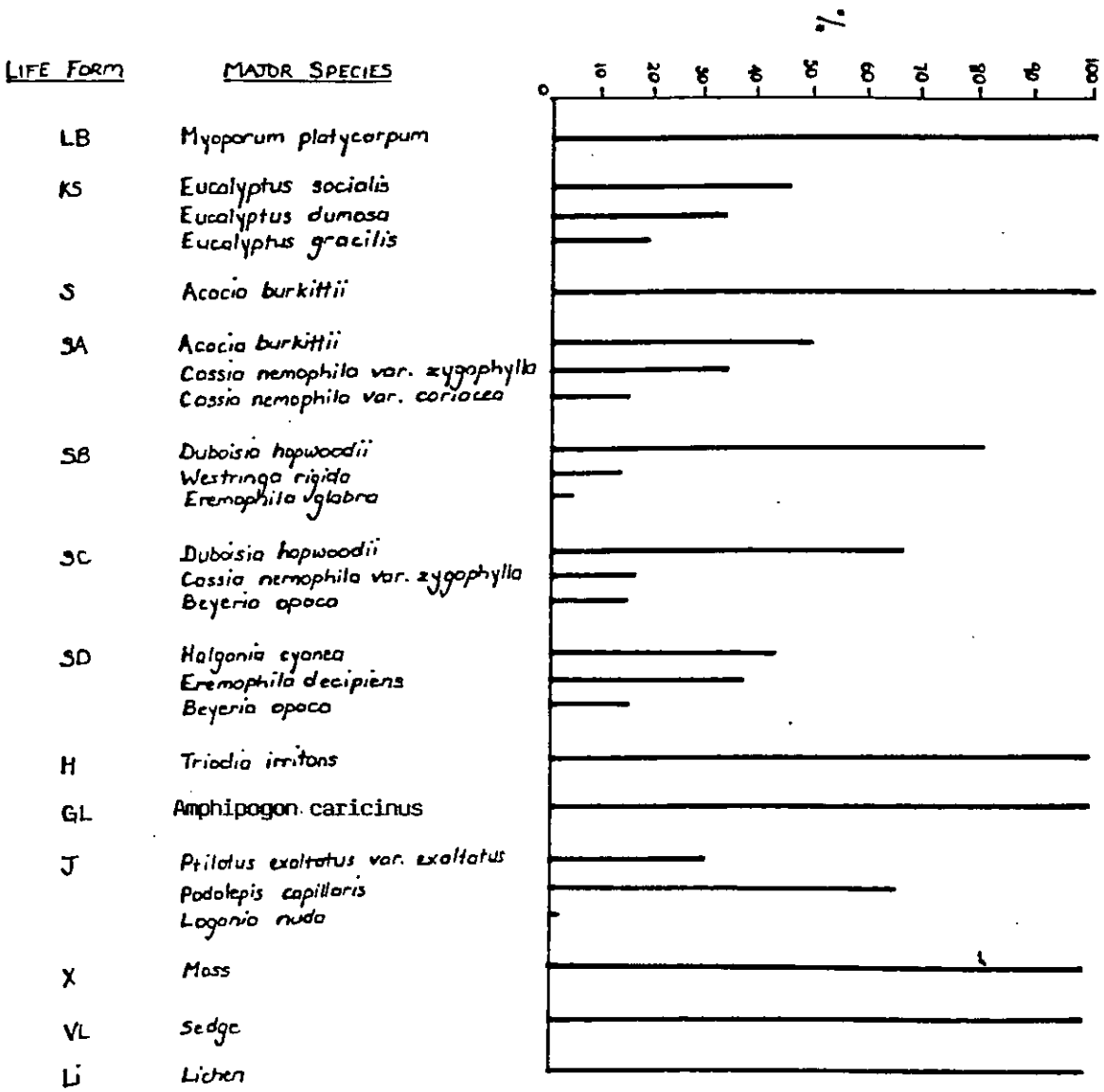


FIGURE 5.4 BURNED: Major Species of Each Life Form, 1989

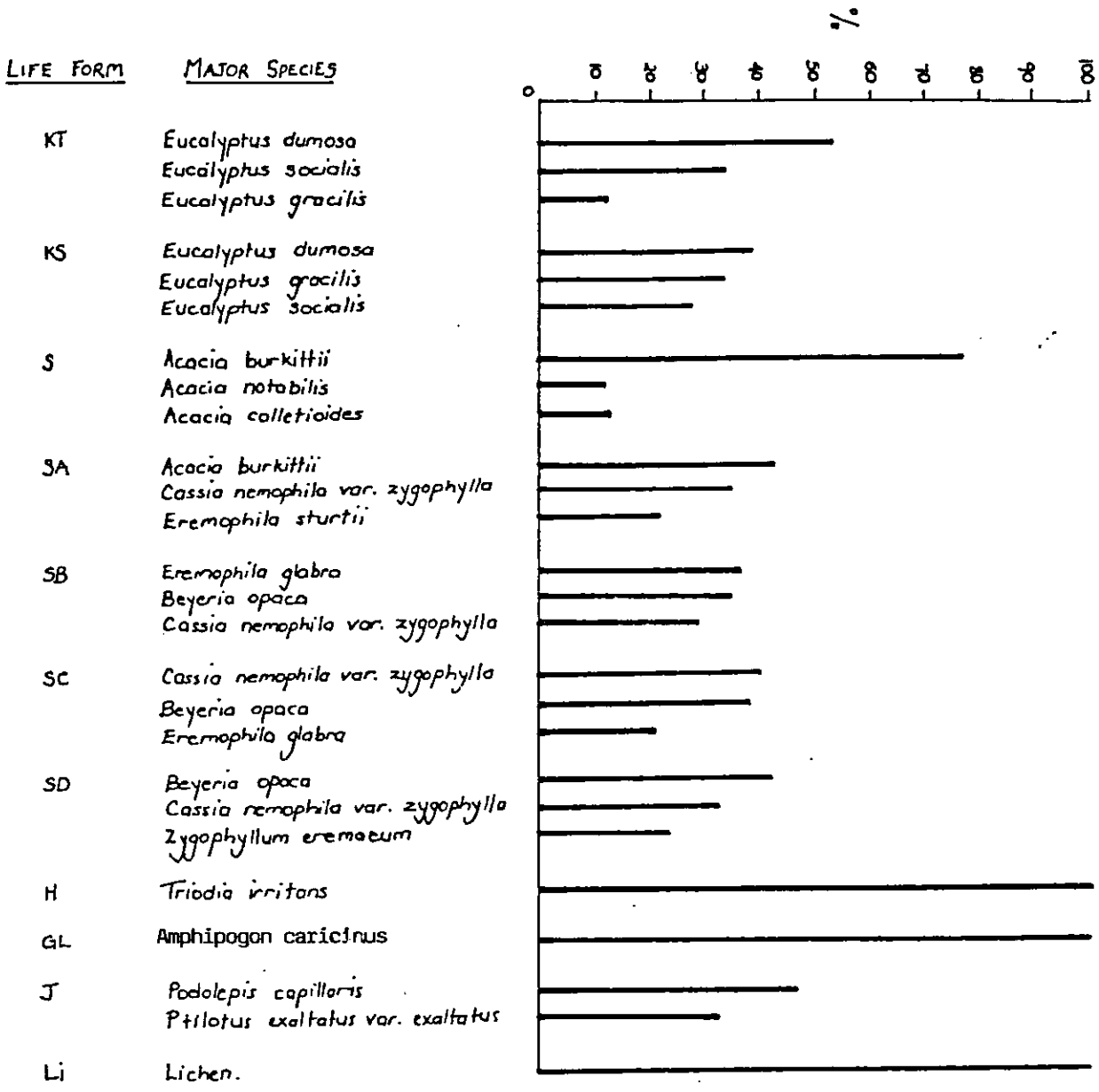


FIGURE 5.5 UNBURNED : Major Species of Each Life Form, 1989

The understorey or shrublayer in both areas was mainly formed by the life forms: SC, shrubs 0.5-1 metre with an estimated canopy cover mainly of 2-10% and SD, shrubs below 0.5 metres, which mainly occurred with an estimated canopy cover of 10-30%. This indicates that species within these life forms are successfully regenerating. The remaining shrub life forms had almost an equal number of individual occurrences, but contributed little to the stratum.

Within the ground cover, the life form GL, bunchgrass less than 0.5 metres was present, but the hummock grasses were by far the most abundant. At most sampling points the estimated canopy cover was 10-30%. The herbaceous life forms, including the sedges, were not common and overall contributed little to groundcover. The microphytic layer was found to mainly consist of lichens rather than mosses.

Fig. 5.4 and Fig. 5.5 show the three major species in each life form for both the burned and unburned patches, and the percentage each contributed to that life form. From this, it is possible to recognize and then compare the different species which form the major life forms between the patches.

5.4.2 Results of VSA Mapping

Within the quadrat a Vegetation Sample Area (VSA) was established in 1987 in both the burned and unburned patch to allow changes in growth patterns to be monitored. This enables changes in the diversity and density of species to be recognized.

The trees and shrubs greater than one metre were quantitatively sampled in each VSA using the standard methods (section 2.0). The data collected were then used to compile VSA maps showing the results. Fig. 5.6 shows the position of trees and shrubs in the burned area, and Fig. 5.7 shows the unburned area.

The burned patch had a diverse range of upperstorey species, but density was low. Eucalyptus dumosa was the most abundant mallee shrub, with Eucalyptus foecunda next. Eucalyptus socialis was the least abundant. There were no shrubs above one metre in the VSA, indicating a relatively slow rate of growth. Shrubs of this height were recorded elsewhere in the burned patch of Mallee-Triodia.

In comparison with the burned patch, Eucalyptus dumosa and Eucalyptus socialis were also the most common mallee shrubs in the unburned VSA. However, both the diversity and abundance of species in the upperstorey was lower than in the burned patch. Shrubs over one metre high were present but sparse. Acacia burkittii and Beyeria opaca were the most common. The least abundant was Acacia colletioides.

The shrubs and groundcover less than one metre in the two sample areas are mapped in Fig. 5.8. From the data collected the subshrub layer in the burned patch was found to be dominated by Halgania cyanea and Beyeria opaca. The species Eremophila decipiens and Baekea crassifolia also formed much of the stratum showing rapid germination and relatively high growth rates. The least abundant species were found to be Westringia rigida and felted nightshade, Solanum coactiliferum.

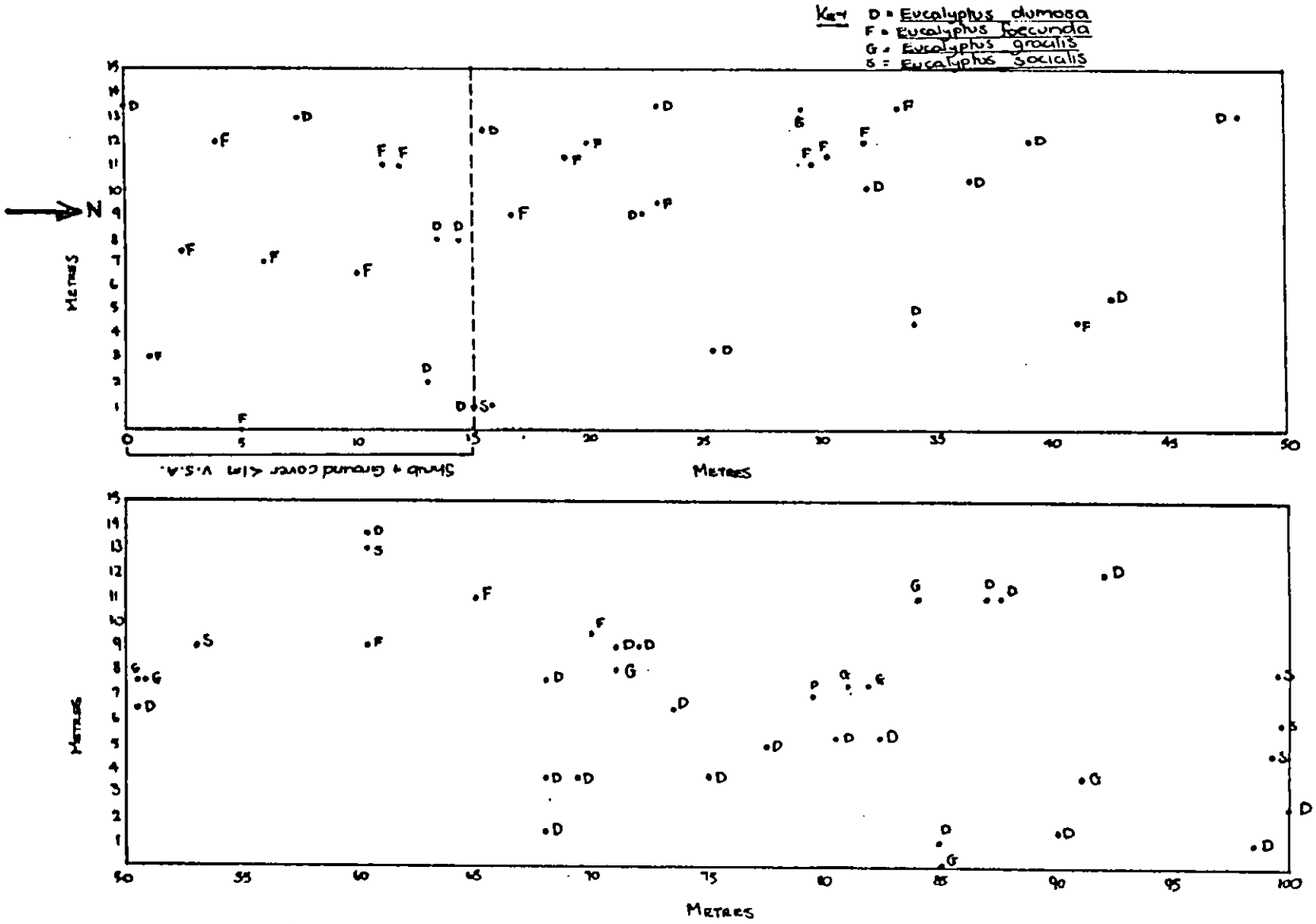


FIGURE 5.6 V.S.A. Map for Trees and Shrubs : Burned Area (Little Bunyip Dam) 1989

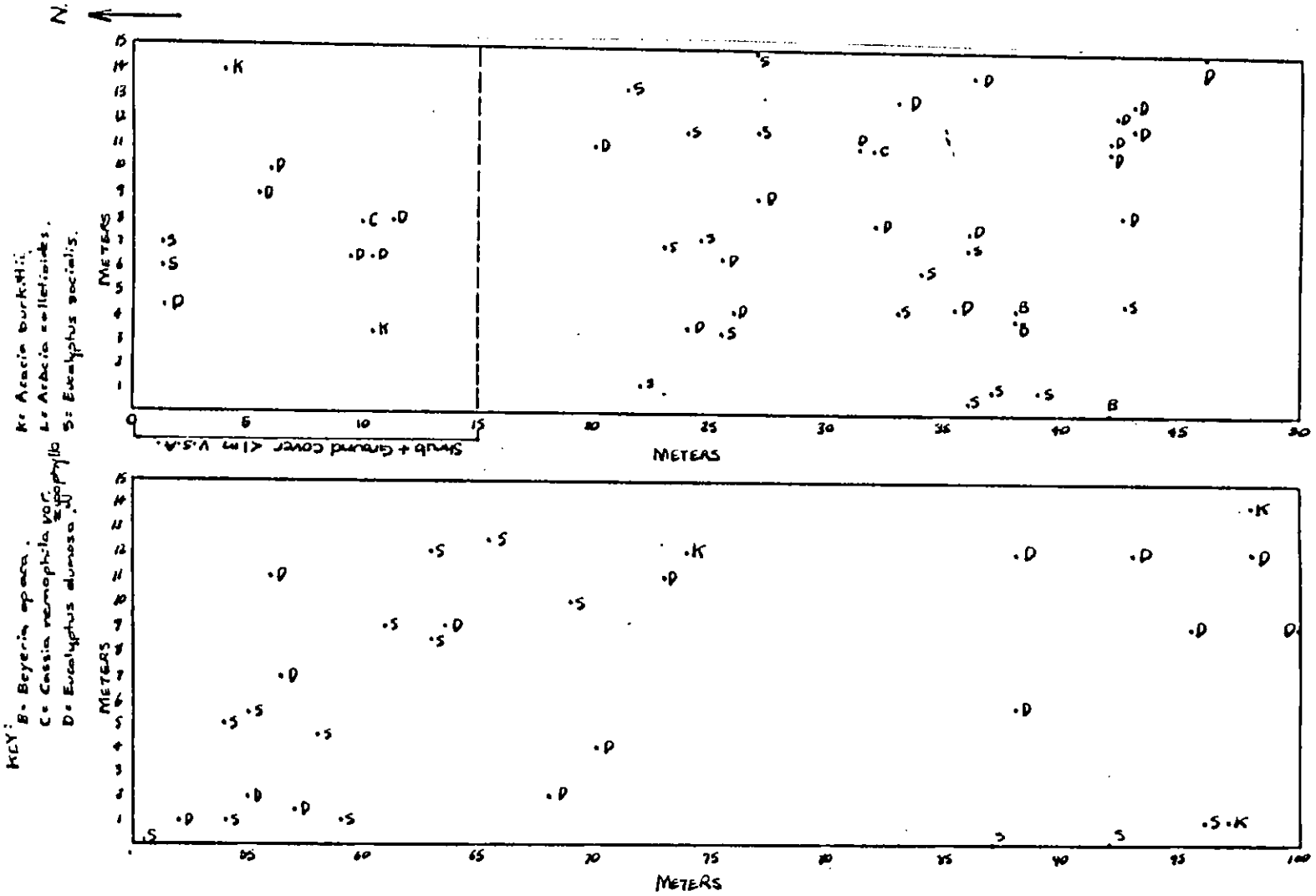


FIGURE 5.7 V.S.A. Map for Trees and Shrubs : Unburned Area (Little Bunyip Dam) 1989

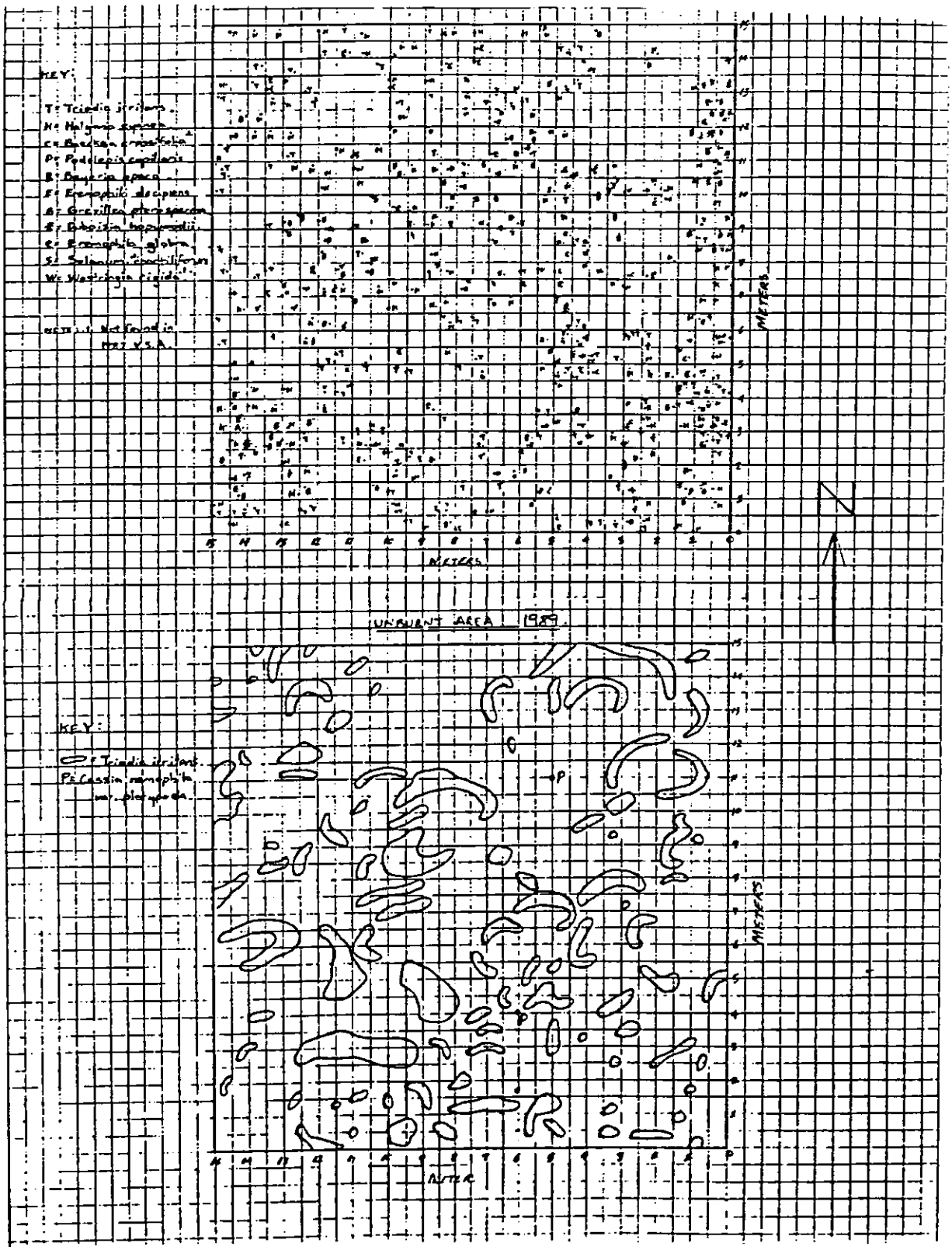


FIGURE 5.8 Little Bunyip Dam : Burned Area
Shrubs and Groundcover V.S.A. 1989

The hummock grass, Triodia irritans, which was mainly seen in its juvenile state, was found to be the most abundant ground cover species. The reason for this is that Triodia hummock grasslands are promoted by hot summer fires. The herbaceous species, Podolepis capillaris was also seen to be growing quite frequently throughout the burned patch. This species is considered as an early colonizer after fire, mainly because temporary gaps are created by removing the canopies of overstorey vegetation, these gaps enable such herbs to establish and reproduce, thereby replenishing seed pools before the shrub stratum becomes dominant once again (Noble, 1989).

In the unburned VSA, the vegetation below one metre was dominated by Triodia irritans also. Only one other species was recorded which was Cassia nemophila var. platypoda. These shrubs were young and very sparsely distributed. In contrast to the burned area the Triodia hummocks were generally large with 'rings' formed in many cases. Triodia irritans is important for soil stability and nutrient turnover, and also provides a microhabitat for a variety of reptiles and invertebrates.

Overall, the data showed the burned patch to have the greatest diversity of species and the most evidence of regeneration and germination. This is typical of recently burned Mallee-Triodia associations (Noble, 1989). The opening of the canopy and reduced competition from Triodia allows a wide variety of herbs and small shrubs (many of which have seeds that are dependent on fire for germination) to exploit the temporary gaps. Hence, these species grow rapidly and set seed to await the next fire.

5.4.3 Comparison between 1987 and 1989 results

The 1989 results are similar to those collected in the burned patch in 1987. Both years showed that the patch was dominated by juvenile upper-storey species such as Eucalyptus socialis and Eucalyptus dumosa, showing continuing regeneration. The 1987 results indicated that Eucalyptus foecunda and Eucalyptus incrassata were also found to be commonly occurring species, yet, this year both species were recognized as being less common. The shrub layer was found to be dominated by Acacia burkittii for the second time, but this year's results have shown that Cassia nemophila var. zygophylla had also become common.

In both years, the burned patch showed signs of rapid regeneration and germination of early colonizing species such as Halgania cyanea, Duboisia hopwoodii, Beyeria opaca and Eremophila decipiens. Due to being widespread, Halgania cyanea was the most dominant subshrub throughout the burned patch, yet, none was observed in the unburned patch in both years' sets of results. One slight difference was that the 1989 results showed that Eutaxia microphylla had become less common within the patch. Furthermore, the VSA map of the shrub and groundcover below one metre exposed a variety of species that were not recorded in the 1987 report. These species were Solanum coactiliferum and Westringia rigida.

In both years, Triodia irritans dominated the groundcover. It is favoured by summer fires which stimulate the seeds to germinate. However, the notable difference between years was that in 1987 the herbaceous species Podolepis capillaris and Ptilotus exaltatus var. exaltatus were not recognized as common. In 1989 both herbs were conspicuous by growing prolifically throughout the burned patch. Also, bunchgrass Amphipogon caricinus was not recorded during 1987, yet this species was found to be growing among other ground cover species. The microphytic layer was

mentioned in both cases, however, signs of rapid regrowth have been observed during this year. This indicates rapid stabilization of the soil surface, thereby reducing erosion.

The results from the unburned patch in both 1987 and 1989 show that the dominant upperstorey mallee species were similar to those of the burned patch. The shrub layer was still seen as sparse, but in 1989 it consisted of a different set of common species which were: Eremophila sturtii; Eremophila glabra, and Cassia nemophila var. zygophylla. These species have increased in density at the expense of Duboisia hopwoodii which was noted as being very common in 1987. The subshrub layer contained similar species to 1987. The species Zygophylla eremaeum was not recorded as being common within this patch in 1987, but was found to be commonly occurring in 1989.

The groundcover in both years was dominated by Triodia irritans, although, its density has decreased when compared with the 1989 results. Once again, Amphipogon caricinus, and the herbaceous species Podolepis capillaris and Ptilotus exaltatus var. exaltatus were not recorded as common in 1987. Thus, this year's results suggested rapid growth rates of a diversity of species within the groundcover stratum. This is mainly due to recent rain which has provided appropriate conditions for seed germination. Herbs are capable of rapid germination and high relative growth rates before re-entering another dormant phase in their life histories (Noble, 1989).

5.4.4 Summary and Conclusions

Establishing a permanent study quadrat at Little Bunyip gave an excellent opportunity for studying the recovery of a community after fire by observing the succession of regrowth over a series of years. It also provided an opportunity to gain a greater insight on the effects of backburning on vegetation structure, composition, species diversity and the amount of time particular species require to mature. The conclusions made from reassessing LB1 quadrat are explained in the following.

Mallees have grown vigorously in both the burned and unburned patch. Although they are still young, they are now capable of providing nesting sites for small birds. The upperstorey throughout the quadrat has increased in density, but not in diversity.

The shrub layer within the burned patch consisted of an abundance of regenerating species. During this year new species have been found to be commonly growing within this patch. This suggests a greater structural diversity of the vegetation is developing, but this does not necessarily indicate increasing stability. Shrub species, such as Acacia burkittii and Cassia nemophila var. zygophylla are seen throughout most of Muir's shrub life forms, showing various stages of growth. Those within the life forms S and SA, shrubs 2 metres high, have reached maturity.

The greatest diversity of species is found in the subshrub layer. The precise role of fire in promoting species richness in mallee communities has yet to be ascertained (Noble, 1989), however, as time since the fire increases the diversity of species will decrease. The reason for this is that the fire-induced species will die and only be stimulated to germinate by another fire. Also, the gaps created by the removal of the upperstorey canopy will close again causing some of the herbaceous species

to become dominant. This suggests that fire exclusion may, in the long-term, work against the interest of plant conservation. Therefore, Australian mallee ecosystems are considered as being both fire-dependent and fire-promoting (Noble, 1989).

Another observation made is that the growth of a variety of groundcover species has resulted in an increase in diversity in both the burned and unburned patch. Nevertheless, fire may not be responsible for all the changes within the groundcover stratum or in other strata. An increase in diversity may be a result of a 'good' season which provided a sufficient amount of rain, or changes may still be occurring due to the removal of domesticated stock.

The unburned patch is, by contrast, a mature community with a greater structural diversity of species. Less species diversity in the subshrub layer here, may indicate that many of the regenerating plants emerging in the burned patch are early colonizers and will be replaced during the period of succession until the community reaches a stage similar to the unburned patch. Over the sampled years, the tall shrub layer has shown evidence of becoming greater in diversity, although, density has remained the same or is slightly higher than in 1987.

Overall, the effects of backburning on vegetation structure, composition, species diversity and maturation are diverse and complex. These effects are not recognized immediately following a fire, some take time to become visible. Thus, to be able to gain a more comprehensive knowledge of the full effects of fire the LB1 quadrat should continue to be reassessed every 2-4 years for as long as necessary. In order to monitor the rate of recovery after fire successfully, rapid field checks will not be sufficient. Instead, the study quadrat should be sampled using the standard methods of previous years.

5.5 Fauna

5.5.1 Invertebrates

Micropitfalls were used to sample invertebrates from burned mallee (Patch I) and unburned mallee (Patch II). These were set out according to the methods described in section 2.0. Results are based on the remaining micropitfalls that were not disturbed by large animal activity. Where disturbance was obvious the samples were rejected, but if it possible some samples are incomplete.

Micropitfalls are biased toward mobile species (Southwood, 1966). They are a measure of activity as much as abundance. They are, however, a useful tool and should continue to be used.

Thirty-six species of invertebrates were recorded here. Sixteen species of ants, order Hymenoptera, were recorded, with genus *Iridomyrmex* being the most common in frequency and numbers. The fact that *Iridomyrmex* is relatively abundant in both patches would suggest that the burned area is recovering with the mix of ant species returning to that commonly found in semi-arid Australia. The ant fauna in such areas is dominated by *Iridomyrmex* species (Greenslade, P.J.M., 1985). At Little Bunyip, *Iridomyrmex* species appear to favour open areas with low vegetation such as *Triodia irritans*, *Halganea cyanea*, leaf litter or a combination of

these. Iridomyrmex species 1 and 2 make up 90% and 88% respectively of recorded totals for ants from Patch I and II. One possible explanation for this tendency toward monopoly is a low intensity of the diffuse competition that can act as a constraint on populations of dominant ants (Greenslade, 1971, 1981, 1985). It could also mean that pitfalls happened by chance to be close to nests of these species.

Other relatively abundant species caught include generalized myrmicines, such as Monomorium, Pheidole and Grematogaster.

Results for non-ant species are given in Table 5.2. Six species of Diptera (true flies) were recorded in the unburned section, and two species in the burned area. This may relate to habitat as more litter is present in the unburned patch. High numbers of Colembola were recorded in both patches which may indicate this group's ability to adjust to a variety of microhabitats. Coleoptera (beetles) species seemed to favour open areas associated with litter. No scorpions were trapped but many nesting holes were observed.

A greater diversity of invertebrates were caught in the unburned area. This is likely to be related to the larger diversity of microhabitats occurring in the unburned patch.

5.6 Conclusions

The responses of vegetation to recent rain and previous fire can be seen by comparing the burned and unburned patches at LB1, from studies in 1987 and 1989. Rains have stimulated germination and growth of more of the same shrub species in the mature mallee, the unburned patch. These could be called the climax species, Beyeria opaca and Cassia nemophila zygophylla. Zygophyllum eremaeum appeared in the mature mallee after rains, but may be short-lived and responding to rain because it was not there before the rains. In both the unburned and burned patches, the herbaceous species, invisible plant, Podolepis capillaris, and mulla mulla, Ptilotus exaltatus exaltatus, were abundant after the rains. Also the grasses, Amphipogon caricinus and Triodia irritans, have resprouted from rootstock in both patches, probably from the high rainfall. Moss and lichen crustwas also enhanced after rains.

In the burned patch, the succession of shrubs after fire indicates that pituri, Duboisia hopwoodii, is abundant for two or three years after fire, then declines in numbers by year four. Acacia burkittii, which germinates also after fire, is probably longer lived and may dominate the tall shrub layer for years. The dwarf shrub, Halgania cyanea, germinates after fire and has an unknown life span, but is probably short to intermediate. Cassia nemophylla zygophylla was found in both patches at all stages of growth.

Generally, invertebrate species were more diverse in the unburned patch, presumably because litter and microhabitats were more abundant and diverse. Of the ant fauna, Iridomyrmex tends to dominate other genera, especially in the more open, burned area. This quadrat should be re-assessed every 2-4 years to check shrub dynamics such as longevity of pituri, Halgania, and other shrubs and flowering age and season.

TABLE 5.1 Ant Genera, caught in micropitfalls : LB1

FUNCTIONAL GROUP	MAJOR TAXA	V.S.A. I (BURNED)			V.S.A. II (UNBURNED)		
		Species No.	No. of Individuals	Frequency (%)	Species No.	No. of Individuals	Frequency (%)
1.	Dominant Species	1	140	40	1	160+	25
	Iridomyrmex	2	417	65	2	135+	35
		5	60	25	5	40	30
		6	2	5	-	-	-
2.	Subordinate Species	-	-	-	1	2	10
	Camponotus	3	6	20	3	3	5
		-	-	-	7	2	5
		-	-	-	8	1	5
3(a)	Hot Climate Specialists	4	9	20	4	37	25
	Melophorus						
(b)	Cold Climate Specialists	-	-	-	-	8	10
	Prolasius	-	-	-	1	1	5
	Nctercus						
5.	Opportunistic Rhytidoponera	3	16	40	3	7	35
6.	Generalized Myrmicines	1	9	10	1	96	25
	Monomorium	1	17	10	1	77	40
	Pheidole	2	-	-	2	3	5
	Cromatogaster	1	22	25	1	52	45

TABLE 5.2 Non-Ant Orders caught in Micropitfalls : LB1

Non-Ant Orders	VSA I 41-50 Burned			VSA II 1-40 Unburned	
	Species No.	Nos. caught	Frequency (%)	Nos. Caught	Frequency (%)
Acarina	B	2	10	6	25
Araneae	B	2	10	5	10
Collembola	I	35	55	10	50
Coleoptera	A	1	5	5	15
	B	1	5	4	15
	F	-	-	1	5
Diptera	B	-	-	3	5
	C	10	30	7	20
	D	-	-	1	5
	F	-	-	3	15
	R	-	-	1	5
	T	8	35	4	20
Hemiptera	A	4	5	-	-
Hymenoptera	B	3	5	1	5
Isoptera	A	3	15	-	-
Lepitoptera	A	1	5	1	5
Orthoptera	-	-	-	-	-

6.0 EASTERN BORDER 1 (EB1) : Blackoak/Mallee Mosaic

6.1 Introduction

The Eastern Border 1 quadrat was chosen to represent heterogeneous Mallee, Mallee-Triodia and Blackoak communities. These distinct vegetation types are closely associated with the landforms in the area.

Most of the 1000 x 1000 metre quadrat consists of a Blackoak community. The plant species found in this community are associated with relatively flat plains, resulting in the spread of these species throughout the quadrat.

The eastern boundary of the quadrat is described as sand dune and elevated areas. The sand dunes are stabilised by a Mallee-Triodia community, while the calcareous soils of the elevated areas support a Mallee community. This landform and vegetation complex develops clear boundaries between the plant communities.

Extensive fauna studies were also carried out, using various techniques. The results of these studies are presented and discussed in the following sections.

6.2 Quadrat Details

The Eastern Border 1 quadrat was located 41.1 km East-Northeast of the Canopus Homestead, and 3 km north along the Eastern Border fence from the Mornington Dam Track. A quadrat 1000 x 1000 metres was chosen on the western side of the South Australian and New South Wales border, at map reference 3223 14059, on the Chowilla sheet in the 1:250,000 series. A permanent road marker has been placed at the 500 metre point along the road boundary, from which the sampling sites have been located. For quadrat details refer to Fig. 6.1.

6.3 Landforms and Soils

6.3.1 Landforms

The eastern section of EB1 consists of a dune system which runs in a west-south-west, east-north-east direction. Vegetation in the dunes is mainly a mallee/Triodia association. On the dunes windblown red sand has formed crests, and the swales are characterised by flat areas which have hard-setting surfaces, due to the accumulation of water and subsequent drying of the soil.

Towards the western section of the quadrat the dunes give way to flatter ground, where, compared to the dune system, only a shallow surface sand layer occurs (refer to Fig. 6.2). Throughout the quadrat there was no evidence of surface rocks.

6.3.2 Soils

The soil sampling site studied was situated on a slope of about 3°, with an east-south-east aspect. The north-west corner of the soil pit was located at 68 metres from the north-east corner of the VSA at 148° (see Fig. 6.1).

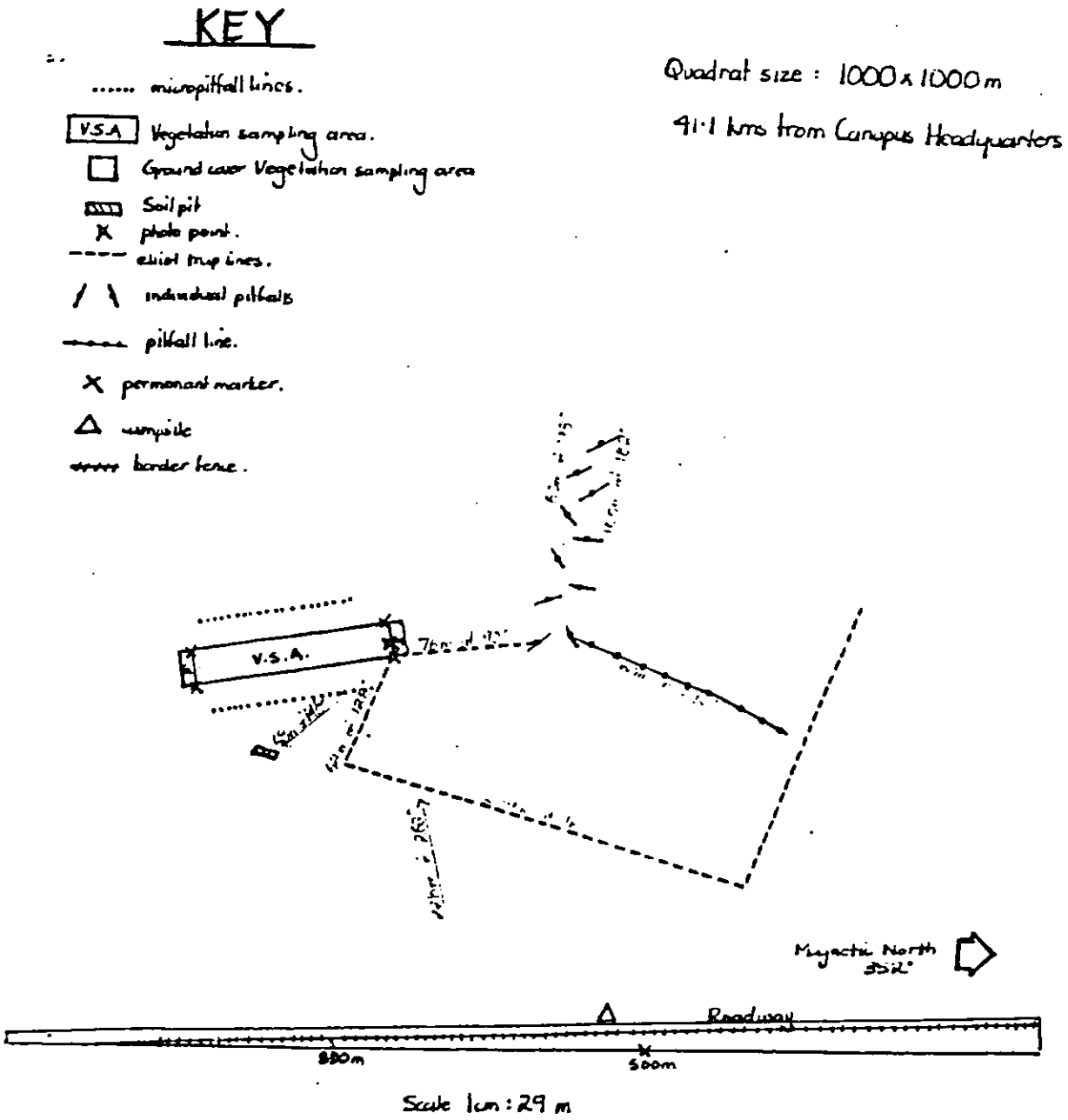


FIGURE 6.1 Quadrat details for Eastern Border 1

The location of the soil pit was near an ecotone where a vegetation association of white mallee, Eucalyptus dumosa, and porcupine grass, Triodia irritans, merged with an area dominated by blackoak, Casuarina cristata. There was little surface litter near the soil pit, so humus does not feature much in the soil forming process.

The profile is classified as DR 2.13 (Northcote, 1971), and is fully presented in the soil profile diagram (Appendix 6.1).

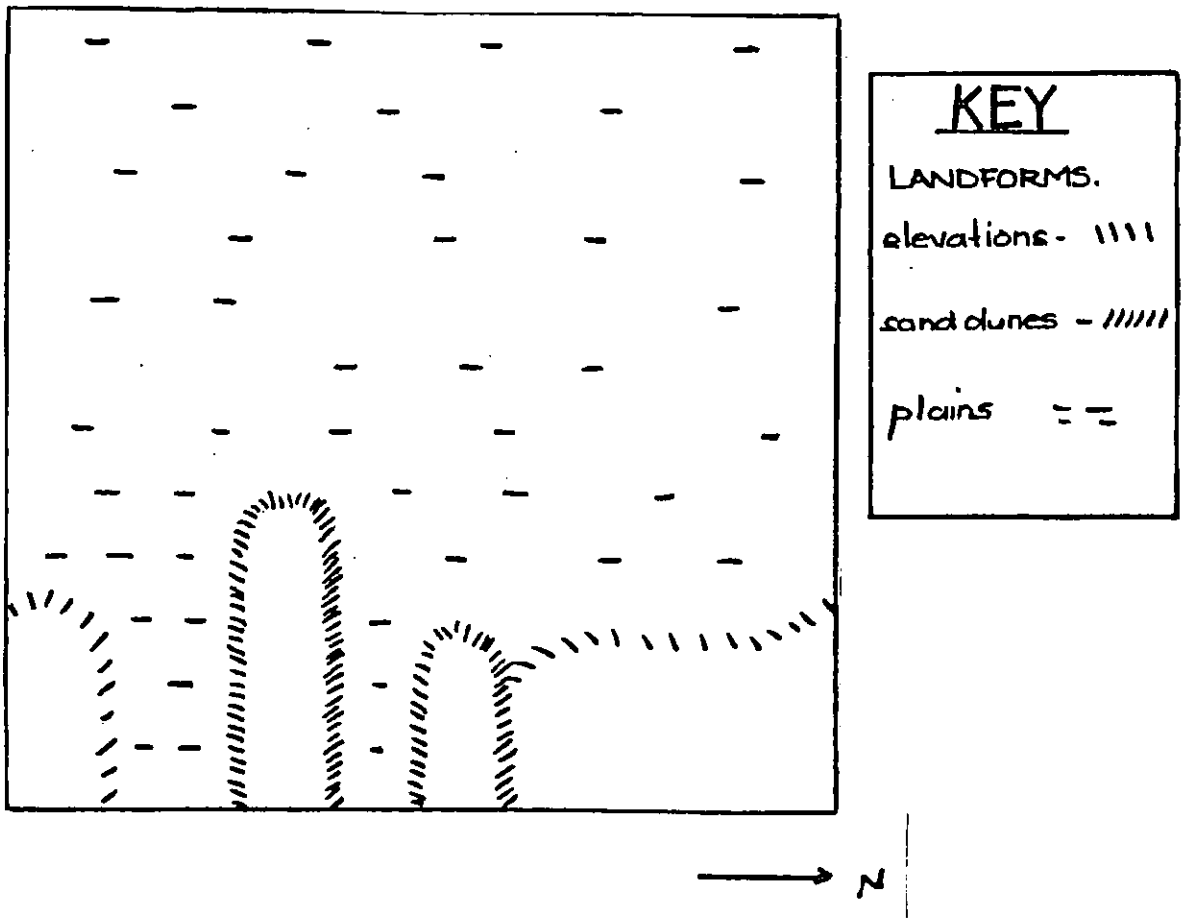


FIGURE 6.2 Landform systems in Eastern Border 1 Quadrat (EB1)

At 30cm depth, the profile changes in texture as clay becomes more evident. This occurs over a vertical distance of 10cm. The angular pools in the sandy textured A horizon are weakly structured, allowing leaching of free salts down the profile (Corbett, 1969). From 30-40cm depth there is a significant increase in both soil salinity and soil pH. As depth increases both soil properties gradully increase. This can be related as a direct result of increased clay content, allowing attachment of salts and nutrients to the colloids.

Throughout the B horizon blocky lime nodules occur. Although superficially different in colour to the matrix, Munsell's Colour Chart indicates that both are the same colour. This is significant in classification of the soil.

In flat areas of the quadrat, the sandy topsoil is liable to both wind erosion and sheet erosion, where bare patches occur. It is only in areas where a microphytic crust does not cover the ground and bind the soil, that erosion of this type occurs.

Throughout the quadrat there is evidence of soil runoff where tracks formed by goats and kangaroos have disturbed the vegetation and soil. On some dunes, severe localised erosion has occurred where burrowing and grazing by rabbits is evident.

TABLE 6.1 Soil Summary EB1

Depth (cm)	Texture	Salinity (milli-siemens per cm)	pH	Lime Reaction
10	Sandy loam	.04	7	Negative
30	Sandy clay loam	.13	8.5	Negative
50	Sandy clay loam	.61	9-9.5	Positive
110	Sandy clay loam	.77	9-9.5	Positive

6.4 Flora, Vegetation and Habitat Types

6.4.1 Description of Vegetation

The quadrat was chosen because it provided a mixture of vegetation types. The three major communities in our quadrat were Blackoak, 81%, Mallee, 8%, and Mallee-Triodia, 7%. There was also a community that we named Blackoak-Mallee, 4%, this occurred in areas where Blackoak community graded into Mallee community (refer to Fig. 6.3). It was also noted that there were large areas within the Blackoak community where the trees were sparse allowing proliferation of shrubs, mainly hopbush (Dodonaea angustissima).

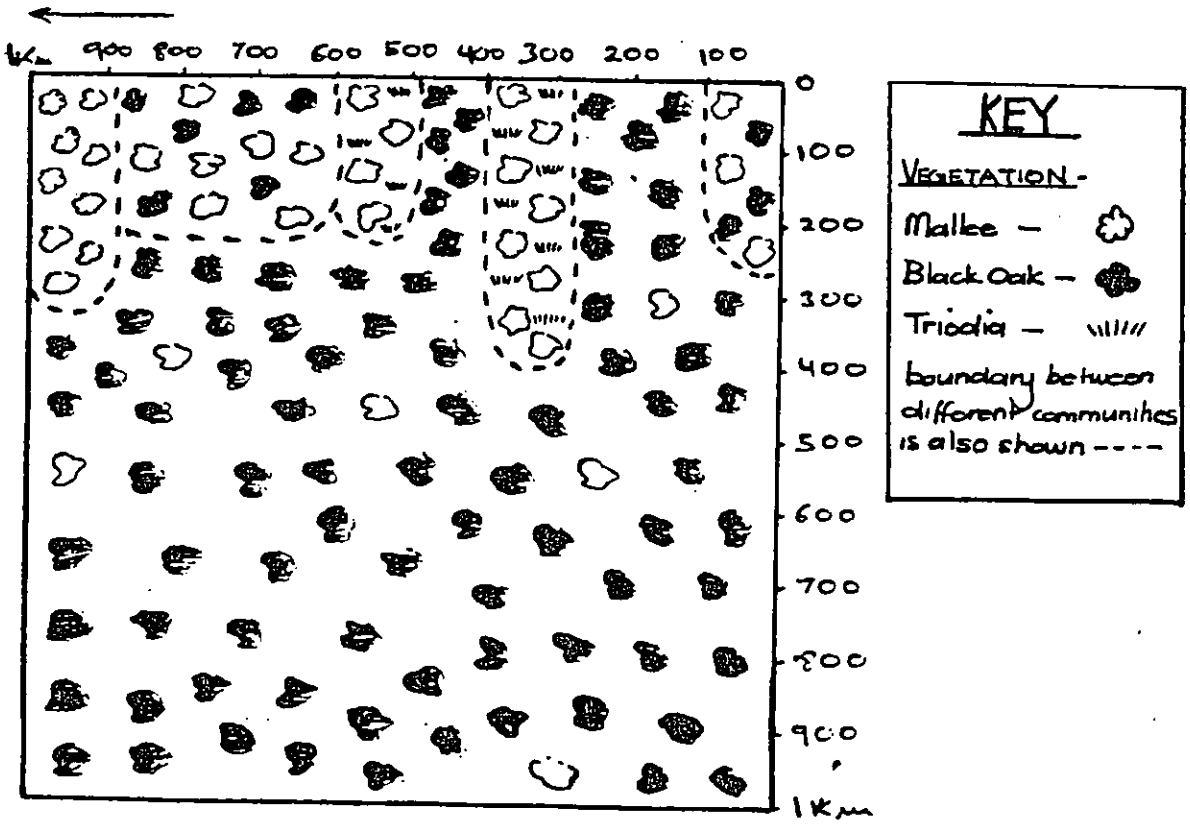


FIGURE 6.3 Distribution of plant communities at EB1

The dominant species in the tree layer in the Blackoak community was Casuarina cristata, at 75% dominance. Dodonaea angustissima, at 28%, was dominant in the shrub layer and Sclerolaena diacantha, 51%, was dominant in the shrub layer (refer to Table 6.2).

TABLE 6.2 Blackoak Community point quarter results

BLACK OAK COMMUNITY

POINT QUARTER.

SPECIES	NO. OF INDIVIDUALS	REL % DENSITY	DENSITY	DOMINANCE	REL % DOMINANCE	FREQUENCY	REL % FREQUENCY	IMPORTANCE VALUE	RANK ORDER OF IMPORTANCE
TREES.									
Casuarina cristata.	41	64 %	·8	16·78	75·3 %	1·00	48 %	187·3	1
Myoporum platycarpum.	18	28 %	·35	5·00	23·0 %	·56	34 %	85	2
Eremophila oppositifolia.	4	6 %	·075	·29	1·2 %	·25	15 %	22·3	3
Heterodendrum oleaefolium	1	2 %	·025	·18	·8 %	·05	3 %	5·8	4
	64	100 %	1·250	22·19	100 %	1·86	100%	////	////
SHRUBS									
Olearia muelleri.	9	14 %	8·23	1·65	9·7 %	·25	10 %	34	4
Enchylaena tomentosa.	4	6 %	3·53	2·05	12·00 %	·19	8 %	26	6
Cassia nem. var. coriacea	11	17 %	10·00	1·8	11·0 %	·44	18 %	46	2
Maireana georgei	23	36 %	21·2	2·35	13·7 %	·69	28 %	78	1
Maireana pentatropis	2	3 %	1·8	·07	·4 %	·13	6 %	9·5	8
Atriplex stipitata	3	5 %	2·9	·52	3·0 %	·19	8 %	16	7
Dodonaea attenuata	5	8 %	4·7	4·79	28·0 %	·25	10 %	46	2
Olearia pimeleoides	1	1·5 %	·9	1·59	9·3 %	·06	2 %	85	9
Cassia nem. var. platypoda	5	8 %	4·7	1·93	11·3 %	·19	8 %	28·5	5
Eremophila glabra.	1	1·5 %	·9	·29	1·7 %	·06	2 %	4·5	10.
	64	100 %	58·86	17·02	100 %	2·45	100 %	////	////
GROUND COVER / HERBS									
Zygophyllum billardierei	5	6 %	13·6	·56	32·5 %	·25	11 %	51	3
Sclerolaena diacantha	32	50 %	86·2	·86	51·0 %	·75	34 %	135	1
Maireana georgei	1	1·5 %	2·6	·008	0·5 %	·063	3 %	5	7
Rhagodia nutans	8	5 %	8·6	·13	8·0 %	·19	8 %	21	4
Ptilotus spp.	1	1·5 %	2·6	·0026	·15 %	·063	3 %	4·7	8
Bunchgrass	18	28 %	48·3	·00087	·05 %	·63	29 %	57	2
Pimelea microcephala	1	1·5 %	2·6	·026	1·5 %	·062	3 %	6	6
Podolepis capillaris	1	1·5 %	2·6	·002	·12 %	·063	3 %	4·62	9
Maireana pentatropis cuspis.	1	1·5 %	2·6	·002	·12 %	·063	3 %	4·62	10
	1	1·5 %	2·6	·104	6·2 %	·063	3 %	10·7	5
	64	100	172·57	1·69	100 %	2·198	100 %	/////	/////

BLACK OAK COMMUNITY TOTAL DENSITY:

TREES = 1·25
SHRUBS = 58·8
HERBS = 172·4

In the Mallee community Eucalyptus socialis was dominant in the tree layer at 50%. The shrub layer was dominated by Dodonaea angustissima, 46%, and Maireana georgei, 70%, was the dominant species in the herb layer (refer to Table 6.3).

TABLE 6.3 Mallee Community point quarter results

MALLEE COMMUNITY

POINT QUARTER

SPECIES	NO. OF INDIVIDUALS	REL % DENSITY	DENSITY	DOMINANCE	REL % DOMINANCE	FREQUENCY	REL % FREQUENCY	IMPORTANCE VALUE	RANK ORDER OF IMPORTANCE
TREES									
Eucalyptus dumosa	29	16·7	0·08	5·4	20·1	0·4	18	44·8	2
Eucalyptus socialis	31	33·3	0·16	13·4	50·0	0·7	31	114·3	1
Heterodendrum oleaefolium	17	22·9	0·11	1·6	6·0	0·2	9	37·7	3
Beyeria opaca.	4	8·3	0·04	3·0	11·2	0·3	14	33·5	4
Myoporum platycarpum	4	8·3	0·04	1·5	5·6	0·3	14	27·9	5
Eucalyptus gracilis	4	8·3	0·04	1·9	7·1	0·2	9	24·4	6
Cassia nem. var. platypoda.	1	2·1	0·01	0·01	0·1	0·1	5	7·1	7
	90	99·9%	0·48	26·81	100·1%	2·2	100%	////	/////
SHRUBS									
Dodonaea attenuata	26	41·7	6·8	20·2	45·8	0·8	26·7	114·2	1
Acacia colletioides	9	10·4	1·6	12·6	28·6	0·3	10	49	2
Maireana georgei	18	16·7	2·5	2·8	6·8	0·7	23·3	46·3	3
Cassia nem. var. coriacea	15	12·5	1·9	1·3	2·9	0·3	10	25·4	4
Eremophila glabra	4	4·1	0·6	5·3	12	0·2	6·7	22·8	5
Olearia muelleri	4	4·1	0·6	0·4	0·9	0·2	6·7	11·7	6
Cassia nem. var. zygophylla	2	2·1	0·3	0·5	1·1	0·1	3·3	6·5	7
Erichylaena lomentosa	2	2·1	0·3	0·5	1·1	0·1	3·3	6·6	7
Maireana sedifolia	2	2·1	0·3	0·1	0·2	0·1	3·3	6·6	8
Templetonia egena	2	2·1	0·3	0·2	0·5	0·1	3·3	6·9	9
Eremophila sturtii	2	2·1	0·3	0·2	0·5	0·1	3·3	6·9	9
	86	100%	15	44·1	99·9%	3	99·9%	////	////
GROUNDCOVER/HERBS									
Maireana georgei	12	2·5	30·3	7·9	70·4	0·5	19·2	119·6	1
Bunchgrass	19	39·6	48·0	0·14	1·2	0·8	30·8	81·8	2
Scleroleana diacantha	7	14·6	17·7	0·62	5·5	0·3	11·5	31·6	3
Solsoli kali var. kali	1	2·1	2·5	1·25	11·1	0·1	3·8	16·0	4
Dodonea attenuata	1	2·1	2·5	0·75	6·7	0·1	3·8	12·6	5
Zygophyllum billiardii	2	4·2	5·1	0·002	0·02	0·2	7·8	12·02	7
Maireana pyramidata	2	4·2	5·1	0·03	0·3	0·2	7·8	12·3	6
Erichylaena lomentosa	1	2·1	2·5	0·5	4·5	0·1	3·8	1 ·	8
Maireana sedifolia	1	2·1	2·5	0·02	0·2	0·1	3·8	6·1	9
Rhagodia spinescens	1	2·1	2·5	0·002	0·02	0·1	3·8	5·92	10
Olearia muelleri	1	2·1	2·5	0·0002	0·002	0·1	3·8	5·902	11
	58	100·2%	121·2	11·2142	99·99%	2·0	99·9%	////	////

MALLEE COMMUNITY TOTAL DENSITY:

TREES = 0·48

SHRUBS = 15·1

HERBS = 121·2.

In Mallee-Triodia community, Eucalyptus socialis, 46%, was the dominant species in the tree layer. In the shrub layer Olearia muelleri, 65%, was dominant although Dodonaea angustissima was the most frequent and dense species. The dominant species in the herb layer was Triodia irritans, 83% (refer to Table 6.4).

TABLE 6.4 Mallee Triodia Community point quarter results

MALLEE TRIODIA

POINT QUARTER

SPECIES	NO. OF INDIVIDUALS	REL % DENSITY	DENSITY	DOMINANCE	REL % DOMINANCE	FREQUENCY	REL % FREQUENCY	IMPORTANCE VALUE	RANK ORDER OF IMPORTANCE
TREES									
Eucalyptus socialis	25	39	0·32	29·9	45·6	0·81	38·2	122·8	1
Eucalyptus diumosa	19	29·6	0·24	11·9	18·1	0·56	26·5	74·2	2
Eucalyptus incrassata	6	9·4	0·08	21·3	32·2	0·8	5·8	47·4	8
Hyporum platycarpum	6	9·4	0·08	0·8	1·2	0·25	11·8	22·4	4
Heterodendrum oleaefolium	6	9·4	0·08	1·1	1·7	0·18	5·8	16·9	5
Casuarina cristata	2	3·1	0·03	0·6	0·9	0·25	11·8	15·8	6
SHRUBS	64	99·9%	0·83	65·6	99·7%	1·7	99·9%	////	////
Dodonaea augustissima	30	46·9	4·3	49·5	3·2	0·81	29·5	79·6	1
O. Muelleri	1	1·55	0·1	1000	64·6	0·06	2·2	68·4	2
Maireana georgei	11	17·2	1·6	59·2	3·8	0·5	18·2	39·2	3
Enchylaena tomentosa	8	12·5	1·1	61·5	4·0	0·5	18·2	34·7	4
Lycium australe	1	1·55	0·1	250	16·2	0·6	2·2	20·0	5
Cassia nem var. platypoda	3	4·7	0·4	7	0·5	0·19	6·9	12·1	6
Cassia nem var. coriacea	3	4·7	0·4	6·4	0·4	0·19	6·9	12·0	7
Acacia colletioides	3	4·7	0·4	0·6	0·1	0·19	6·9	11·7	8
Olearia muelleri	2	3·1	0·3	29·8	1·6	0·13	4·6	9·3	9
Maireana pentatropis	1	1·55	0·1	62·5	4·0	0·6	2·2	7·8	10
Templetonia egena	1	1·55	0·1	15·6	1·0	0·6	2·2	4·8	11
GROUNDCOVER / HERBS	64	100	8·9	1547·3	99·4%	2·75	100%	////	////
Triodia irritans	8	12·5	6·4	26·04	83·17	0·31	8·3	104·0	1
Maireana georgei	15	23·4	11·9	2·36	7·22	1·8	48·0	78·6	2
Bunch grass	17	26·6	13·6	0·060	0·22	0·6	4·9	40·2	3
Enchylaena tomentosa	6	9·4	4·8	1·92	6·13	0·19	6·0	20·5	4
Sclerolaena diacantha	4	6·2	3·2	0·704	2·25	0·19	5·0	13·5	5
Podolepis capillaris	4	6·2	3·2	0·24	0·77	0·19	5·0	11·0	6
Rhagodia spinescens	3	4·7	2·4	0·007	0·02	0·188	5·0	9·7	7
Zygophyllum billardieri	2	3·1	1·6	0·016	0·05	0·13	3·5	6·7	8
Maireana pentatropis	2	3·1	1·6	0·006	0·02	0·063	2·0	5·1	9
Maireana sedifolia	1	1·6	0·8	0·024	0·08	0·06	1·6	3·8	10
Salsoli kali var kali.	1	1·6	0·8	0·024	0·08	0·06	1·6	3·8	10
Dodonea attenuata.	1	1·6	0·8	0·0001	0·0003	0·06	1·6	3·2	11
	64	100	51·1	31·3091	100%	2·741	100·9%	////	////

MALLEE TRIODIA TOTAL DENSITY:

TREES - 0·826
SHRUBS - 9·183
HERBS - 51·02

6.4.2 Interpretation of Data

Within the 100m x 15m vegetation sample area (VSA), two 15m x 10m ground cover VSAs were established to monitor changes in low-growing plants over time (Fig. 6.1). It was difficult to choose a homogeneous area in the quadrat because there were three different communities. The area in which the VSAs were conducted was selected because it contained a mixture of the three communities where they were all grading into each other.

A point-quarter transect was undertaken in each of the three major communities. From this data the relative density, dominance and frequency was calculated to show the importance value of each species in the tree, shrub and herb layers (Tables 6.2, 6.3 and 6.4). The results show that the species and the dominance of species differs between communities, indicating a high diversity of plants in the quadrat (refer to species list in Appendix 6.2). In the tree layer there were only two species common to all three communities, Myoporum platycarpum and Heterodendrum oleaefolium. There were five species common to all communities in the shrub layer, Dodonaea angustissima, Cassia nemophilia var. coriacea, Maireana georgei, Enchylaena tomentosa and Olearia muelleri, and four species in the herb layer, Maireana georgei, Bunchgrass, Sclerolaena diacantha and Zygophyllum billardierei. A descriptive survey of the vegetation was also conducted in this quadrat. Using Muir's code (Muir, 1977), the three major species in each life form were determined. It was extremely difficult to identify the species of bunchgrasses, mosses and lichens, hence they were not divided into major species. Due to the highly diverse nature of our quadrat, most of the life form categories were found to be present; in fact, 15 of Muir's life form categories were recorded. From the data we also estimated the proportional percentage of the three most abundant species in each life form (Fig. 6.4). In most cases there were more than three species found in each life form category, but only the three major species are presented in Fig. 6.4. This not only shows the high diversity of species in the quadrat but also shows great diversity in structure.

During the descriptive survey of the vegetation, canopy density of each life form was determined, using Muir's classes d, c, i, r (dense to very sparse). There were more plants in life form "shrubs" recorded than trees, mallee shrubs, grasses or herbs. All life forms had canopy densities of sparse, "i", or very sparse, "r". None were classified as being dense "d" (70-100%), and none of the categories were dominated by mid-dense "c" (30-70%) although some were classified as "c" (Fig. 6.5). For vegetation sampling maps refer to Fig. 6.6 and Fig. 6.7.

6.4.3 Condition of Vegetation

Thick litter accumulation was obvious under clusters of trees, especially in blackoak communities. Clear ground under large shrubs and near Triodia had a high density of mosses, fungi and lichens. Evidence of grazing was observed, probably due to goats, rabbits and kangaroos. Fresh kangaroo, rabbit and goat scats were noted throughout the quadrat along with fox, goat and kangaroo tracks. Several rabbit warrens were also observed within the quadrat.

There were many annual and perennial plants in the quadrat due to the good conditions (i.e. rain).

The size of trees, shrubs and Triodia rings suggests that it has been a long time since the last fire, but the occasional dead tree or stump seems to have been burned, perhaps from lightning strikes.

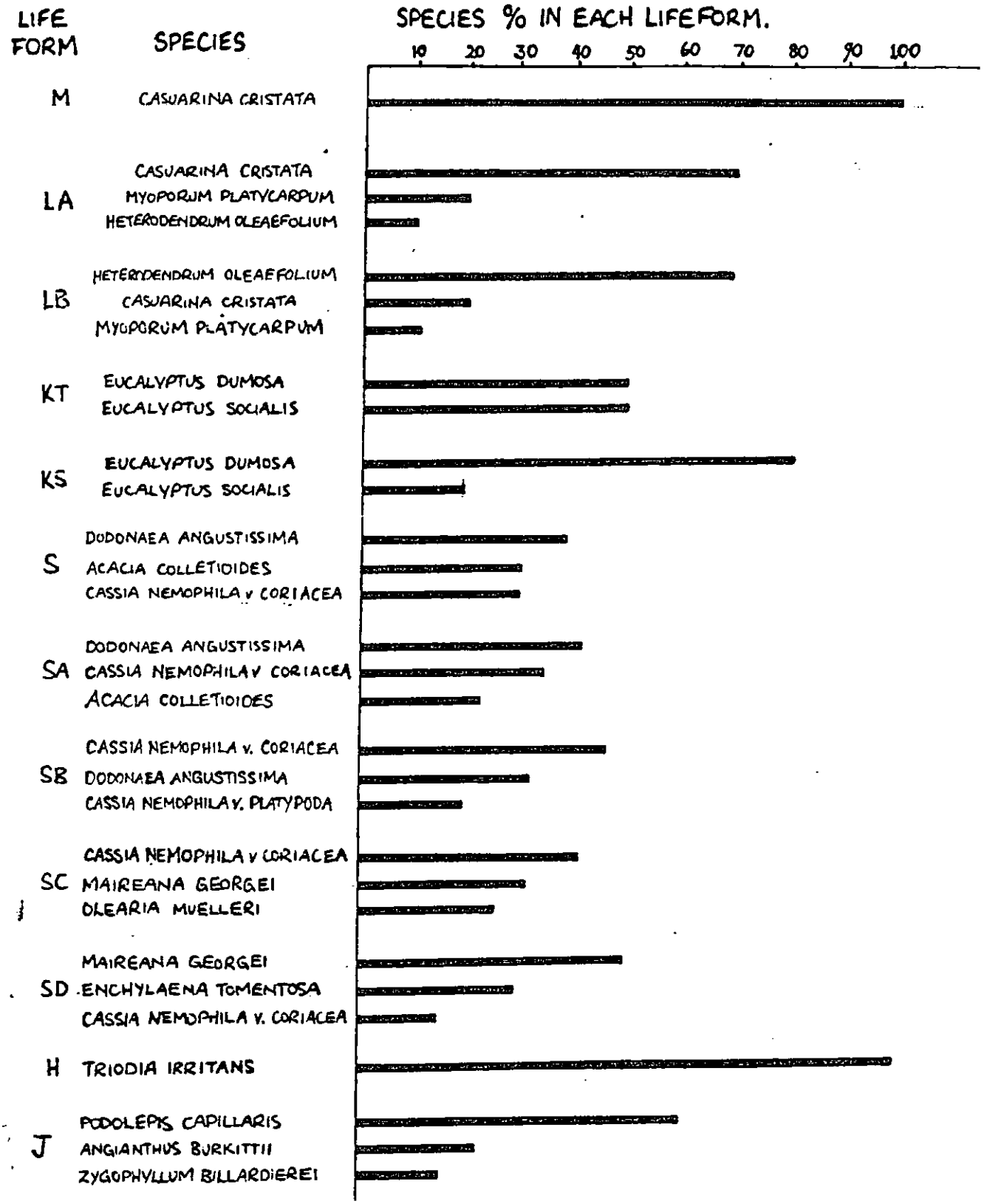


FIGURE 6.4 Proportional percentage of the most dominant species in each life form

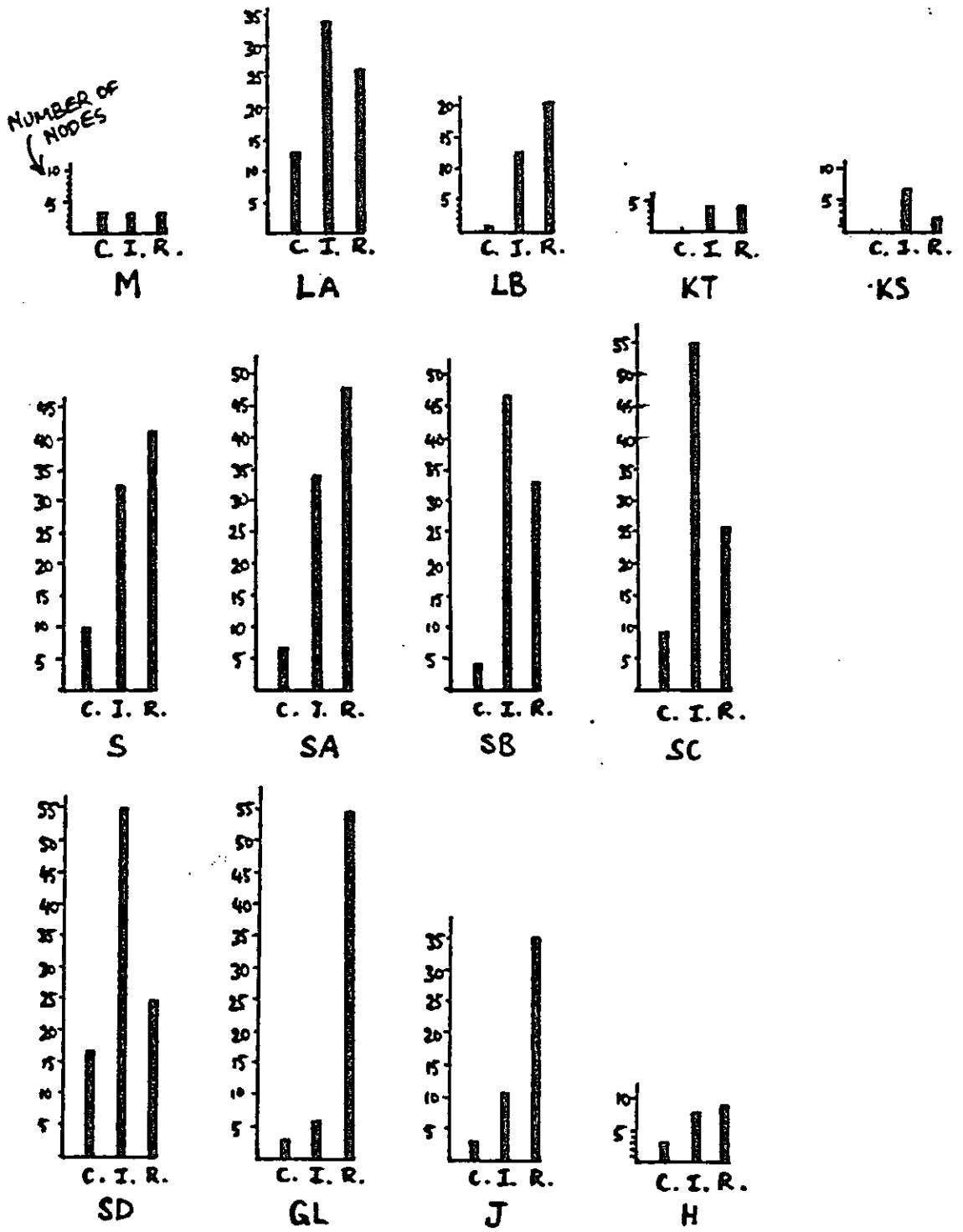


FIGURE 6.5 Canopy density for each life form

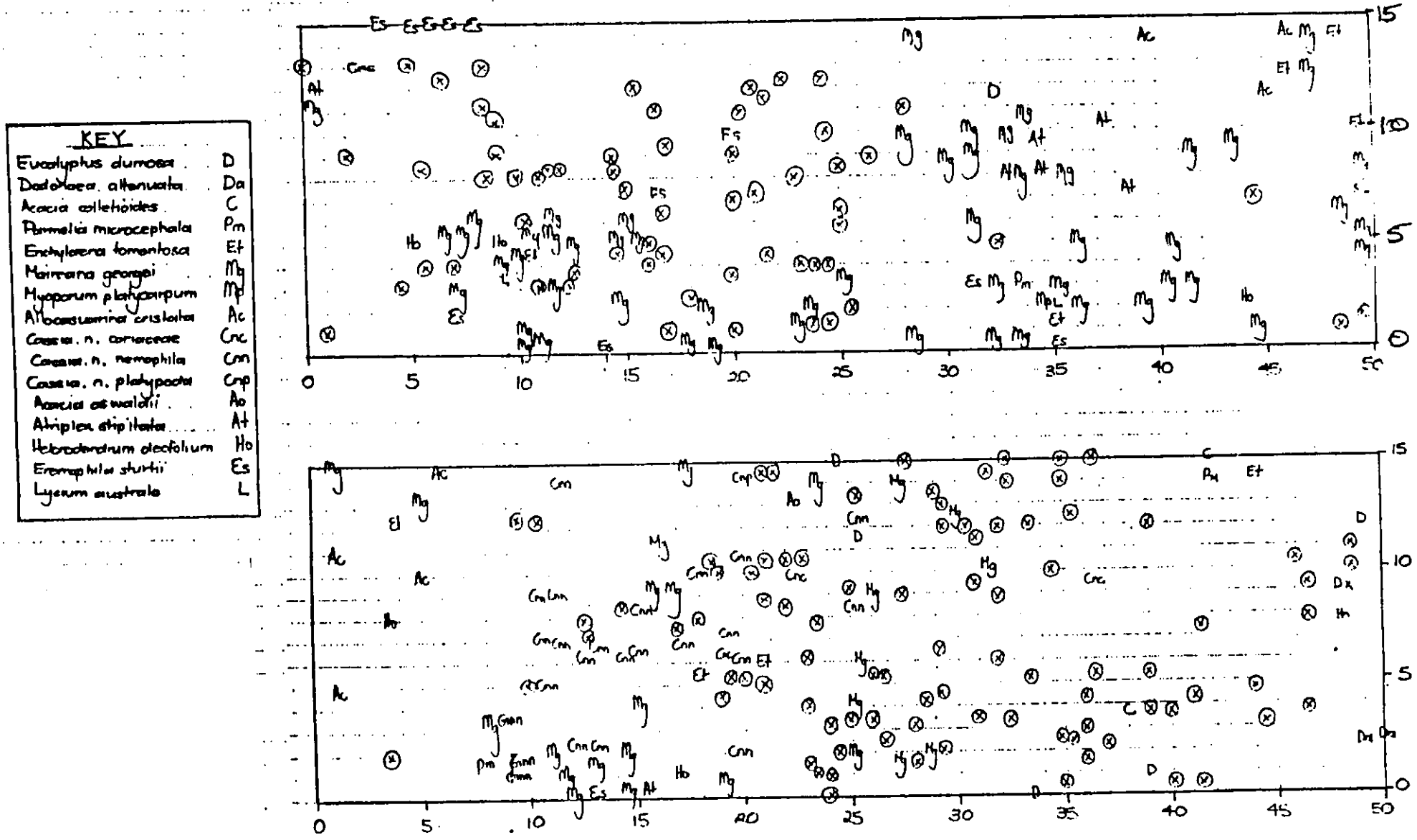


FIGURE 6.6 VSA Map for tree and shrub species, EB1

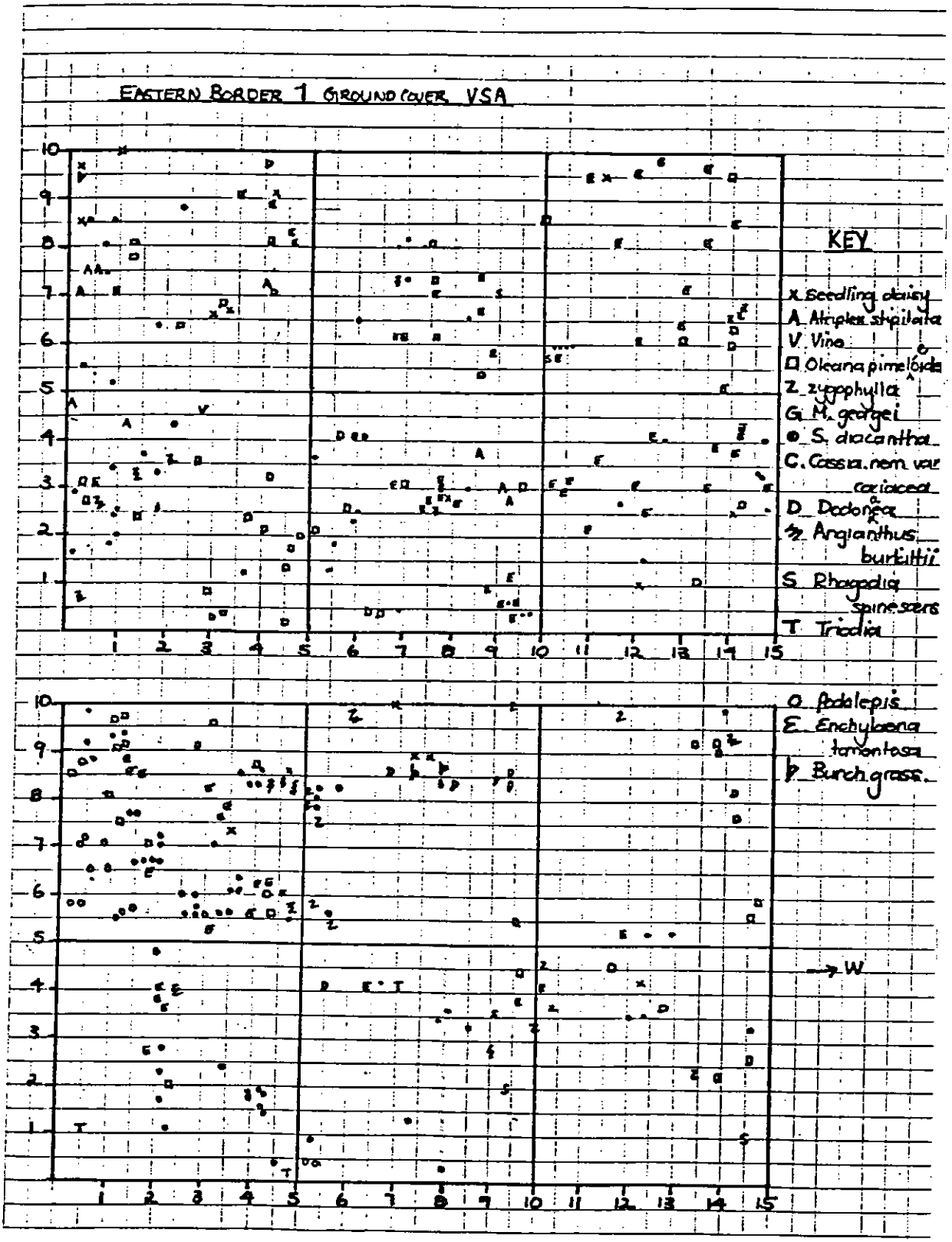


FIGURE 6.7 VSA map of Groundcover species for Eastern Border 1

6.4.4 Soil-Vegetation Relationships

The dunes in this area consist of red calcareous sands which are generally leached of minerals and salts. Here, the open tree mallee formation consists mainly of red mallee, E. socialis, and white mallee, E. dumosa, with an understorey of porcupine grass, Triodia irritans. The flats are associated with blackoak, Casuarina cristata, which prefers lower lying sites and moderately heavy soils, such as clay loams. The understorey is usually of narrow-leaf hopbush, Dodonaea angustissima, desert cassia, Cassia nemophila (vars. nemophila, coriacea, zygophylla and platypoda) and wait-a-while, Acacia colletioides.

Areas where calcium carbonate occur lower in the soil profile support a mixed community of blackoak and mallee species and in some cases a pure mallee community. The latter was found in small pockets in the northeastern and southeastern corners of the quadrat.

6.4.5 Microhabitats

The structurally diverse vegetation, rich in species, provides a variety of microhabitats for animals. There is a great variety of shelter and food resources available for animals, explaining the high diversity of animals in the quadrat. Many prickly refuges are provided by Triodia irritans, Acacia colletioides and Grevillea huegelii, for reptiles and small animals. Large spider webs were observed between trees and larger shrubs, while smaller net-like webs were in herbs and grasses. The variety of tree species allowed a number of different birds to nest and forage in the quadrat area. Dead and hollow trees provided microhabitats for bats, lizards, termites and birds. Fallen logs and loose bark also provided microhabitats for small animals. Thick litter accumulation under clusters of trees provides areas for invertebrates and small reptiles. Scorpions, lizards, ants, spider holes and other burrowing organisms were common in the sandy soils of the quadrat, creating their own underground habitats.

PLATE 6.1 Trapdoor spider emerging from its burrow

6.5 Fauna

6.5.1 Birds

A total of 477 birds, comprising of 39 different species, were recorded along the 500m bird transects (see Methods section 2.0). This is a larger number than on previous occasions and may be attributed to the improved method of sampling.

The density of the birds in the quadrat was found to be an average of six birds per hectare, but the actual density would be higher than this since the density of the vegetation would have made it harder to observe every bird that occurred along the transects, and many could have flown off before being observed.

The species which were found to have the highest densities were the Chestnut-rumped Thornbills (Acanthiza uropygialis), Spiny-cheeked Honeyeaters (Acanthogenys rufogularis), Weebills (Smicrornis brevirostris), Mulga Parrots (Psephotus varius), White-browed Babblers (Pomatostomus superciliosus) and Red-capped Robins (Petroica goodenovi). All of these, except the Mulga Parrots, are insectivorous (Frith, 1976). This may indicate that the area is rich in invertebrates, and so would be able to support high densities of these bird species. The Mulga Parrots occur in such high densities because they are likely to be utilising a food source that the other dominant species do not. Table 6.5 shows the diversities of each species recorded, along with the number recorded, the plant community in which they were observed, and the strata in which they occurred.

The only species which was found to be dominant in this quadrat that was also found to be dominant in all similar blackoak communities in the previous years, was the Spiny-cheeked honeyeater. This species has also been recorded as being amongst the dominant species in other plant community types. Its success may be attributed to its diverse range of food types which along with flower nectar includes berries, fruits, insects, small lizards and even nestlings of other bird species (Frith, 1976). This allows it to exploit a wide range of habitats.

Even though blackoak is by far the major plant community in the quadrat, it was found to support fewer birds relative to its size, when compared to the Mallee community and the Mallee/Blackoak ecotone, as shown by Table 6.6. This may be attributed to the fact that the mallee community was such a small percentage of the total quadrat that it was acting more like an ecotone rather than a separate plant community, and as such is able to support a greater range of bird numbers and species.

It appears that the type of habitat dictates what species are likely to be present. In the mallee, it is more likely that Weebills, Southern Whitefaces (Aphelocephala leucopsis) and Grey Fantails (Rhipidura fuliginosa) will be encountered. This may be because these birds are generally found feeding in the outer foliage of the Eucalypt species, which provides a more abundant supply of food than the blackoak. In the case of the Weebills, they were reported as feeding mostly on insects in eucalypts (Frith, 1976). Other species, however, were only found to occur in the blackoak community. Many of these may not have been encountered in the mallee area only because it was a relatively small area and the likelihood of an observer being there when the birds were, was therefore slight.

TABLE 6.5 Density of bird species and the plant communities in which they were found

Species	Total No. Recorded	Density (per ha)	Numbers in each plant community M	M/B	B	Strata g - ground l - < 0.5m m - > 0.5, < 5.0 u - > 5.0 o - overhead
Chestnut-rumped thornbill	74	0.92	10	6	58	g, l, m, u
Spiny-cheeked honeyeater	64	0.80	6	3	55	g, l, m, u*, o
Weebill	54	0.68	21	16	17	l, m*
Mulga-parrot	34	0.42	4		30	g, l, m, u*
Whitebrowed babbler	34	0.42	1	8	25	g, l, m, u, o
Red-capped robin	28	0.35	3	1	24	g, l, m, u, o
Southern whiteface	17	0.21	12	2	3	g, l, m, u*
Grey fantail	15	0.19	7	4	5	l, m*
Crested bellbird	14	0.18	3		11	g, u*
Mallee ringneck	12	0.15	3	1	8	m, u*, o
Splendid fairy-wren	12	0.15		2	6	l*, m,
White-winged fairy-wren	10	0.12		1	14	l, m*,
Yellow-rumped thornbill	9	0.11			9	m
Pied butcherbird	9	0.11	1		8	m, u*,
Mistletoebird	7	0.09			7	m, u*,
Inland thornbill	7	0.09	2		5	g, l, m*, u,
White-browed treecreeper	7	0.09			7	l, m,
Singing honeyeater	7	0.09	2		5	m, u*,
White-eared honeyeater	6	0.08	3	1	2	l, m*, u,
Common bronzewing	5	0.06		2	3	g,
Jacky Winter	5	0.06	2		3	g, l, u*,
Chestnut-crowned babbler	5	0.06			5	l,
Striped honeyeater	5	0.06			5	m, u*,
Grey butcherbird	5	0.06	2		3	u,
Australian raven	5	0.06	3		2	m, u*, o
Grey shrike-thrush	4	0.05			4	g, m, u,
Crested pigeon	3	0.04			3	g,
Black-eared cuckoo	3	0.04			3	m,
White-fronted honeyeater	3	0.04	1	2		l,
Galah	2	0.02		2		u,
Black-faced cuckoo-shrike	2	0.02			2	u, o
Brown treecreeper	2	0.02			2	l,
Fan-tailed cuckoo	1	0.01			1	m,
Yellow-plumed honeyeater	1	0.01			1	
Brown-headed honeyeater	1	0.01	1			u,
Pied honeyeater	1	0.01	1			u,
White-browed woodswallow	1	0.01			1	u,
Grey currawong	1	0.01	1			m,
Mallee fowl	heard on one transect on 2 different days	0.02				
39 SPECIES	477	5.96				

M - Mallee
M/B - Mallee/Blackoak ecotone
B - Blackoak

* - occurred in this strata > 50% of occurrences

TABLE 6.6 Plant Communities in which birds were recorded

Plant Community	Percent of Quadrat	Percent of Total No. of Birds	Percent of Total No. of Species
Mallee	8	19	54
Mallee/Blackoak	5	10	33
Blackoak	87	71	82

However, of the birds only recorded in blackoak, the Mistletoe bird (Dicaeum hirundinaceum) and the White-browed Treecreeper (Climacteris affinis) require special comment. The Mistletoebirds were restricted to the blackoak primarily because their major source of food, the mistletoe fruit, was found mainly in the blackoak communities in the EB1 quadrat. The White-browed Treecreepers are found only in blackoak because they avoid eucalypts, where other species of Treecreepers usually become more dominant (Frith, 1976). Danggali is a stronghold for the species in South Australia because it contains extensive blackoak woodlands (SACAE, 1988). Other species appear to be cosmopolitan, being commonly encountered in all habitats. The most noteworthy of these being Chestnut-rumped Thornbills and Spiny-cheeked honeyeaters, which because they are not specialised and reliant on a particular plant community, are able to exploit a variety of habitats.

The only species that were abundant, and were restricted to lower strata (less than 5 metres) of these habitats, was the Splendid Fairy Wren (Malurus splendens) and the White-winged Fairy Wrens (Malurus leucopterus) which rely on low shrubs for protection and feeding. Although many birds were only observed in the upper strata the only ones whose occurrence would be restricted to EB1 would be the Mistletoebird, which feeds on the fruit of mistletoe in the upper strata of blackoaks. White-browed woodswallows which feed on insects were also recorded as flying above the trees.

A total of 8 honeyeater species were recorded, the only species found in large numbers being the Spiny-cheeked honeyeaters. Such a large number of different species may be attributed to a variety of available habitats being present, with the small pockets of mallee providing an ecotone effect. Also Yorrell, Eucalyptus gracilis, was flowering which would provide food in the form of nectar as well as insects which are attracted to the flowers. This may also help account for the large numbers of other birds and species recorded in the quadrat.

In an area that was found to be rich in small birds, reptiles and small mammals there was a surprising lack of raptors. This may be attributed to the relatively dense cover of shrubs, trees and fallen logs which provide protection for these animals against birds of prey.

Table 6.7 provides a comparison of the number of birds seen on transects to the weather conditions at the time. On the first day a relatively low number of birds were seen even though the weather was fine and clear while on the following day, which was cold and overcast, just before

TABLE 6.7 Numbers of birds seen compared to weather conditions

DAY	WEATHER	NO. OF BIRDS RECORDED
1	Fine and clear	120
2	Cloudy, just before rain	148
3	Foggy and cold	117
4	Fine and sunny	131

rain, a greater number of birds were observed. This may be because on the first day the observers were less practised at observing birds and some may have been missed, also insects, particularly ants may have been on the move on the second day so as to escape the oncoming rain. Fewer birds were recorded on the third day because it was harder to observe birds in foggy conditions and the birds may have been less active. A larger number was again observed on the fourth day, which was fine and sunny, therefore they were busy foraging after two cold wet mornings when they were unable to do so.

Special mention should be given to the Mallee Fowl which was heard on two separate days along the same transect by two different people.

The high density of birds and the species richness in EB1 may be attributed to an improved systematic method of surveying bird numbers, i.e. by multiple bird transects. Also the presence of areas of mallee on dune crests act as an ecotone, and the flowering of one species of mallee, Eucalyptus gracilis, would contribute to the large number and diversity of birds recorded by providing a wide range of habitats which birds were able to exploit. The actual numbers of birds recorded were found to vary according to the weather.

6.5.2 Invertebrates

The methods used to study invertebrates in this quadrat were: pitfalls, micropitfalls, bushbeating, hand capture and placing a gas light beside the white background of a marquee at night. The results (Table 6.8) indicate that micropitfalls give the highest diversity as well as the highest number of individuals caught. However, this method is only successful for ground dwelling invertebrates and not as successful for flying insects. It does, however, provide a quantitative method of sampling invertebrates that can be repeated at a later date so that comparisons can be made. Placing the light by the side of the marquee at night proved to be a successful method of sampling flying insects present at night (Plate 6.2). Six Lepidoptera species (moths) were captured by this method, three of which were different species of bardi moths, probably brought out by the rain during that day.

Comparisons with quadrats in blackoak areas from previous years shows that two new orders were recorded in EB1. These were Amphipoda and Phasmitoda. However, there were not as many orders recorded in EB1 as in Ca8 (1988). This is not considered significant because the orders recorded in Ca8, but not in EB1, were only in small numbers and may be attributed to coincidence. In both years there were similar numbers of different species recorded indicating both areas are equally diverse and therefore of similar land condition.

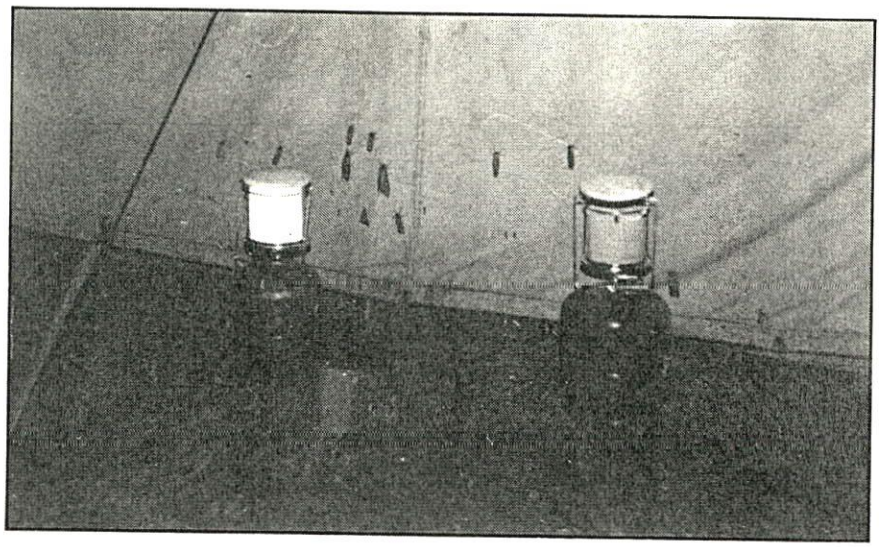


PLATE 6.2 Monitoring of Lepidoptera (moths) at night

TABLE 6.8 Method of Capture of Invertebrates in EB1 and numbers caught by each method

ORDER	Number of Species (Number of Individuals)					
	Capture Method					
	Micropitfalls	Macropits	Bush Beating	Hand	Light*	TOTAL
Hymenoptera						
- ants	28(622)	4(33)	7(29)	1(5)		30(689)
- wasps		3(3)	1(1)			3(4)
Araneae	13(127)	3(8)	13(16)	3(3)		29(154)
Coleoptera	8(26)	7(13)	2(3)			15(42)
Diptera	11(280)		1(1)			12(281)
Lepidoptera		1(1)	3(5)	1(1)	6(6)	11(13)
Collembola	- (24+)					- (24+)
Hemiptera	1(2)		8(18)			8(20)
Orthoptera	1(1)	2(3)				3(4)
Acari	2(6)	1(4)				2(10)
Psocoptera			2(4)			2(4)
Isoptera	1(9)					1(9)
Amphipoda	1(5)					1(5)
Blattodea				1(1)		1(1)
Phasmitoda				1(1)		1(1)
Thysauoptera	1(1)					1(1)
Total	67+ (1103+)	21(65)	37(77)	7(11)	6(6)	120+ (1262+)

*Light on side of tent at night

Bush bashing was a method of invertebrate sampling carried out in EB1, this was not done in previous years. This method gives an indication of associations between species and microhabitat as shown in Table 6.9. Dodonaea angustissima proved to produce the most diversity with six different orders and nine different species being present. This may indicate that invertebrates are attracted to its sticky resinous leaves. Acacia colletioides contained the most species of Araneae (spiders). This may be because the prickly nature of its foliage provides more protection against insectivorous birds. Also the large number and diversity of ants were recorded under Acacia colletioides. This may be due to the ants being attracted to the elaiosome bearing seeds of the Acacia.

Bush bashing was the most successful method for sampling the order Hemiptera (bugs), because these invertebrates are generally only found on vegetation, where they suck on the sap of the plant for food. On Eucalyptus socialis, the largest number of Hemiptera were recorded. These were all lerps.

It is suggested that in the future bush bashing be done in conjunection with sweep netting of the same vegetation so as to sample both the flying and non-flying invertebrates. Bush bashing alone does not sample the whole range of invertebrates which inhabit a particular vegetation type.

TABLE 6.9 Number of Invertebrates Species captured by the Bush Bashing of different vegetation types. Numbers in brackets indicate numbers of individuals.

ORDER	MICROHABITAT					
	Allocausarina cristata	Eucalyptus socialis	Heterdodendum deaefolium	Acacia colletioides	Myoporum platycarpum	Dodonaea attenuata
Aranea	1(3)	1(1)	2(2)	6(7)	1(1)	1(1)
Hempitera		1(10)	2(2)	1(1)	2(2)	2(3)
Lepidoptera	1(1)	1(1)				1(3)
Diptera	1(1)					
Coleoptera			1(1)		1(1)	1(1)
Psocoptera	1(1)					1(3)
Hymenoptera			1(7)	6(16)		3(7)
Totals	4(6)	3(12)	6(12)	13(24)	4(4)	9(18)

6.5.3 Non-Ant Invertebrates

TABLE 6.10 Non-Ant Species caught in Micropitfalls EB1

ORDER	No. of Species	No. of Individs.	Frequency %	Common Name	Comments
Araneae	13	127	85.0	Spiders	3 species make up 79%
Diptera	11	280	87.5	Flies	1 species makes up 69%
Coleoptera	8	26	40.0	Beetles	No outstanding species
Collembola	-	24+	15.0	Springtails	Different species were not distinguished
Acari	2	6	15.0	Mites	
Isoptera	1	9	10.0	Termites	
Amphipoda	1	5	5.0	Amphipods	
Hemiptera	1	2	5.0	Bugs	
Orthoptera	1	1	2.5	Crickets	
Thysanoptera	1	1	2.5	Thrips	

Table 6.10 shows the ten non-ant orders captured in the micropitfalls. The most diverse were Araneae (spiders) This would appear to indicate that they must exploit a wide range of different niches as well as a variety of habitats. This is supported by Appendix 6.3 which shows all non-ant species caught in micropitfalls along with the microhabitats in which they were found. Two of the different species of Araneae are shown in Plates 6.1 and 6.3.

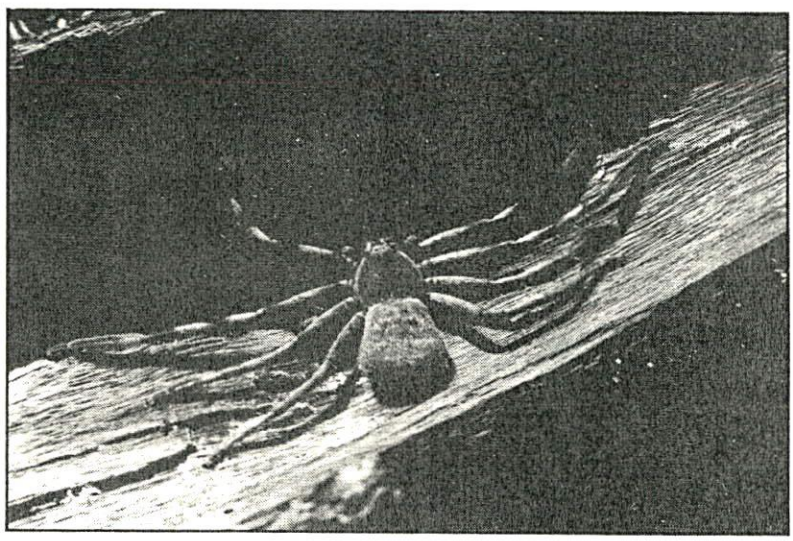


PLATE 6.3 Araneae species found during de structive sampling

The most dominant non-ant order captured was Diptera (flies), however, 192 of these were from the one genus, which may indicate that this species is attracted to the methylated spirits in the micropitfalls or perhaps even to the light reflecting from the surface. It is likely that this does not give a true indication of diversity or the density of Diptera, or other flying invertebrates since they are less likely to fall into the pitfalls than the invertebrates which are ground dwelling.

Table 6.10 also indicates that Coleoptera (beetles), had a relatively large species diversity but a relatively small abundance. This is probably due to their being large in size for an invertebrate and therefore requiring a larger range to support each individual's feeding and territory requirements, yet different species may be able to occupy the same area because they have different niche requirements.

6.5.4 Ants

Iridomyrmex was found to be the most dominant species in both the black-oak and the Mallee/Triodia communities as shown by Table 6.11. Pheidole was found to be the second most dominant group.

TABLE 6.11 Plant Community in which Ants were found

ANTS	PLANT COMMUNITY				TOTAL
	Mallee/Triodia Dune 14 micropitfalls		Blackoak 26 micropitfalls		
Genus	f(%)	#	f(%)	#	
Iridomyrmex	91	171	88	205	
Pheidole	43	28	35	62	
Rhytidoponera	43	8	42	28	
Camponotus	14	4	19	6	
Notoncus	0	0	27	68	
Melophorus	7	1	8	4	
Tetramorium	7	2	8	2	
Brachyponera	0	0	8	3	
Meranoplus	0	0	8	2	
Tapinoma	7	2	0	0	
Calomyrmex	1	1	0	0	
Monomorium	1	1	0	0	
Stigmacros	1	1	0	0	
Crematogaster	1	1	0	0	

The species designated Pheidole SP1 was found mainly in the Mallee/Triodia community while the other four species were found only in Blackoak community as shown in Appendix 6.4. This requires further study in order to determine if there is any relationship between where Pheidole species occur and the type of habitat in which they occur.

The genus Notoncus, of which there was only one species, requires special mention. It was caught in only 17.5% of pitfalls, but when it was caught it was in large numbers (refer to Appendix 6.4). This may indicate that the micropitfalls in which they occurred were in close proximity to the ant nest. Also this genus was only found in the blackoak community (refer to Table 6.11) indicating that it may be occupying a niche unavailable to it in the Mallee/Triodia community, but this, too, would require further research to verify.

By studying the functional groups within which the different ant species fall, we are able to obtain an indication of the conditions of the area. This is because ants are good bio-indicators for terrestial systems. Fig. 6.8 shows that functional group 1, Dominant Species, are the most abundant and frequently encountered as well as having a high diversity of species. This indicates that the area is healthy and relatively undisturbed. When an area is disturbed by such things as fire or grazing then the dominant species are less competitive and the subordinate species become dominant (Clay, pers. comm.). Therefore, EB1 must be a relatively undisturbed quadrat, and the effects of past grazing practices no longer have much influence on ant species in the quadrat. Functional group 6, generalised myrmicines, are also able to exist in relatively large numbers, with large diversity and occur frequently in pitfalls, because of their unspecialised behaviour, effective defences and rapid recruitment, which makes them successful competitors (Lecture handout, 1989).

Conclusions

Of the methods used to sample invertebrates in EB1, micropitfalls proved to be the most successful, both in terms of numbers and diversity.

Bush bashing was used to show any associations between species and micro-habitats. The resinous leaves of Dodonaea angustissima resulted in the largest diversity of invertebrates being captured on this bush. Acacia colletioides was found to support the largest diversity of Aranaea because of the protection provided by its foliage, while its seeds also attracted a large number of ants.

Of the non-ant species captured in micropitfalls, the Arachnids were the most diverse, being caught in a variety of habitats which indicates the diversity of niches it occupies. Large numbers of a particular species of Diptera were also caught in the micropitfalls indicating this species is attracted to the liquid in them. Beetles were also found to be diverse but only in small abundance for each species due to a relatively large range being required to support each one's feeding and territory requirements.

Of the ant species captured in micropitfalls, Iridomyrmex were by far the most abundant and frequently captured. Since these belong to the dominant functional group, it indicates the quadrat was relatively undisturbed and in good health. The one species of Notoncus captured was found to only occur within the blackoak community, while a species of Pheidole was found to occur predominantly within the Mallee/Triodia community.

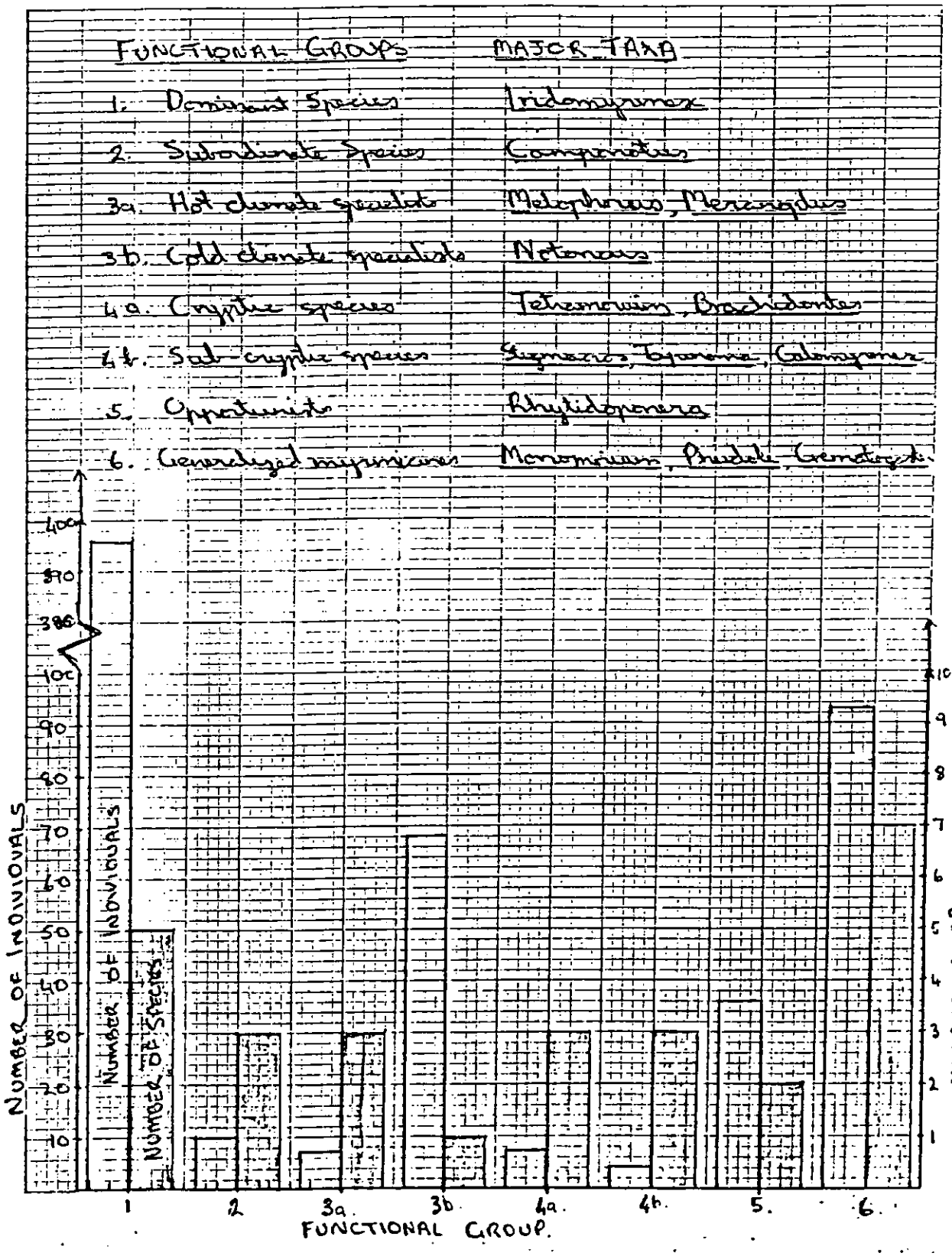


FIGURE 6.8 Abundance and numbers of species for each functional group

6.5.5 Reptiles and Amphibians

Of the reptiles captured, 16 different species were identified in Eastern Border 1, and consisted of seven skinks (Scincidae), four dragons (Agamidae), four geckos (Gekkonidae), and one legless-lizard (Polypodidae). While a wide range of species were identified, only a few individuals of each species were found (Table 6.12).

The most common species found in the area were the Gehyra variegata and Ctenophorus fordi. The Gehyra variegata species were commonly found under the bark of dead blackoak trees during the daytime, and on the tree surface at night. The Ctenophorus fordi species were only ever seen during the day when it was warm and was found in association with Triodia irritans which provided protection to these reptiles when threatened.

Information on these reptiles was gathered through the use of a number of different sampling techniques. Destructive sampling was used for removing Triodia clumps, logs and bark in order to find the lizards or signs of inhabitance. This method was proved to be effective, as two species rarely seen in Danggali were found; these being Diplodactylus elderi and Lerista punctatovittata. D. elderi was captured while digging out a Triodia clump, being found 10cm under the sandy surface, while L. punctatovittata was found after breaking open a rotting blackoak log.

Other methods which were used to capture reptiles, were pitfalls and Elliott traps. The pitfalls captured two lizards, those being Morethia boulengeri and Ctenophorus pictus, while the Elliott traps failed to capture any reptiles.

The only amphibian seen in Eastern Border 1 was Neobatrachus sudelli, a burrowing species which is usually only found after summer rains, when it breeds. Danggali had experienced summer rains, so this sighting was not unusual. These frogs were only active at night, and were captured during this time (refer to Plate 6.4).

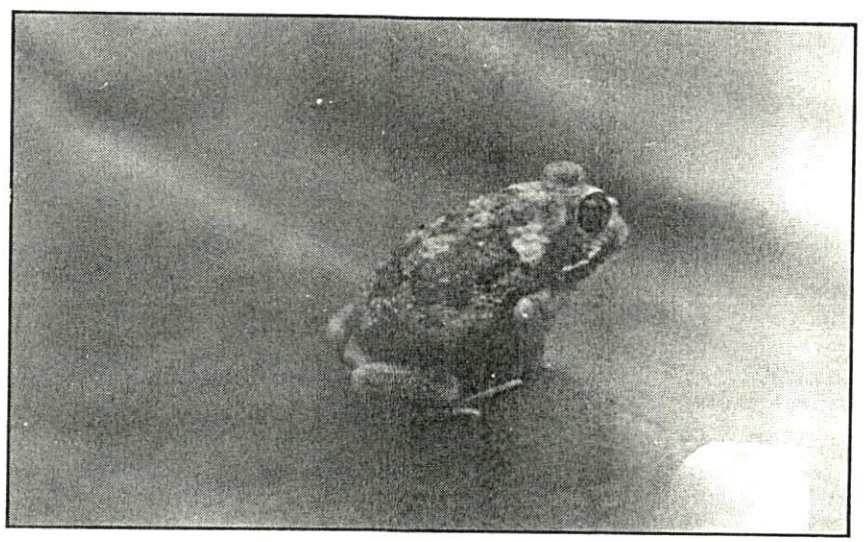


PLATE 6.4 Neobatrachus sudelli

TABLE 6.12 Reptile species recorded at Eastern Border 1

SPECIES	No. Recorded	Adjacent plant species	Comments
AGAMIDAE			
Ctenophorus fordi	numerous	Triodia	Never in pits or Elliotts
Gammatophora nobbi	3	with logs and leaf litter	Never seen with Triodia
Ctenophorus pictus	3	in leaf litter	one caught in pit during day
Pogona vitticeps	2	Blackoak	
SCINCIDAE			
Cryptoblepharus carnabyi	2	in cas. cristata litter or on cas. cristata trunk	
Ctenotus regius	2	Triodia	2 seen but never caught
Egernia striolata	1	cas. cristata logs	
Lerista punctatovittata	1	in a fallen cas. cristata log	caught during destructive sampling
Menetia greyii	1	in Mallee litter	smallest skink
Morethia boulengeri	3	mallee ?	one caught in pitfall
Trachydosaurus rugosus	1		2 dead ones also seen
GEKKONIDAE			
Diplodactylus elderi	1	Triodia	destructive sampling
Diplodactylus williamsi	1	dead cas. cristata under bark of dead c.c.	
Gehyra variegata	Numerous		came out at night especially
Heteronotia binoei	1	Ere. striolata litter	
PYGOPODIDAE			
Lialis burtoni	3	Triodia	destructive sampling

TABLE 6.13 Comparison of reptile species recorded in the two quadrats closest to EB1; TD1 and TL01

SPECIES	TD1 (1986)	TL01 (1988)	EB1 (1989)
AGAMIDAE			
Ctenophorus fordi	X	✓	✓
Ctenphorus pictus	✓	✓	✓
Gammatophora nobbi	✓	X	✓
Pogona vitticeps	✓	✓	✓
ELAPIDAE			
Demansia psammophis	X	✓	X
GEKKONIDAE			
Diplodactylus elderi	X	X	✓
Diplodactylus williamsi	X	X	✓
Gehyra variegata	✓	X	✓
Heteronotia binoei	✓	✓	✓
Lucasium damaeum	X	✓	X
Rhychoedura ornata	✓	X	X
PYGOPODIDAE			
Lialis burtonis	X	✓	✓
SCINCIDAE			
Cryptoblepharus carnabyi	✓	X	✓
Ctenotus atlas	X	✓	X
Ctenotus regius	✓	✓	✓
Ctenotus schomburgkii	✓	✓	X
Egernia striolata	X	✓	✓
Lerista punctatovittata	X	X	✓
Menetia greyii	X	✓	✓
Morethia boulengeri	✓	X	✓
Morethia obscura	X	✓	X
Trachydlosaurus rugosus	✓	X	✓
TOTALS 23	11	13	17

It is interesting to compare the reptile species which were recorded at Eastern Border 1, to those which were recorded at Toby Dam (TD1) and Three LO Dam (TLO1), the quadrats which are closest to EB1.

Eastern Border 1 is a Mallee-Triodia and Blackoak community, while Toby Dam 1 is a blackoak community compared to the Mallee-Triodia shrubland community in Three LO Dam.

The lizards which were found in each quadrat are Ctenophorus pictus, Pogona vitticeps, Heteronotia binoei and Ctenotus regius (Table 6.13). From the relatively wide distribution of these reptile species, we can infer that these species are not restricted to any type of vegetation, like other reptile species.

In comparing EB1 to the Blackoak community of TD1, the following species of reptiles, Gammatophora nobbi, Gehyra variegata, Cryptoblephorus carnabyi, Morethia boulengeri and Trachydosaurus rugosus (Table 6.13), were consistently associated with the Blackoak vegetation community. Thus we can suggest that these reptile species may be restricted to the Blackoak communities for their value as food source or protection.

In comparing EB1 to the Mallee-Triodia and shrubland community of TLO1, four species were found to be commonly in this vegetation type, Ctenophorus fordi, Lialis burtonis, Egernia striolata and Menetia greyii (Table 6.13) in both years. G. fordi and L. burtonis were associated and restricted to Triodia, and M. greyii was commonly found in mallee leaf litter. An association was found between E. striolata and mallee, but this reptile species was also found in Blackoak in EB1, and in mallee in TLO1.

These results cannot be conclusive, as it would take months and years of recorded data to compile an authoritative correlation between reptile species and plant communities, but these associations between reptile species and vegetation or habitat type can be generally observed.

6.5.6 Mammals

In order to obtain an idea of the resident and itinerant mammal species within EB1, both observation and trapping techniques were used.

The positioning of 50 Elliot traps and 18 pitfall traps (Fig. 6.1) for the trapping of small mammals, was not very successful. Only five mammals were caught in the Elliot traps, and four mammals were caught in the pitfall traps over a period of eight nights. The bat net, however, was very successful in the capture of 12 bats (between 6 p.m. and 11 p.m.) over a period of three nights.

The Elliot traps caught four Common House Mice (Mus domesticus), two caught under mallee trees and two under hopbush. The other capture was a Common Dunnart (Sminthopsis murina) under an Acacia colletioides. The pitfall traps captured two native mice (Pseudomys bolami), one in an open area nearest to Acacia colletioides) and the other between two A. colletioides. Two S. murina were also caught in the pitfalls, one near Acacia colletioides and the other on a Mallee/Triodia dune. The S. murina were caught on the same night, after a few fine and warm days. Thus we can infer that S. murina increases its activity only after warm days.

The bat net was erected in a flyway, in a transition zone between Mallee/ Triodia and Blackoak. While six different species were caught only 13 bats in total were captured (Table 6.14). The bats appeared to be most active between 6.30 p.m. and 10 p.m.; the net was taken down at 11 p.m. It is difficult to make inferences about the feeding times of individual species, when only one of most species was captured.

PLATE 6.5 Nyctophilus geoffroyi (Lesser long-eared bat)

A little pied bat (Chalinolobus picatus) was caught by the survey team while carrying out destructive sampling; it was found during the day, roosting alone in a hollow of a small dead blackoak. Strahan (1983) suggests that they roost in colonies but mentions nothing about roosting in trees, only in mineshafts, caves and houses. The capture of the C. picatus was exciting, as it is said to be "uncommon in a limited habitat".

Mammals which were seen in the quadrat (Table 6.14) were the red-Kangaroo (Macropus rufus) and the feral goat (Capra hircus). Two red kangaroos were seen in the Blackoak community, along with scats, tracks and wallows, which were more common in the blackoak than the mallee. This is probably because there were more grasses to graze on in the blackoak community, whereas in the mallee sandy soil, few palatable grasses grow. Goats and evidence of goats were also seen in the blackoak, many being heard but not seen. Red kangaroos and goats were also seen outside the quadrat.

Indirect evidence of mammals proved to be the most effective method of assessing their presence, with a further four species identified. Echidna (Tachyglossus aculeatus) diggings were found in the mallee community, though diggings were very rare. Kangaroo tracks, scats and wallows from the western grey kangaroo, as well as the Red Kangaroo, were found. Many Western greys were seen outside the quadrat, especially at night while spotlighting. An old rabbit warren was located in the north of the quadrat in blackoak. Despite fresh tracks and scats, sightings of rabbits was rare.

TABLE 6.14 Mammal species recorded at EB1

SPECIES	Common Name	Evidence	Abundance
MONOTREMES			
Trachyglossus aculeatus	Echidna	diggings	Uncommon (rare)
CARNIVOROUS MARSUPIALS			
Sminthopsis murina	Common Dunnart	captured	Uncommon
KANGAROOS			
Macropus rufus	Red Kangaroo	sighted	Common
Macropus fuliginosus	Western Grey Kangaroo	tracks, wallows, scats	Common
BATS			
Chalinolobus gouldii	Goulds wattled bat	captured	3 caught
Chalinolobus picatus	Little-pied bat	captured	2 caught
Mormopterus planiceps	Little Mastiff-bat	captured	1 caught
Nyctophilus geoffroyi	Lesser long-eared bat	captured	1 caught
Nyctophilus timoriensis	Greater long-eared bat	captured	2 caught
Tadarida australis	White-striped Mastiff-bat	captured	4 caught
NATIVE MICE			
Pseudomys bolami	Native mouse	captured	Uncommon
INTRODUCED ANIMALS			
Mus domesticus	House Mouse	captured	Uncommon
Oryctolagus cuniculus	Rabbit	burrows, scats	Uncommon
Vulpes vulpes	Fox	tracks	Uncommon
Capra hircus	Feral goat	sighted	Uncommon

Table 6.15 shows the times in which bats were caught in the net, these times can be used in future years to help discover when the species are most active so that worthwhile comparisons can be made.

TABLE 6.15 Times bats were caught in net at EB1

SPECIES	TIME (P.M.)
Chalinolobus gouldii	6.40, 6.40, 8.15
Chalinolobus picatus	8.45
Mormopterus planiceps	8.20
Nyctophilus geoffroyi	9.30
Nyctophilus timoriensis	6.30, 9.15
Tadarida australis	6.30, 8.30, 8.35, 10.15

It is interesting to note that the Greater long-eared bat (Nyctophilus timoriensis) was caught outside the times described by Strahan (1983). Strahan claimed that the Greater long-eared bat emerges late in the evening, but in EB1 they were caught at 6.30 p.m. and 9.15 p.m (Table 6.15).

It should also be noted that the same book suggests that the White-Striped Mastiff Bat (Tadarida australis) is "docile to handle", however, given a chance it will inflict a nasty bite.

6.6 Conclusions

6.6.1 Future Studies

- Estimate the population of scorpions in an area by counting the holes.
- Determine why a large number of scorpion holes were present but no scorpions were observed or caught.
- Develop field identification techniques for moss and lichens, bunchgrasses and fungi.
- Monitor sheet erosion and its effects on flora and fauna in the areas.
- Intensively study bats to determine if there are any differences in species occurrence between habitats, through the re-positioning of the nets.
- Determine the availability of nesting sites for birds by recording and monitoring nest sites.

- Attempt to locate the dam in the area and monitor the role it plays for fauna.

- Monitor the effects of goats and kangaroos around the dam.

6.6.2 Habitat value

The main habitat value of Eastern Border 1 is the ecotone. Within the 1000 x 1000 metre quadrat, three different vegetation communities exist. The Blackoak community is generally associated with plains, while the mallee and mallee-triodia communities are found on dunes and elevations. This variety of habitats result in the wide diversity of birds, bats and reptile species being found in the area. Rarely found in a semi arid area, this ecotone and species diversity should be preserved and managed to protect the species which depend on the habitats.

Eastern Boarder 1 also maintains habitat value due to the capture of Chalinolobus picatus (little pied bat). This bat was found roosting in a hollow during the day, and was an exciting capture as it is uncommon in a limited habitat. This capture, and the observation of many bird species adds to the value of the quadrat.

6.6.3 Management implications

As this was the first detailed study of this habitat type in Danggali Conservation Park, the data compiled is an important starting point for management decisions to be made of these areas.

The study has shown through recorded data that this habitat type is rich in birds, mammals, reptiles and invertebrate species. The area also maintains a stable plant community which is relatively diverse in species.

Monitoring of pest species found in the quadrat should also be carried out to determine the effects mice, goats and kangaroos have on the native flora and fauna. This monitoring includes any disturbed zones which can cause problems with the pest animals. Management should ensure these areas are properly monitored to protect the flora and fauna.

7.0 EASTERN BORDER 2 (EB2) : Dunes with Sand Pine (Callitris verrucosa)

7.1 Description of Study Quadrat

The EB2 quadrat (1500 x 500m) was specifically located to include stands of Callitris verrucosa which were mainly concentrated on the dune crests. This habitat/vegetation type had not previously been studied in any detail. The quadrat site was also chosen because the area had not been burned for a long time (possibly not since 1917). The large Callitris and large Triodia rings indicated that this was so, and it is possible that some of the larger Callitris trees may be several hundred years old (Clay, R.E. pers. comm. 1989).

The quadrat map coordinates are grid reference 000 east 270 north or 33°12' latitude 141°00' longitude on the Chowilla map, S154-6 edition 1, 1:250,000 scale. The quadrat can be further located by a permanent road-marker which is adjacent to the fence 23.8km north of the Mornington Dam turnoff on the eastern boundary track.

The photopoint (C157-60) which also marks the 53m mark of the eastern side of the Vegetation Sample Area (VSA) is situated 84.5m in from the road marker at 270° (mag). This and other details of the quadrat including locations where various sampling methods were used are illustrated in Fig. 7.1.

The quadrat which runs in a north-south direction had 7 dunes running through it from an east-north-east to west-southwesterly direction. These dunes varied in height from approximately 8-12m and all decreased in height and flattened out near the middle and western side of the quadrat (see Fig. 7.3).

The soil type was given a Uc classification (Northcote, K.H., 1979) both in the dune crest and swale areas sampled. The soil was dominated by coarse sand and showed a powdery $CaCO_3$ layer present at varying depths.

The vegetation varied considerably with small patches of Callitris low woodland on dune crests with very little understorey at all, while in the swales and lower dune slopes mallee/Triodia low woodland with varying understorey vegetation was present. This understorey was dominated by Acacia wilhelmiana, Cassia nemophila spp, Beyeria opaca, and Maireana georgei species.

The soil microphytic crust was not a consistent feature and was confined to low areas where drainage and clay content of the soil would extend moisture availability. It was also evident that this layer was present under the thicker stands of Callitris which provide shade and where there was little litter accumulation.

7.2 Landforms and Soils

7.2.1 Landforms

The topography in EB2 consists of dune crests, swales and occasional flat areas creating a dune system with mallee, Callitris and Triodia as the major vegetation types. The dunes run in a west-south-west, east-north-east direction through the quadrat, at approximately right angles to the NSW-SA border (Fig. 7.3).

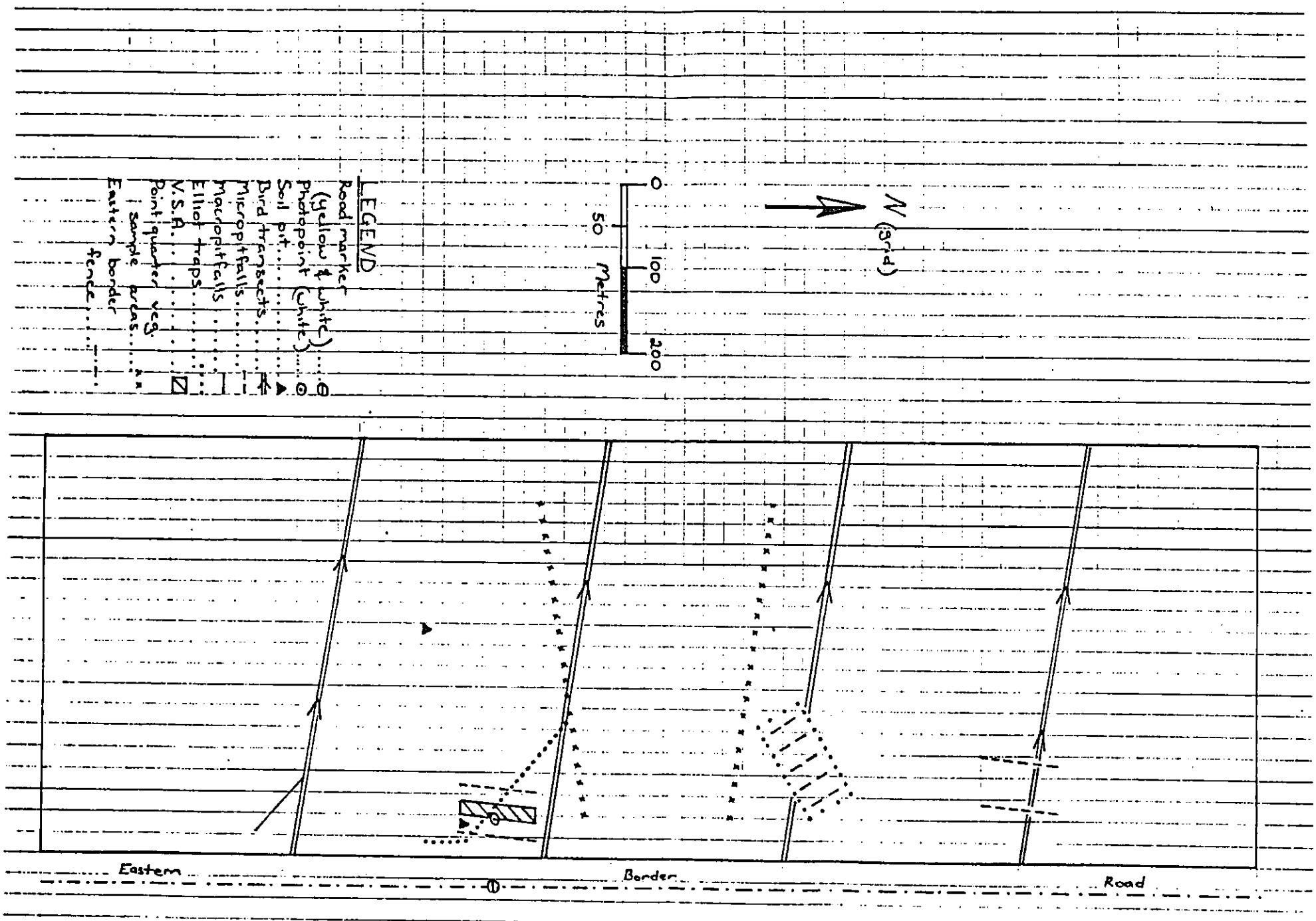
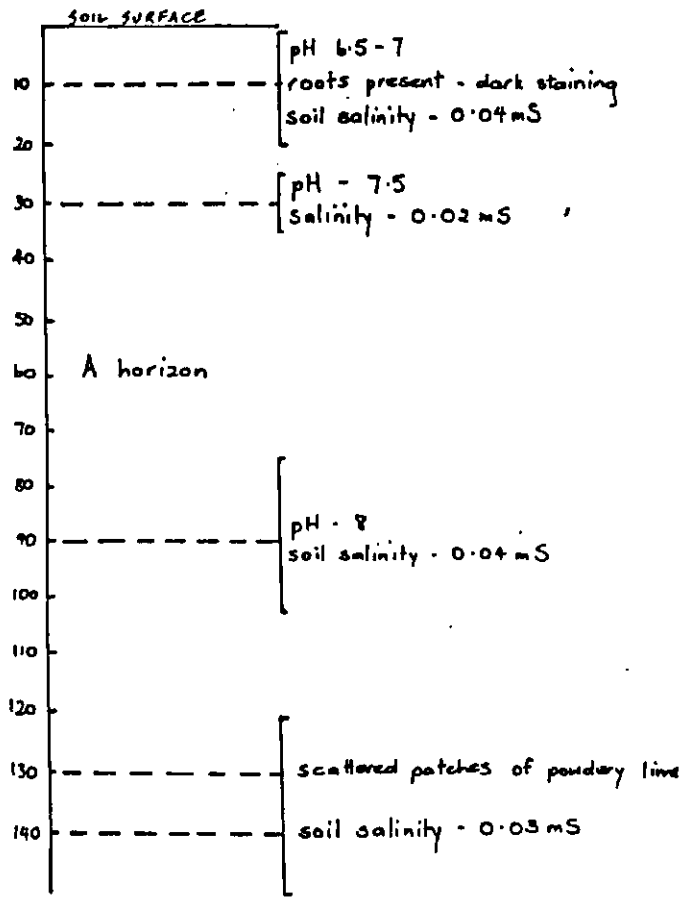


FIGURE 7.1 Mallee/Callitris Dune Quadrat, EB2

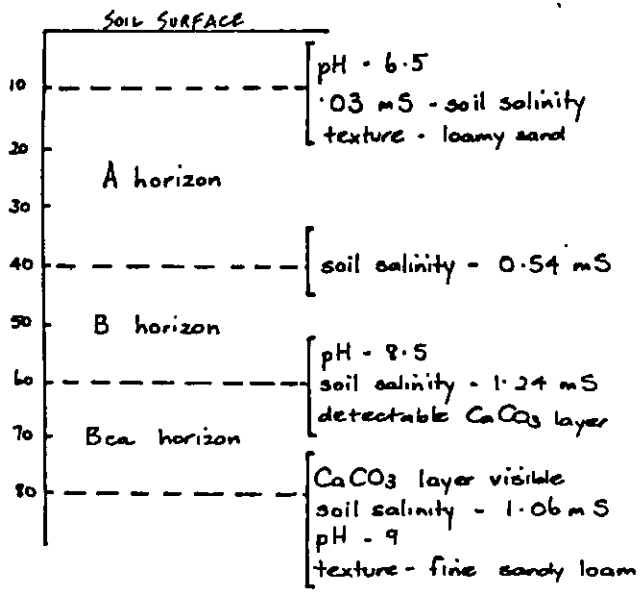
PROFILE 1



IN GENERAL THE SOIL IS:

- STRUCTURELESS THROUGHOUT
- ROOTS THROUGHOUT
- LOAMY SAND TEXTURE
- YELLOWISH RED COLOUR.

PROFILE 2.



IN GENERAL THE SOIL IS:

- STRUCTURED MASSIVELY THROUGHOUT
- YELLOW RED TO YELLOWISH RED COLOUR

FIGURE 7.2 Soil Features of Profiles 1 and 2

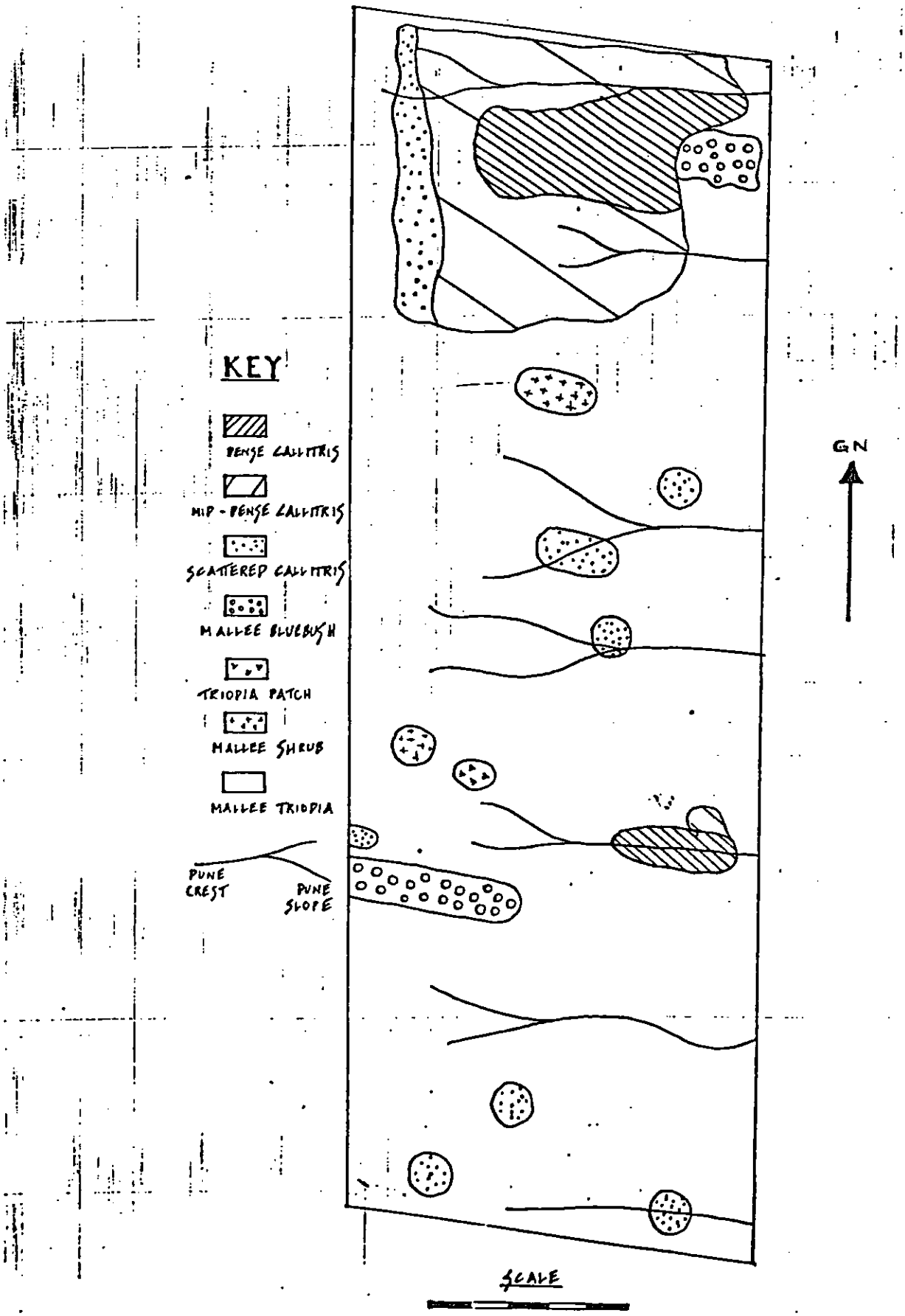


FIGURE 7.3 Vegetation and Landform Associations in EB2

Within the quadrat there are seven main dunes with varying distances between them. Other small dunes branching from the main dunes can also be recognised toward the west side of the quadrat. The dune crests grade into westerly slopes and flat regions between 200-400 metres west from the eastern quadrat boundary. The swales can be up to 300 metres wide and are actually large, flat plains areas between the crests (see Fig. 7.3).

7.2.2 Soils

The dune/swale topography resulted in distinct depth changes between the two profiles studied and subsequent differences in the location of calcareous material. Slight textural changes occurred and structural differences were noticeable between the profiles.

Two soil sampling sites were studied and located in a dune swale and on a crest within the quadrat. Profile 1 was located approximately 500 metres north of the southern quadrat boundary, just east of the VSA (see Fig. 7.1). The overlying vegetation was a stand of sand pine, Callitris verrucosa. It was a coarse, uniform soil - Uc 1.22 (Northcote, 1971) and structureless throughout. A slight staining of the soil in the top 1-2cm of the profile suggested the presence of some organic matter, however, surface litter was discontinuous with bare patches and patches of litter to a depth of 1-2cm. The pH graded from neutral to slightly alkaline with increased depth and soil salinity low throughout the profile (see Fig. 7.2). Small scattered patches of powdery lime were just visible at 130cm indicating the possibility of a calcareous layer below this depth.

Profile 2 was located in a large swale or flat between dunes 2 and 3 approximately 300 metres west of the quadrat's eastern boundary (see Fig. 7.1). The area demonstrated a vegetation change or ecotone between mallee/Triodia irritans and assorted Maireana species. This sampled soil was also coarse and uniform but at shallow depth showed a distinct calcareous layer - Uc 5.32 (Northcote, 1971). No surface litter existed except for a microphytic crust on the soil surface. The soil was massive throughout with a slight increase in clay content with depth. A relationship was recognised between the soil salinity, pH and the location of the calcareous layer.

Soil salinity was relatively low and pH was neutral until 40cm. Between 40-60cm a calcareous layer became evident and as a result, the pH became increasingly alkaline and soil salinity increased (see Fig. 7.2). At the base of the profile, at 60cm, calcium became visible with similar results in pH and soil salinity.

7.2.3 Soils and Dune Vegetation

In mallee dune quadrats studied in past years, the soils sampled have demonstrated distinct similarities, especially on the dune crests (see Table 7.1). The association between these soils and the presence of Triodia irritans can also be seen. Nearly all the profiles demonstrated deep soils with sandy textures within one texture class. This indicates that dune crest soil types contain the most suitable conditions for the growth of this hummock grass. The soil depth, neutral to slightly alkaline pH and inaccessible $CaCO_3$ horizons are advantageous for the growth of Triodia irritans.

TABLE 7.1 Soil Associations in Mallee Dune Systems

Soil characters / year + quadrat	SOIL DEPTH	pH	SOIL SALINITY	POSITION OF $CaCO_3$ HORIZON	TEXTURE	ASSOCIATED VEGETATION
1986 Ca 3	PROFILE 1: (SLOPE) 70 CM	7·5 AT 10 CM 8 AT 30 CM 9 AT 60 CM	95 Umhos AT 10 CM 150 Umhos AT 30 CM 600 Umhos AT 50 CM	50 CM	LOAMY SAND AT 10 CM SILTY LOAM AT 30 CM LIGHT SANDY CLAY LOAM FROM 50-70 CM	EUCALYPTUS DUMOSA, E. SOCIALIS, E. GRACILIS, E. INCRASSATA WITH TRIODIA IRRITANS
	PROFILE 2: (CREST) 90 CM	7·5 AT 10 CM 9 AT 30 CM	220 Umhos AT 10 CM 100 Umhos AT 50 CM 300 Umhos AT 90 CM	70 CM	LOAMY SAND TO 70 CM SANDY CLAY LOAM TO 90 CM	AS ABOVE.
1987 LB I	BURNT (FLAT) 100+ CM	7	90 Umhos AT 100CM 150 Umhos AT 100+ CM	-	SAND	TRIODIA IRRITANS WITH MIXED SHRUBS
	UNBURNT (FLAT) 100 + CM	7	75 Umhos AT 10 CM 110 Umhos AT 100CM 250 Umhos AT 100+CM	-	SAND	EUCALYPTUS SOCIALIS, E. DUMOSA, E. GRACILIS AND TRIODIA IRRITANS
1988 Ca 9	135 CM	7·5 to 100 CM 8·5 at 135CM	NONE RECORDED	135 CM	LOAMY SAND TO 100CM SANDY LOAM TO 135 CM	EUCALYPTUS SOCIALIS E. DUMOSA E. OLEOSA E. GRACILIS WITH TRIODIA IRRITANS.
1989 EB2	PROFILE 1: 140 CM	6·5-7 AT 10 CM 7·5 AT 30 CM 8 AT 90 CM	·04 mS at 10CM ·03 mS AT 140CM	130 CM	LOAMY SAND	CALLITRIS VERRUCOSA AND TRIODIA IRRITANS
	PROFILE 2: 80 CM	6·5 AT 10 CM 8·5 AT 60 CM 9 AT 80 CM	·06 mS AT 20CM ·54 mS AT 40CM 1·24 mS AT 60CM 1·06 mS AT 80CM	60CM	LOAMY SAND AT 10 CM TO FINE SANDY LOAM AT 80 CM	ECOTONE FROM MAIREANA SPECIES AND TRIODIA IRRITANS

* NOTE: FOR SOIL SALINITY mS = milli SIEMENS; Umhos = MICROMHOS } MEASUREMENTS IN DIFFERENT SCALE.

7.3 Flora, Vegetation and Habitat Types

7.3.1 Description of vegetation

The presence of Callitris verrucosa (sand pine) in the quadrat makes the mallee-Triodia dune system different from other studies at Danggali. The trees may be over 200 years old in this area on the eastern border of the park.

The Callitris occurred in clumps of old trees on the highest dune crests, associated with isolated patches of Eucalyptus incrassata (see Plate 7.1). It seemed to decrease in density down the north-south slopes and also to the west. Within the quadrat, the only exception to this is in the northeastern corner, where juvenile trees (perhaps regenerating after the 1917 fire) were not confined to the highest crests, and were more continuously distributed.

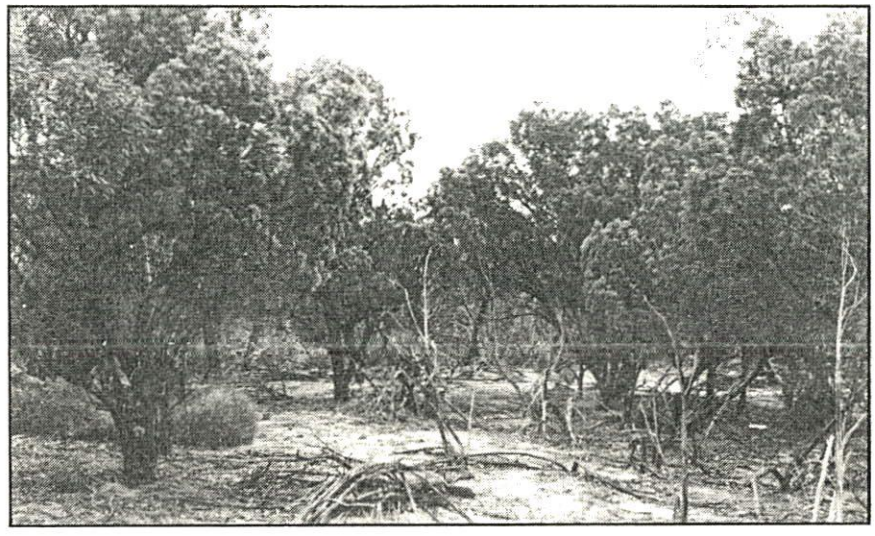


PLATE 7.1 A typical Callitris stand in EB2

The Callitris clumps seem to be fire resistant, and the old clumps may be all that survived the 1917 fire. The 1983 fire, that burned through the northeast part of the park, left at least one clump of pine unburned even though all the surrounding mallee was burned (Clay, 1989, pers. comm.).

The understorey of the Callitris showed little in the way of shrub, herb layer or hummock grass in the thickest stands, although shrub species such as Rhagodia spinescens, Maireana georgei, Acacia wilhelmiana, Grevillea huegelii and Duboisia hopwoodii appeared in low densities in the stands that were not as thick. This may be due to available sunlight.

On the lower crests and dune slopes a mallee-Triodia low woodland dominates. The dominant mallee trees included Eucalyptus socialis, E. dumosa, E. gracilis and E. foecunda. The understorey of the mallee-Triodia areas is low density shrub and herb layers, and mid-dense to dense hummock grass depending on topography. The shrub layer seems to be dominated by Cassia nemophila platypoda, Acacia wilhelmiana, Beyeria opaca and dwarf shrubs Maireana georgei. Bunchgrass, possibly Amphipogon caricinus, also occurred.

In the lowest areas of the swales, Triodia irritans gives way to large open areas, dotted with Maireana georgei and M. triptera (see Section 5.3.5).

One area of very low lying land lies at approximately 400m north of the southern boundary and 200m east of the western boundary. This is a run-on area where water accumulates after rain. The approximate size of this area is approximately 50m wide, and 200m long. (Fig. 7.3 quadrat vegetation map.)

The vegetation in this area includes Maireana sp, with Cassia nemophila var. platypoda and Acacia colletioides limited to areas where the accumulations of water were not evident. The outer boundaries of the soak supported a mallee-Triodia vegetation. One large Casuarina cristata was observed right on the eastern edge of the run-on area.

7.3.2 Results of quantitative methods

Two quantitative methods were used to determine density, dominance and cover (photosynthetic input) within the quadrat. These two methods were point quarter and Vegetation Sample Area (VSA) plot using the rangefinder method.

Results of the point quarter method : the standard point quarter technique and calculations were used. From these calculations each species is assigned a rank with number one given to the species with highest importance value. This importance value is a measure of the photosynthetic input of the species to a community. Results and calculations for the two transects (one on a crest, the other on a swale) are tabulated in Appendices 7.3 and 7.4, and importance values are shown in Fig. 7.4.

Table 7.2 indicates the presence of the species on the crest, in the swale, or both. Seven species occur on both the crest and swale, five on the crest only and seven in the swale only. It can also be seen from this Table that the mallee species occur on both transects, and that it is mainly shrubs that occur on one transect or the other.

Of the mallee species that occur on both transects, Eucalyptus dumosa is the most dominant, with slightly higher importance value in the swale (Fig. 7.4). E. gracilis, E. socialis and E. foecunda also occur on both transects, with E. gracilis having much more importance value in the swale, E. socialis slightly more importance value in the swale, and E. foecunda having more importance value on the crest (Fig. 7.4).

Shrubs that occur on both transects include Cassia nemophila var. platypoda (more dominant in the swale) and Acacia wilhelmiana and Grevillea huegelii (both more dominant on the crest).

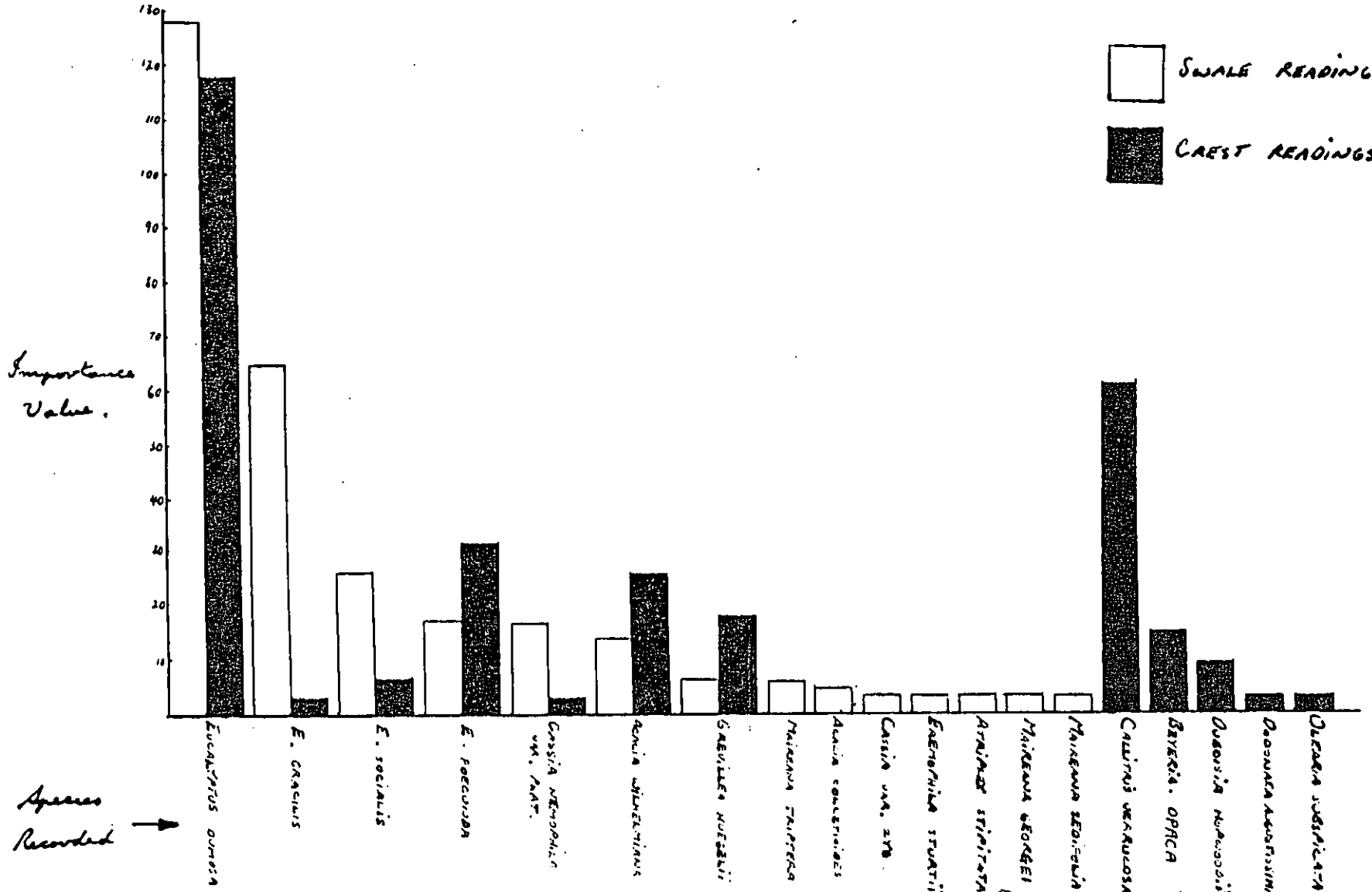


FIGURE 7.4 Bar Graph showing importance values for species in swale and on Crest, EB2

TABLE 7.2 Species presence on crest and/or swale according to point quarter results

Species	Presence on both crest and swale	Presence on crest only	Presence in swale only
Eucalyptus dumosa	✓	—	—
Eucalyptus gracilis	✓	—	—
Eucalyptus socialis	✓	—	—
Eucalyptus foecunda	✓	—	—
Cassia nemophila var. platypoda	✓	—	—
Acacia wilhelmiana	✓	—	—
Grevillea huegelii	✓	—	—
Callitris verrucosa	—	✓	—
Beyeria opaca	—	✓	—
Duboisia hopwoodii	—	✓	—
Dodonaea angustissima	—	✓	—
Olearia subspicata	—	✓	—
Maireana triptera	—	—	✓
Acacia colletioides	—	—	✓
Cassia nemophila var. zygophylla	—	—	✓
Eremophila sturtii	—	—	✓
Atriplex stipitata	—	—	✓
Maireana georgei	—	—	✓
Maireana sedifolia	—	—	✓

Fig. 7.4 also shows that besides E. dumosa, Callitris verrucosa is also a dominant tree on the crest, but differs in having a lower importance value than E. dumosa and does not occur in the swale at all. However, there is a greater diversity of shrubs occurring in small numbers in the shallower profiles of the swales. There are seven shrubs that occur only in the swale, and four that occur only on the crest.

Overall, from Fig. 7.4 it can be seen that in the swale four mallee species contribute most photosynthetically, with a diverse shrub layer contributing a little, whilst the crest is dominated by two trees, Callitris verrucosa and Eucalyptus dumosa with a less diverse shrub layer contributing relatively more photosynthetically than in the swale.

Results of the VSA rangefinder method : to determine the differences between Callitris and mallee-Triodia vegetation types, the VSA was chosen to include a crest and the change downslope between the two vegetation types. The first 60m (approx.) from the southern end includes Callitris but the last 40m (approx.) at the north end is downslope and contains mallee-Triodia. Two groundcover VSAs were measured, one at the southern end in Callitris and one at the northern end in mallee-Triodia (Fig. 7.5). The position and size of individuals in the > 50cm VSA is shown in Fig. 7.5.

Table 7.3 indicates that seven species occur throughout the VSA (> 50cm layer) and four species occur at one end only. Acacia wilhelmiana and Grevillea huegelii occur downslope only, and Eremophila glabra and Maireana georgei upslope only. (Maireana georgei appears in the downslope groundcover VSA).

Fig. 7.6 shows the number of individuals in each 50m section. It can be seen that Callitris verrucosa is more abundant at the southern upslope end, and that Eucalyptus dumosa and E. socialis are the most abundant mallees at the northern downslope end. It can also be seen that Beyeria opaca is an abundant shrub throughout the VSA, but is more abundant at the southern end. Other shrubs that occur only at one end or the other have been mentioned above.

Fig. 7.7 and Fig. 7.8 show the distribution and size of the species that occupy the two groundcover VSAs and Table 7.4 indicates which species are present in both groundcover VSAs and which are present in only one. Seven species occur in both Callitris and mallee-Triodia groundcovers. Three occur only in the mallee-Triodia and one only in Callitris. Fig. 7.9 indicates the number of individuals in each groundcover.

Fig. 7.7 shows that in the mallee-Triodia VSA groundcover, Triodia irritans dominated on the western side, with large, open patches surrounding the individuals, and very few small shrubs or bunchgrass associated with it. There is an almost abrupt delineation at about 6 metres from the western boundary, where Triodia irritans suddenly disappears and the groundcover becomes dominated by bunchgrass. Bunchgrass (Amphipogon caricinus) is far more dominant in this groundcover than the Callitris one. (See Fig. 7.0 and also Section 7.3.1). Some small shrubs occur randomly in the eastern side of this area (Fig. 7.7). In the northeast corner of this VSA there is a bare patch under Eucalyptus dumosa, Acacia wilhelmiana and Beyeria opaca. This may be due to lack of sunlight under these closely spaced mallee and shrubs.

TABLE 7.3 Species presence in VSA > 50cm layer, EB2

Species	Presence at both ends	Presence only upslope (southern end)	Presence only downslope (northern end)
Callitris verrucosa	✓	—	—
Eucalyptus dumosa	✓	—	—
Eucalyptus socialis	✓	—	—
Eucalyptus incrassata	✓	—	—
Beyeria opaca	✓	—	—
Eucalyptus foecunda	✓	—	—
Olearia subspicata	✓	—	—
Acacia wilhelmiana	—	—	✓
Grevillea huegelii	—	—	✓
Eremophila glabra	—	✓	—
Maireana georgei	—	✓	—

TABLE 7.4 Species presence in Groundcover VSAs, EB2

Species	Presence in mallee-*Triodia* and *Callitris*	Presence in *Callitris* only	Presence in mallee *Triodia* only
Amphipogon caricinus	✓	–	–
Triodia irritans	✓	–	–
Maireana georgei	✓	–	–
Rhagodia spinescens	✓	–	–
Sclerolaena parviflora	✓	–	–
Schoenus subaphyllus	✓	–	–
Beyeria opaca	✓	–	–
Podolepis capillaris	–	✓	–
Eremophila glabra	–	✓	–
Enchylaena tomentosa	–	✓	–
Acacia wilhelmiana	–	–	✓

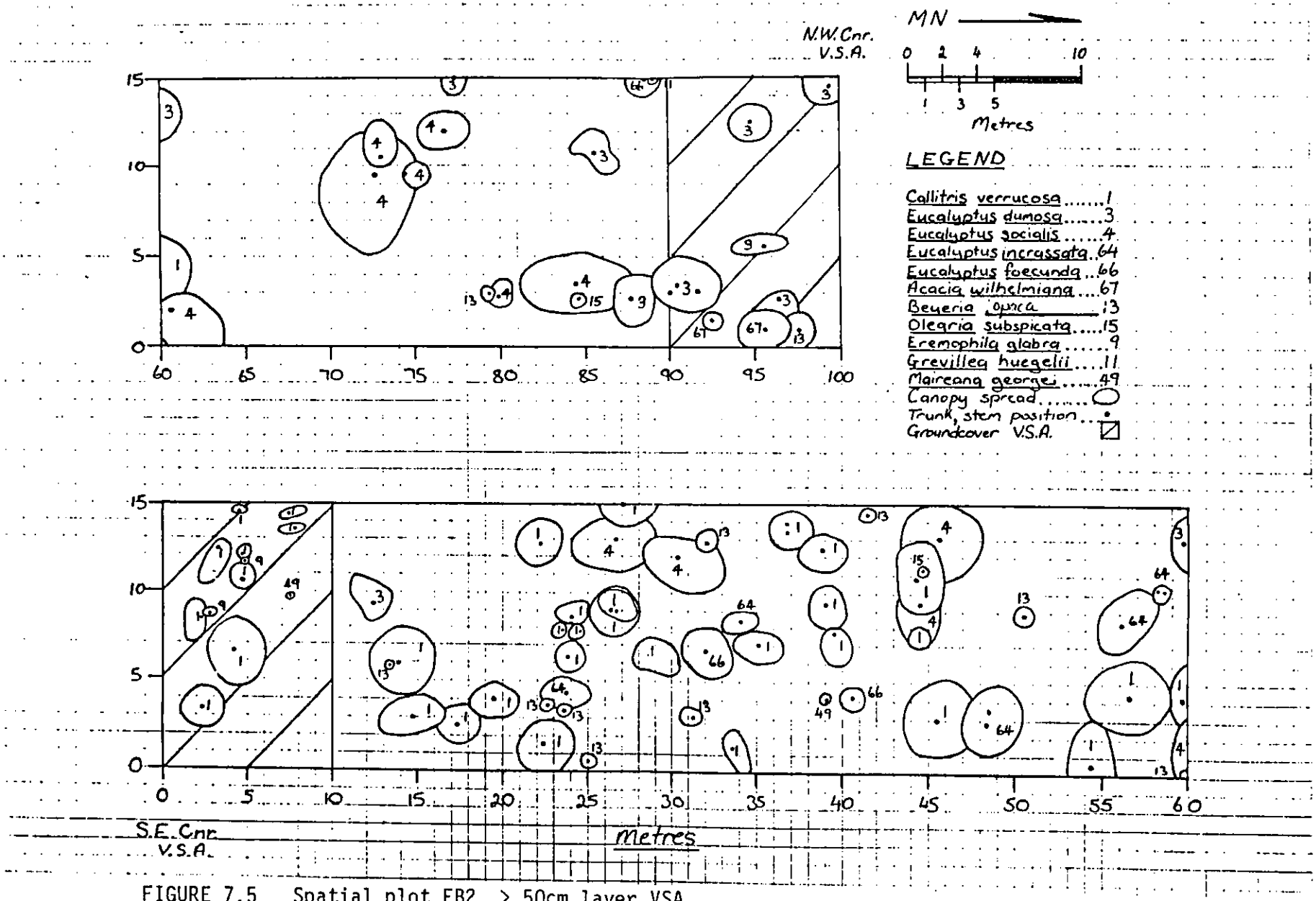


FIGURE 7.5 Spatial plot EB2, > 50cm layer VSA

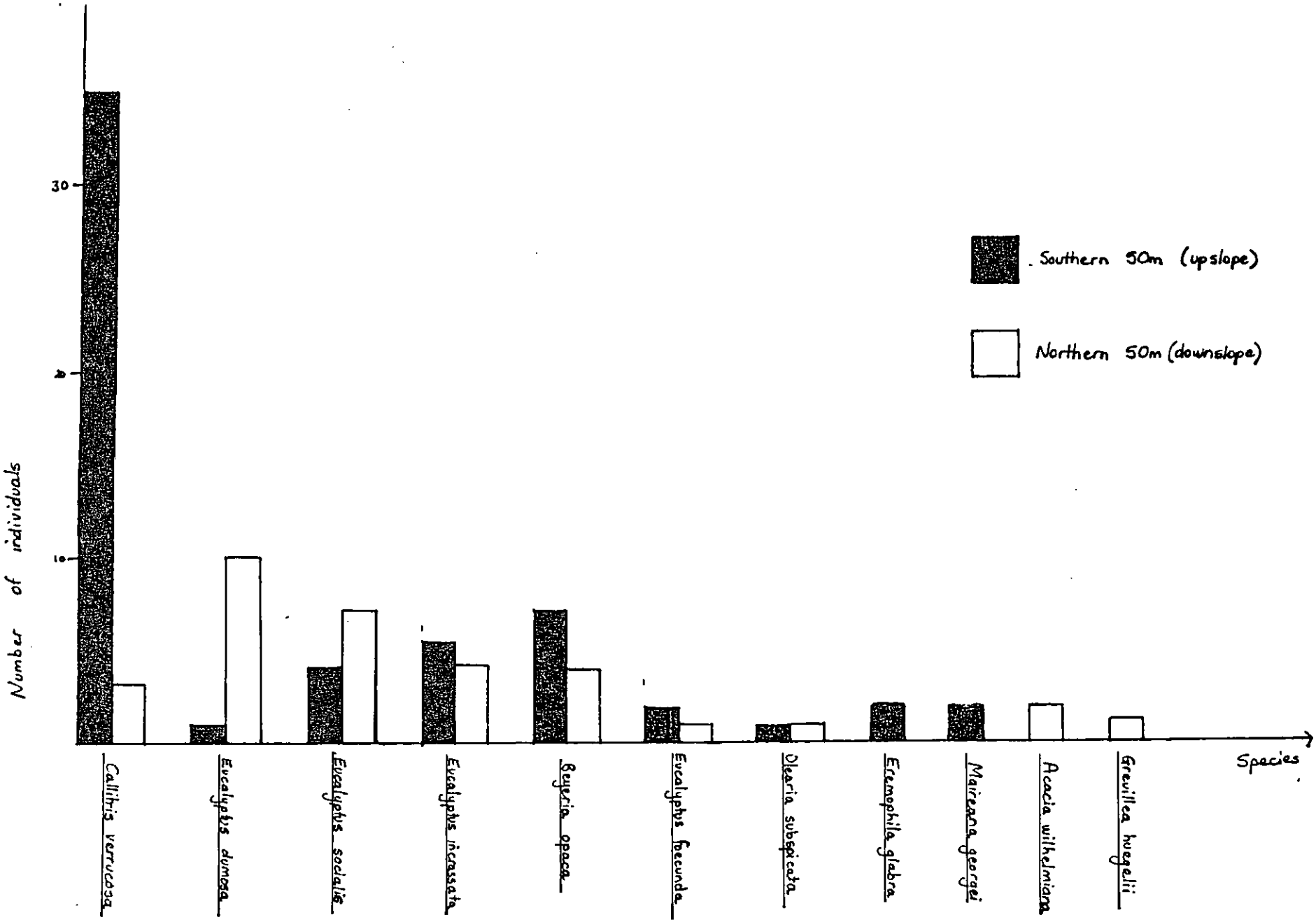


FIGURE 7.6 Comparison of southern 50m and northern 50m, > 50cm layer VSA, EB2

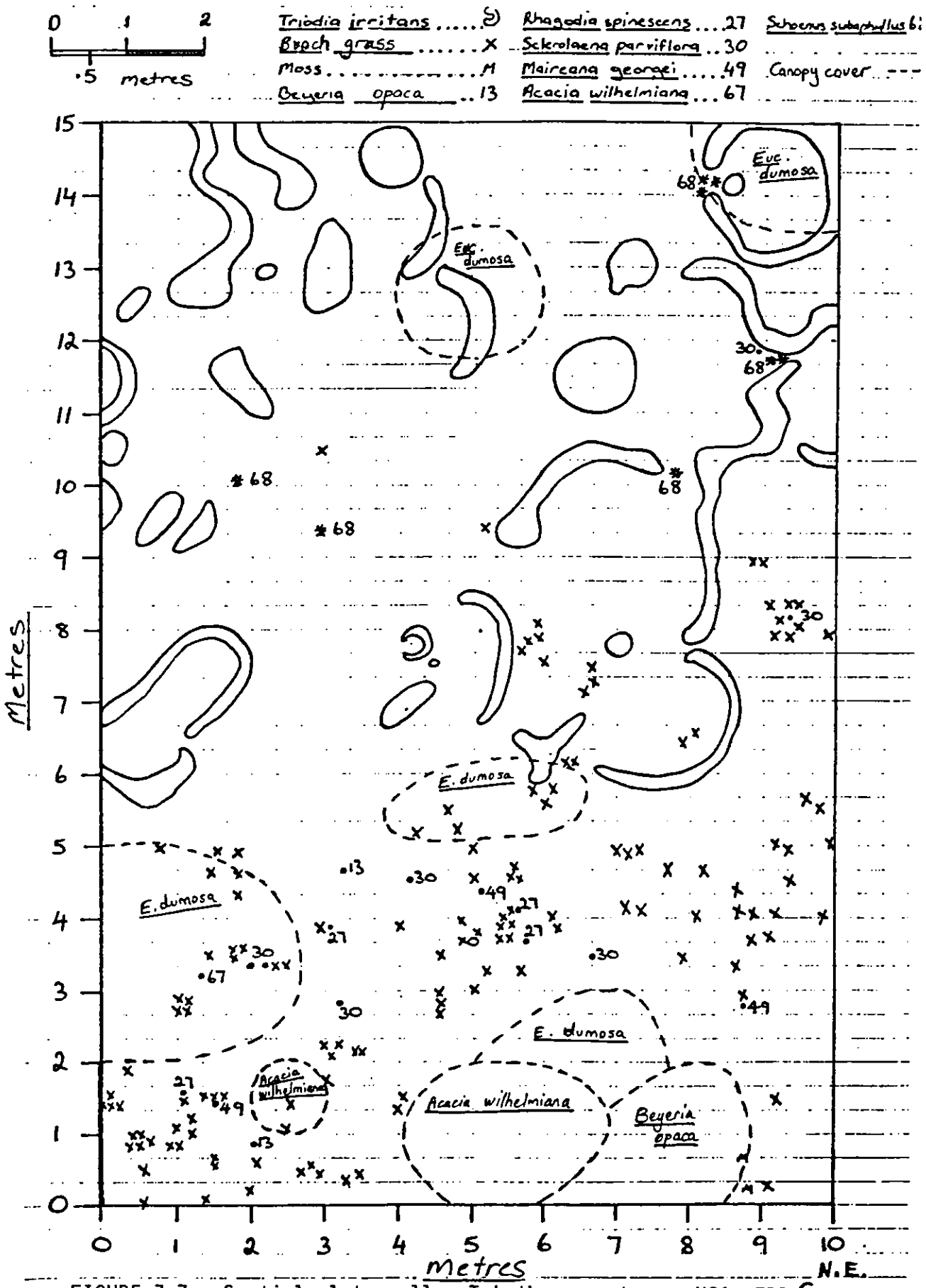


FIGURE 7.7 Spatial plot, mallee-Triodia groundcover VSA, EB2

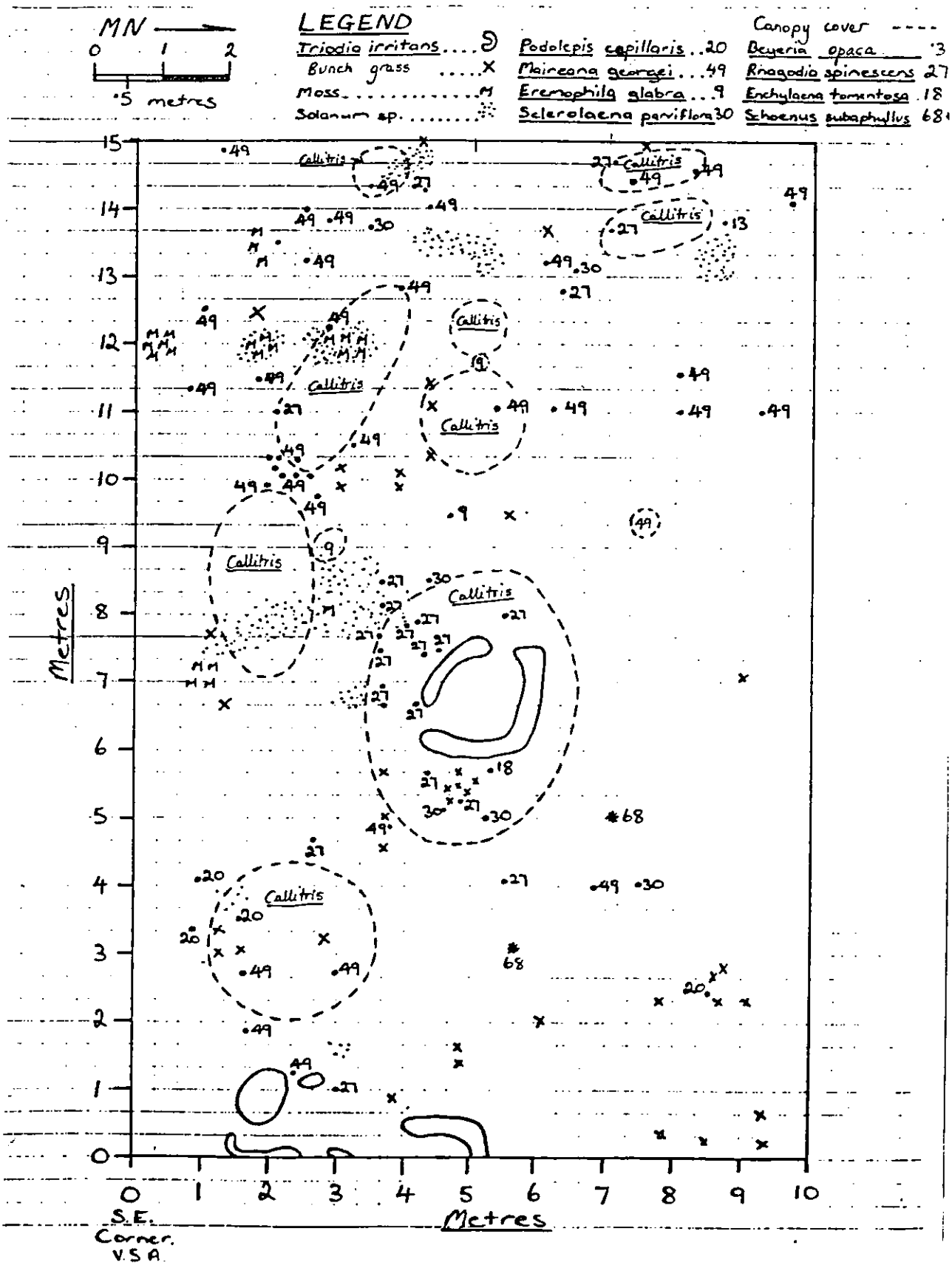


FIGURE 7.8 Spatial plot, Callitris groundcover VSA, EB2

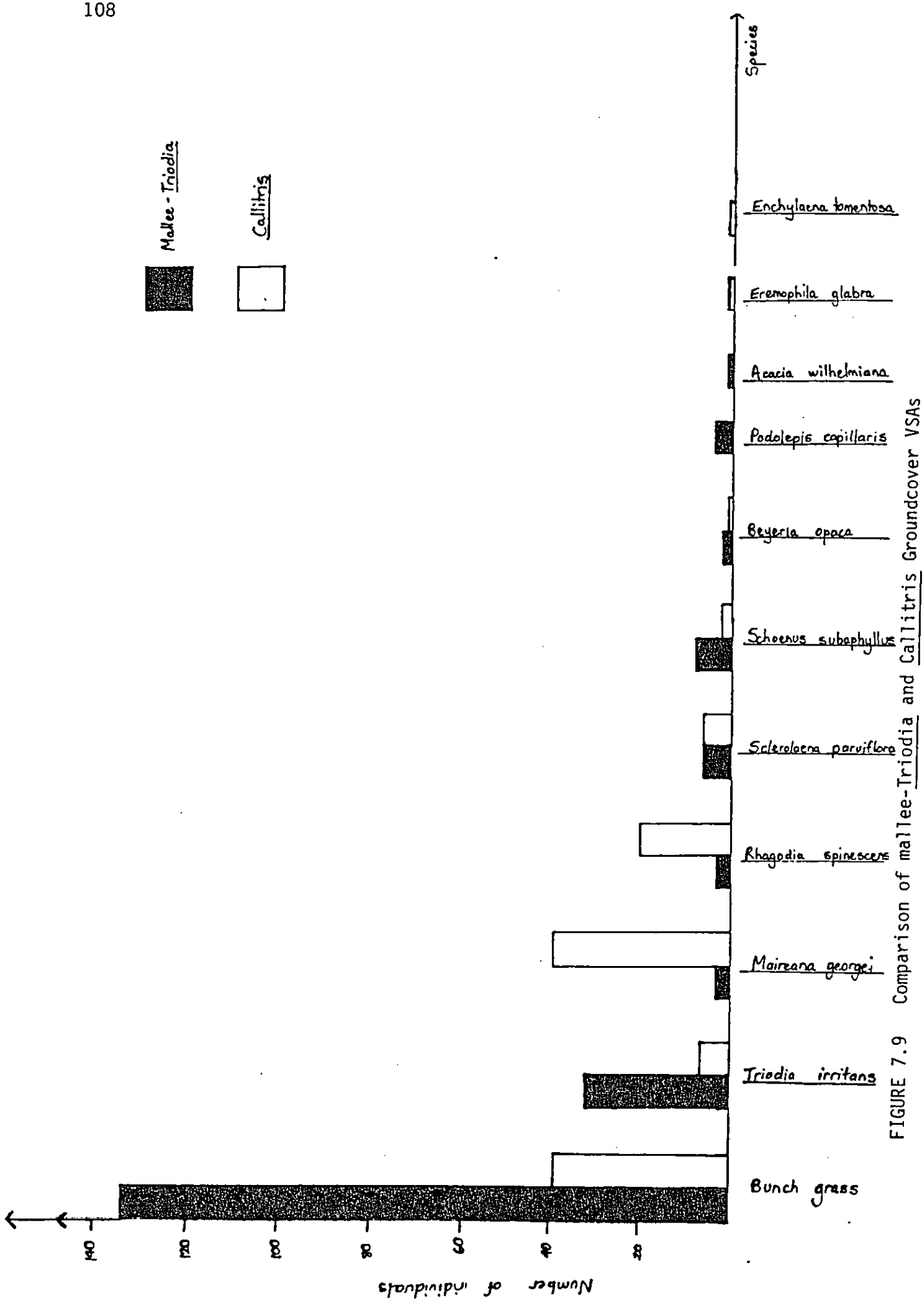


FIGURE 7.9 Comparison of mallee-Triodia and Callitris Groundcover VSAs

In the Callitris VSA, there is a greater diversity of species, although the number of species counted is less. Most obvious is the almost total absence of Triodia irritans, except for a few on the eastern boundary, and one under a large Callitris. (Fig. 7.8). This large Callitris seemed to be the only one with a significant number of associated shrubs, mainly Rhagodia spinescens (Fig. 7.8). Bunchgrass is also noticeably less in the Callitris area, than in the mallee-Triodia (see Fig. 7.9).

Within the western side of the Callitris VSA, Maireana georgei is a common shrub, and is much more frequent here than on the eastern side, or in the mallee-Triodia VSA (see Figs. 7.7 and 7.9). It is much more common on the crest, but qualitative observations have shown that it also occurs in the swales.

The dozens of Solanum sp. seedlings may be an indication of local disturbance, as Solanum coactiliferum was observed to be quite common in other areas of the park that had been disturbed by fire, and was also observed to be common on the firebreak.

7.3.3 Condition of vegetation

The eastern boundary of the park is an area that was less grazed during pastoral activities than other areas of the park, and it is evident that the quadrat has not been disturbed by either grazing or fire for some considerable time. The large number of bunchgrasses remaining and lack of grazing lines on the taller trees suggest little grazing by goats or kangaroos, although there is evidence of their presence from fresh tracks and scats.

The area has not been affected by fire for a long time (possibly not since 1917) and this is evident in the condition of the vegetation. The mallees are 7m or more in height with no burned or dead branches and foliage is evenly spread. Most of the mallees observed had fewer than 5 trunks, and branches were up to 15cm in diameter.

The Callitris clumps appear to have escaped fire, and the old clumps may be all that survived the last fire. Accumulation of leaf litter, dead trees, branches and twigs, particularly under the Callitris (see Plate 7.2) and the presence of large Triodia irritans rings provide evidence of old unburned habitats.

Apart from a few small areas in the quadrat there are not many young seedlings regenerating. There is a relatively large patch in the north-eastern corner where there are juvenile Callitris, and within the VSA there are dozens of Solanum sp. seedlings suggesting small, localized disturbance. (See also discussion on VSA groundcover.)

There are one or two very small areas of burned mallees and undergrowth, which possibly have been caused by lightning strikes. There are also numerous charcoal and ash debris mounds along the roadside after boundary clearance for a firebreak.

Of all the species that occur in the quadrat, not many were flowering, or had seeds or fruits.

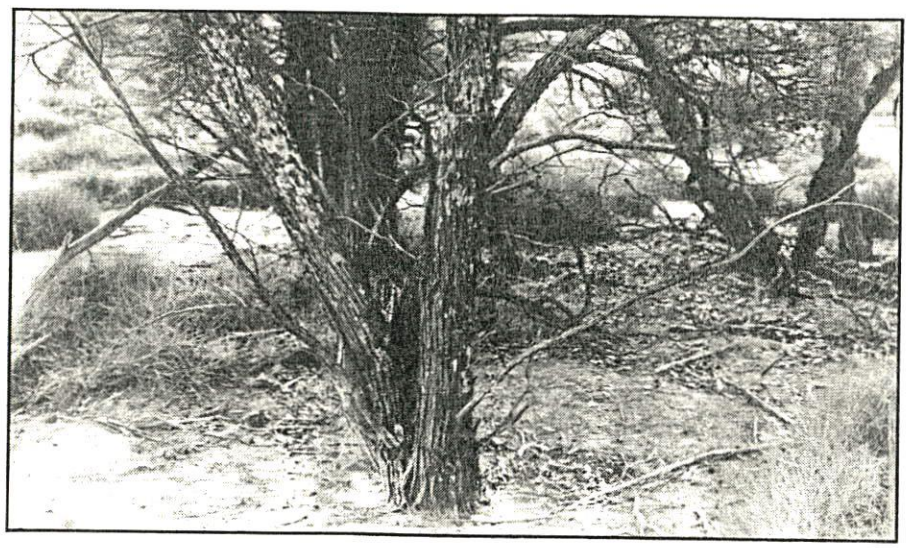


PLATE 7.2 Accumulation of leaf litter under Callitris verrucosa

Species with most individuals flowering included Podolepis cappilaris, Eremophila scoparia, E. glabra, Lomandra leucocephala, Vittadinia cuneata and V. triloba, and ones that had only some or one individual flowering included Zygophyllum apiculatum (one), Cassia nemophila var. coriacea (one), Scaevola depauperata (one) and Westringia rigida (few). Hakea tephrosperma had either fruiting bodies or flower buds in the axils. Solanum coactiliferum and Duboisia hopwoodii were also flowering, but mostly outside the quadrat. The different bunchgrasses were not flowering and this made the species difficult to determine. At least 3 different species were distinguished and further studies should be done to determine the species.

Species that had seed pods were Acacia brachybotrya (most individuals), Acacia wilhelmiana and Acacia colletioides (some individuals). Most of the Callitris verrucosa also had seeds. Species that had fruits were Maireana triptera, Chenopodium gaudichaudianum, Enchylaena tomentosa and Dissocarpus paradoxus.

7.3.4 Vegetation and Soils

The depth of lime, salinity and pH of the soil appeared to determine the distribution of growth of several important plant species within the quadrat.

On the crests and upper dune slopes, the soil profiles were fairly deep and lime was encountered well down the profile (lime was found at 130cm depth, in the 140cm pH). These soils supported the mallee species, Eucalyptus dumosa, E. socialis, E. gracilis and E. incrassata, and Callitris verrucosa. Triodia irritans dominates the understorey down the slope and into the swales until the soil becomes too shallow and alkaline for it. Lime was encountered at 40 cm depth where the Triodia

started to disappear. E. socialis, E. dumosa and E. gracilis were present on these slopes, with a tall shrub layer consisting of Cassia nemophila var. platypoda, Acacia colletioides and Eremophila scoparia, frequently reaching heights of two metres.

In the lowest parts of the swales large, open areas of ground exist, dotted with Maireana triptera and M. georgei. M. georgei also occurs on the crest (ground cover VSA), so does not seem to be affected by depth, lime or drainage. Mosses were also more evident than on the slopes suggesting damper conditions.

7.3.5 Microhabitats

From observations in the field, and the placing of traps, four distinct microhabitats were identified and recorded in the EB2 quadrat.

The tree and shrub foliage provides shelter and food for many bird and insect species. Numerous caterpillar nests were observed in the mallees and other invertebrates were evident in all vegetation types.

Hummock grasses, Triodia irritans are a safe shelter for small mammals, reptiles (in particular, large number of Ctenophorus fordi observed near Triodia irritans) and a variety of invertebrates. Burrows of reptiles and large inch ants, of the genus Myrmecia were found amongst the hummock grasses which were also used as Kangaroo wallows.

Leaf litter provides shelter and food for ants and other invertebrates while hollow logs and trees are suitable refuges for some reptile and bat species.

The sandy soils provided an excellent microhabitat for burrowing animals. The dune slopes and swales, in particular, had numerous burrows of scorpions, ants, spiders and reptiles.

7.3.6 Conclusions

The differences in the results of these two quantitative vegetation sample methods reflect the different techniques and areas examined. The main differences are that the point quarter method does not consider hummock grass or bunchgrass and can only be compared with the > 50cm layer VSA, and that the point quarter transects ran basically east-west for approximately 375 metres along the dune crest and swale, and the VSA ran north-south from a crest and partly downslope.

It can be seen from Tables 7.3 and 7.4 that many of the species that occur in both point quarter transects and both ends of the VSA are the same, and similarities are seen in comparing Figs. 7.4 and 7.6, although Fig. 7.4 is based on importance value and Fig. 7.6 is based on number of individuals.

From Fig. 7.4 it can be seen that Eucalyptus dumosa is common both on the crest and in the swale, as opposed to the VSA results (Fig. 7.6), where it is far less frequent than Callitris on the crest. Within the VSA it is more frequent at the downslope end, than on the crest. The other mallee species, E. gracilis and E. socialis are important in the point quarter swale transect (Fig. 7.4), but they also occur in much lower numbers in the VSA (Fig. 7.6).

The diversity of small shrubs that occurred in the point quarter swale transect only, reflects the fact that the swale transect was in a much lower area than the downslope end of the VSA (Fig. 7.4).

There seemed to be larger accumulations of dead branches and leaf litter under Callitris, and this may affect the area's fire potential. The Callitris trees seem to have escaped or resisted fire, but whether or not the dead branches and leaf litter would carry a mallee-type fire, could be the basis for a further study. To determine the area's fire potential, an examination of leaf litter accumulation in the mallee-Triodia areas would also be required.

The results of qualitative surveys (transect nodes) show a distribution of patches, the dominant species in each patch and the life forms present. This method enables vegetation mapping and description of life forms in each patch. Fig. 7.10 shows the proportion of the three dominant species for each life form (according to Muir, 1977). For example, Triodia irritans was the only species of hummock grass present and is therefore one hundred percent dominant in the H life form.

In contrast, the percentage of J life form was spread evenly between three different species throughout the quadrat, though this life form as a whole was less abundant (see Fig. 7.11). Fig. 7.11 shows how frequently each life form (according to Muir, 1977) was encountered. It also shows for each life form, the number of times each canopy class was recorded. From the data presented it is obvious that the herb layer (J) mosses and lichens (X and Li) and trees between five and fifteen metres (LA) played little importance in the quadrat.

The mallees (KS and KT), shrubs (SC and SD) and hummock grasses (H) were the most common life forms in the quadrat, but most often occurring as sparse or very sparse, but sometimes bordering on mid-dense.

7.3.7 Comparisons/Similarities

In comparing this quadrat with a similar Mallee-Triodia dune quadrat sampled in 1988 (Canopus 9), some interesting comparisons can be made. Like EB2, the mallees were sparse in canopy cover, and similarly the dominant species were Eucalyptus socialis and Eucalyptus dumosa though Eucalyptus gracilis was also equal in dominance in EB2.

In order of dominance, the shrub species of EB2 were Cassia nemophila platypoda, Acacia wilhelmiana and Beyeria opaca, which differed from Ca9 shrubs - Dodonaea angustissima, Cassia nemophila platypoda and Cassia nemophila zygophylla. The predominant canopy cover for all shrubs in both quadrats was very sparse (r).

Hummock grass (Triodia irritans) was the dominant grass species in both quadrats and was recorded as mid-dense. The only life forms which did differ in canopy cover between the quadrats were bunchgrass (sparse in Ca9 and very sparse in EB2) and the major difference occurred in the lichen cover which was recorded as dense (70-100%) in Ca9 and as very sparse (2-10%) in EB2. In EB2, lichen cover seemed to be predominant in the swales, whereas Ca9 noted that the cover was constant over dune and swale.

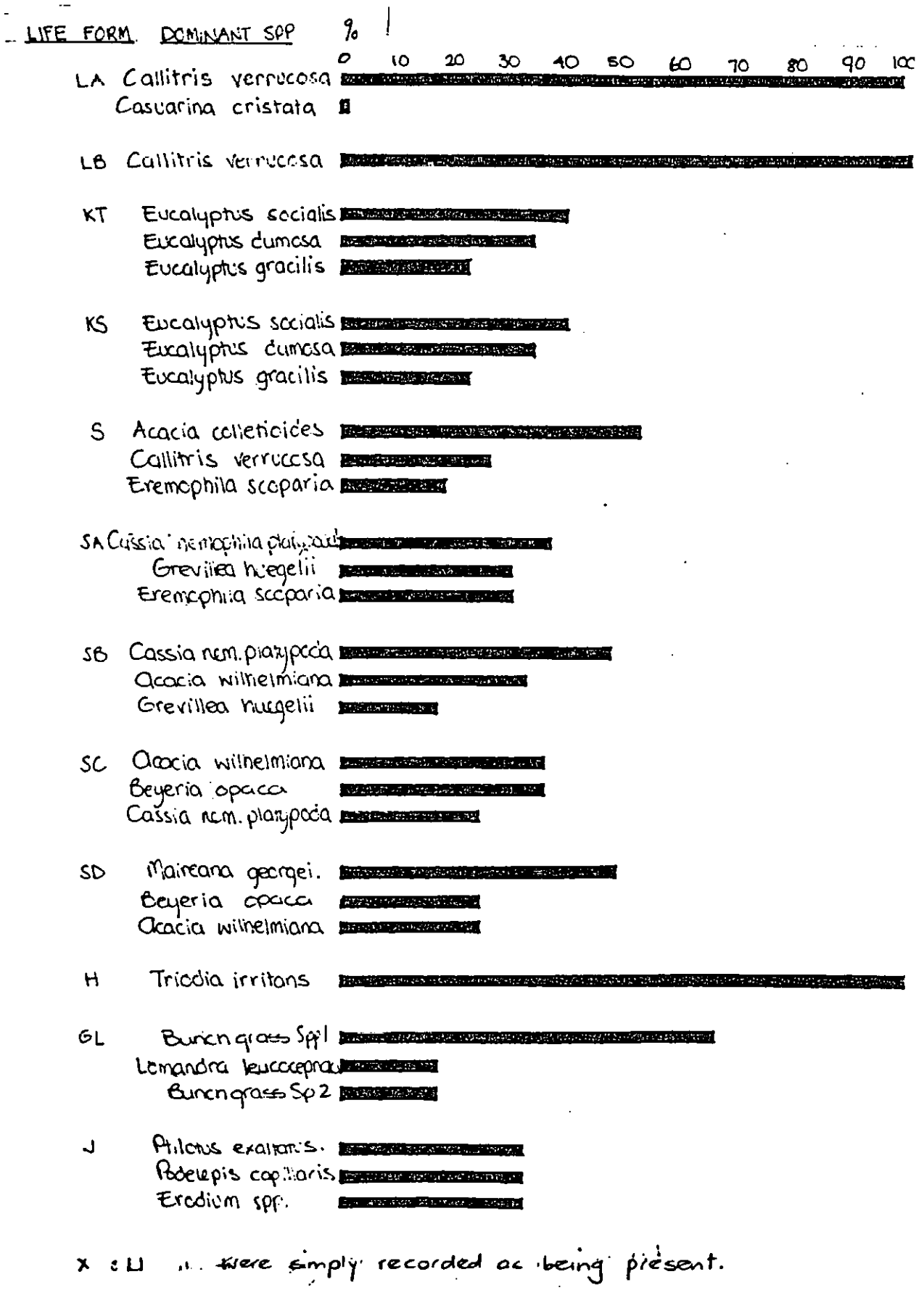


FIGURE 7.10 Dominant species for each Life form (Muir, 1977)

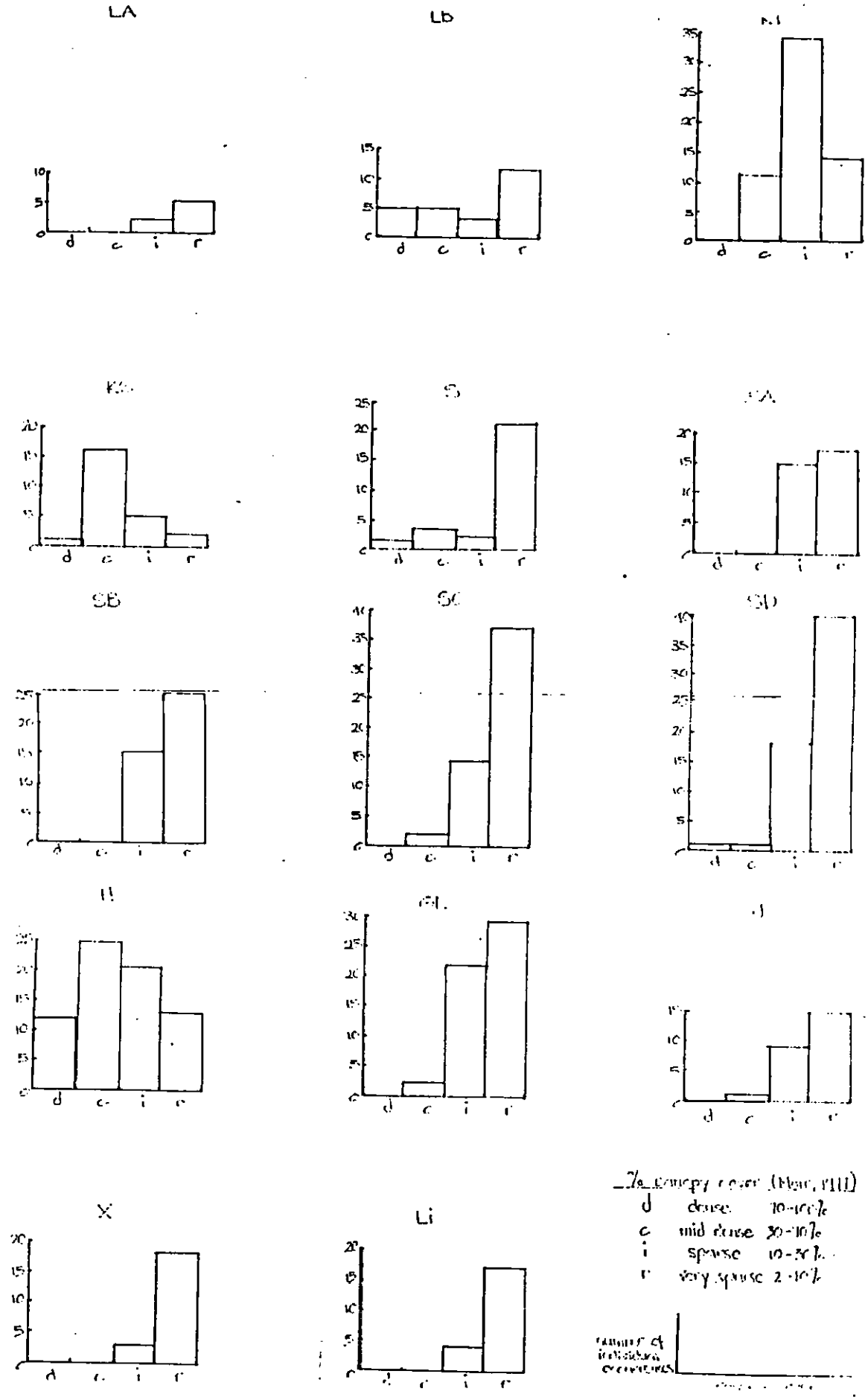


FIGURE 7.11 Number of occurrences of each Canopy Cover within each Life form

7.4 Fauna

7.4.1 Birds

The study of birds was carried out using the standard method (see Section 2.0), observations being made over four transect lines, as shown in Fig. 7.1. Recordings were done for three mornings from 7.00 a.m. to 9.00 a.m., when it was hoped that bird activity would be at its highest. The transect method appeared more effective as the study went on, as birds and their calls became more familiar and people became more confident in identification.

Approximately twenty percent of the total quadrat area was surveyed equivalent to approximately sixteen hectares each day. Hardly any birds were seen in the cleared area along the track side, possibly due to a lack of resources and shelter.

More than three hundred individual birds comprising some twenty-three species were observed during transects. The density of birds in the area was approximately seven birds per hectare. The density for individual bird species can be seen in Table 7.5. Considering the inexperience of the observers the densities should be considered to be minimum values.

Table 7.5 lists all the bird species that were positively identified in the EB2 quadrat and where they most often occurred when observed. Casual observations were also recorded where possible.

Six species of honeyeater, one species of pardalote and the Jacky Winter, were most common in the mallee/Triodia/Callitris quadrat. Casual observations of Willie Wagtails (Rhipidura leucophrys) were frequent around the campsite, though sightings were low during the survey. Hardly any birds were seen in Callitris pine trees. Woodswallows were seen and heard in large flocks, flying high overhead. Yellow-plumed and Grey-fronted Honeyeaters (Lichenostomus ornatus and L. plumulus) in particular were seen at all times in the quadrat.

The majority of birds observed in EB2 were perched in mallee trees (7-9m), foraging or resting while flying through, such as the Yellow-plumed Honeyeater, often seen in groups of three or four. Striated Pardalotes (Pardalotus striatus) were quite common in medium sized mallee trees (4-6m), possibly feeding on insects on tree foliage, in groups of two or three. Spiny-cheeked Honeyeaters (Acanthogenys rufogularis) and White-browed Babblers (Pomatostomus superciliosus) were usually seen and heard, flying low in surrounding scrub areas, possibly feeding at ground level and behaving territorially. The striated Grass Wren (Amytornis striatus) was the only bird seen to be actually hanging from the stout spines of a Triodia bush, possibly foraging at ground level for insects.

Some birds seemed to be passing through the quadrat, occasionally resting while flying through, such as a group of Major Mitchell Cockatoos (Malacorhynchus membranaceus) and a group of Red-rumped Parrots, seen perched high in the mallee branches. A wedge-tailed Eagle (Aquila audax) was observed flying high over the quadrat, possibly searching for small mammals and reptiles.

Rare sightings of birds included those of Willie Wagtails (during the transects), Red-capped Robins (Petroica goodenovii), Hooded Robins (Melanodryas cucullata) and Brown treecreepers (Climacteris picumnus).

TABLE 7.5 Summary of bird transect data from Mallee/Triodia/Callitris habitat, EB2

Common Name	Total No. sighted	Density	Comments
Spiny cheeked honeyeater	31	0.70/ha	In mallee/triodia and surrounding scrub areas
Striated grass wren	2	0.03/ha	In mallee/triodia
Wedge-tailed eagle	1	0.02/ha	Flying high overhead
+White browed woodswallow	80+	1.70/ha	In flocks flying overhead
Major Mitchell	3	0.06/ha	Flying low over scrub flat
Brown treecreeper	3	0.06/ha	In mallee/triodia
Grey shrike thrush	7	0.14/ha	In mallee and calitris and blackoak trees
Emu	-		Tracks only seen. 1 leg found in fence
White eared honeyeater	1	0.02/ha	In mallee/triodia
Yellow plumed honeyeater	42	0.90/ha	Common in mallee/triodia
White plumed honeyeater	1	0.02/ha	In mallee/triodia
Grey fronted honeyeater	58	1.25/ha	Common in mallee/triodia
Hooded robin	2	0.03/ha	Low in Acacia colletioides
Yellow-fronted honeyeater	6	0.13/ha	In mallee/triodia
Jacky Winter	8	0.16/ha	In mallee/triodia
Scarlet chested parrot	6	0.13/ha	In mallee/triodia
Striated pardalote	40	0.83/ha	Common in the lower branches of mallee trees
Red-capped robin	4	0.08/ha	In open mallee/triodia
Chestnut crowned babbler	1	0.02/ha	In mallee/triodia
White browed babbler	4	0.08/ha	Low in Acacia colletioides
Red rumped parrot	4	0.08/ha	In mallee/triodia
Mulga parrot	5	0.10/ha	In higher branches of mallees
Willie wagtail	4	0.08/ha	In callitris and mallee/triodia
Weebill	13	0.27/ha	Common in mallee/triodia
Scrub wren	1	0.02/ha	In mallee/triodia
Total species 25	330+		

+ The plus sign indicatess 'probably more' as a result of large flyovers where definite numbers were unsure.

NOTE: Scientific bird names are given in Appendix 7.5A.

Willie Wagtails and several other species, including White-eared Honeyeaster (Lichenostomus leucotis) were frequently seen outside the study time, possibly preparing to venture out in later hours of the day.

Because nests were not exactly numerous in the quadrat, it is difficult to know whether any of the bird species were in fact residential to the area, or simply using the site as a fly through area. A greater in-depth study would be required to determine this.

A comparison of bird species and numbers from previous years and this year in Mallee/Triodia is given in Table 7.6. Differences in results may be due to such factors as weather conditions at the time. For example, in 1987, it rained heavily late in the year, as compared to this year's heavy mid-Autumn rains, this may influence species richness and the amount of growth existing from area to area. Therefore, the appearances of bird species numbers may depend upon their own resource utilization according to the resources available.

TABLE 7.6 Birds recorded in Mallee/Triodia quadrats in 1986, 1987, 1988 and 1989

	CA3 1986	CA6 1987	CA9 1988	EB2 1989
Yellow-plumed Honeyeater	36	4	5	42
Weebill	-	-	39	13
Striated Pardalote	2	-	7	40
Mallee Ringneck	44	-	2	-
Grey-fronted Honeyeater	5	-	-	58
Spiny-cheeked Honeyeater	12	7	6	31
White-browed Woodswallow	-	-	-	80+
Wedge-tailed Eagle	1	-	-	1
Splendid Fairywren	4	-	1	-
Grey Shrikethrush	6	-	-	7

There were, however, deficiencies with the study, which need mentioning. Before the study was undertaken, little time was spent studying the birds of the area because more attention was being paid to other work. There may have been several more species in the quadrat, which we were too slow to recognise. The data therefore, may be rather deficient.

7.4.2 Invertebrates

7.4.2.1 Introduction

The techniques used to sample the invertebrates in quadrat EB2 were large pitfalls, micropitfalls and plant beatings (see Section 2.0). The results (Table 7.7) indicate that the most successful technique used was micropitfalls. This technique captured the highest diversity as well as the highest number of invertebrates. Invertebrates were not caught by hand. 104 species were caught which is considerably more than in any quadrat in the 1988 study.

TABLE 7.7 Summary of Invertebrates recorded in EB2

* Number of different species

ORDER	Large Pitfalls	Micro-Pitfalls	Plant Beating	Total No. of diff. species.
Acarina	1(23)	1(14)		1
Aranaea	8(42)	13(49)	4(5)	18
Blattodea	1(42)	2(4)		3
Coleoptera	5(45)	8(51)	2(2)	12
Collembola		1(1)		1
Diptera		14(100)	1(2)	15
Hemiptera		3(4)	8(8)	11
Hymenoptera (Non-ants)	2(4)	2(4)	1(13)	3
Hymenoptera (Ants)	12(193+)	22(1293)	1(2)	25
Isoptera	1(1)		1(1)	1
Lepidoptera	1(3)	1(1)	1(1)	3
Lerps			1(5)	1
Mollusca		1(1)		1
Orthoptera	3(13)	2(2)		4
Psocoptera		1(1)	1(6)	2
Scorpionidae	1(2)			1
Thysonura	1(3)			1
Isopoda	(1)			1
Total	36(366)	71(1525)	21(45)	(104)

* Number in brackets indicates number of individuals.

\+ Actual number of individuals not recorded.

According to Appendix 7.10 and 7.11 sixty percent of large pitfalls and micropitfall were distributed in Mallee/Callitris vegetation and forty percent were distributed in Mallee vegetation.

The invertebrates caught were divided into Ants and Non-Ants. Ants were identified to genus and given the same voucher numbers as the College's voucher specimens (Appendix 7.7). The Non-Ants were only identified to Order and given a voucher number (Appendix 7.6). Ants were the most numerous groups (1482+ individuals from 25 species) (Table 7.7). It should be noted that the large pitfall results are not considered very reliable because of inconsistent methods used in recording data. Most ants were found in the micropitfalls and large pitfalls while only two individuals were found during plant beatings. This may indicate that ants are more active on the ground, living and foraging there, but may also be due to seasonal factors (see below).

7.4.2.2 Plant Beating

The plant beatings were carried out around the VSA on the three dominant tree and shrub species of the quadrat. The low number of ants recorded on the plants could also be attributed to the time of year and absence of flowers and nectar and low number of honey-dew producing insects, available as a food source. Trees and shrubs support honey-dew producing insects (Greenslade, 1979). Beyeria opaca produced the most diverse results (Table 7.8) with seven species of invertebrate being recorded. Callitris verrucosa had only three invertebrate species recorded which could imply that it is not a preferred habitat of invertebrates.

TABLE 7.8 Invertebrate Species recorded by Plant Beating in EB2 by Vegetation type

Eucalyptus socialis	=	Es)	
Eucalyptus dumosa	=	Ed)	Trees
Callitris verrucosa	=	Cv)	
Acacia wilhelmiana	=	Aw)	
Olearia subspicata	=	Os)	Shrubs
Beyeria opaca	=	Bo)	

	Microhabitat					
ORDER	Es	Ed	Cv	Aw	Os	Bo
Aranaea	1		1	1		1
Coleoptera	1					1
Diptera					1	
Hemiptera	2			1	2	3
Hymenoptera				1		
Hymenoptera (Ants)	1					
Isoptera			1			
Lepidoptera					1	
Lerps	1	1				
Psocoptera			1			2
Total (Different Species)	6	1	3	3	4	7

Eucalyptus dumosa had only one species of invertebrates recorded whilst Eucalyptus socialis had six species (Table 7.8). E. dumosa has rather leathery leaves which may not be as palatable as the softer E. socialis leaves. Other factors affect palatability including toxins and chemicals present in the plants. Hemiptera species were by far the most abundant group found on the plants, having a total of eight different species (Appendix 7.8). No Hemiptera species were found on C. verrucosa or E. dumosa.

7.4.2.3 Large Pitfalls

In the large pitfalls more Cockroaches (Blattodea), Spiders (Aranaea) and Beetles (Coleoptera) species were caught, than other non-ant species (Appendix 7.6). Blattodea sp 1 had the highest frequency of non-ants captured. This indicates that this species is not restricted by a plant community and can forage anywhere due to the wide distribution in both Mallee/Callitris and Mallee communities.

Appendix 7.7 shows very few Iridomyrmex species were caught and Rhytidoponera species were more abundant. These results may indicate when the dominant Iridomyrmex species are less abundant the opportunist Rhytidoponera increases its number. It is also possible that the generally smaller Iridomyrmex species were able to climb out of the pitfalls (via Triodia stems) or were overlooked. The pitfalls were designed for the capture of small mammals. Placement of pitfalls near nests influences the number of individuals caught of one species. There were many nests of Myrmecia sp 2 around the large pitfalls and a corresponding high number of individuals were caught.

7.4.2.4 Micropitfalls

In the micropitfalls more Aranaea and Diptera species were caught than other non-ant species. Appendix 7.6 shows Aranaea sp 7, Coleoptera sp 6 and Diptera sp 1 were the most abundant non-ant species with Diptera sp 1 having the highest frequency. The large number of Diptera species caught could be due to the attraction of the methylated spirits in the micro-pitfalls.

Iridomyrmex sp 2 had the highest frequency and was by far the most abundant Ant species captured (Appendix 7.7). Iridomyrmex species are aggressive and capable of monopolising resources limiting the presence of other Ant species. This corresponds with Greenslade (1979) who states that Iridomyrmex species generally dominate associations of ant species. Rhytidoponera species were found in over half the micropitfalls but had a low abundance. According to Greenslade (1979) Rhytidoponera are the second most abundant ant in the quadrat.

7.4.2.5 Discussion

Many Non-ant species were found or caught in both micropitfalls and large pitfalls (Appendix 7.5). There were 49 different species caught in the micropitfalls compared to 24 in the large pitfalls. These results indicate that the micropitfalls are the best method for invertebrate capture.

TABLE 7.9 Greenslade's Functional groups of EB2

Functional Groups	Micropitfalls No. species	Micropitfalls No. Indiv.	Micropitfalls Frequency*	Large Pitfalls No. species	Large Pitfalls No. Indiv.	Large Pitfalls Frequency**
1. Dominant Species Iridomyrmex	3	1148	90%	2	8+	10%
2. Subordinate Species Camponotus	4	8	10%	2	9	15%
3a Hot Climate specialists Mercinoplus	2	5	10%			
4a Cryptic Species Aphaenogaster Chelaner	2	25	25%			
4b Sub-cryptic Species Polyractris Calomyrmex Stigmacros	4	12	10%	2	13	30%
5. Opportunists Rhytidoponera	3	76	60%	3	97+	70%
6. Generalized Myrmicines	4	19	125%	1	13	10%
7. Large solitary foragers Myrmecia				2	53+	45%

* Frequency - % of pitfalls genus found in

** Micropitfall data not reliable for numbers of individuals

Table 7.9 shows the different frequencies of the functional groups of Ants (Greenslade, 1984). The dominant species Iridomyrmex is the most abundant in the quadrat and it appears that the little disturbance in the area allows the species to become established and reduce the ant species numbers.

Table 7.10 shows there is a difference in the individual numbers/pitfall of Iridomyrmex sp 2 between the two vegetation types, with higher numbers/pitfall being trapped in the Mallee/Callitris than the Mallee. The Mallee has approximately three times the number of Rhytidoponera species compared to the Mallee/Callitris, however, the average numbers are very small.

TABLE 7.10 Average Number of Individuals/Pitfall

	Mallee	Mallee/Callitris
Iridomyrmex sp 2	22.6	31.6
Rhytidoponera	3.0	1.1

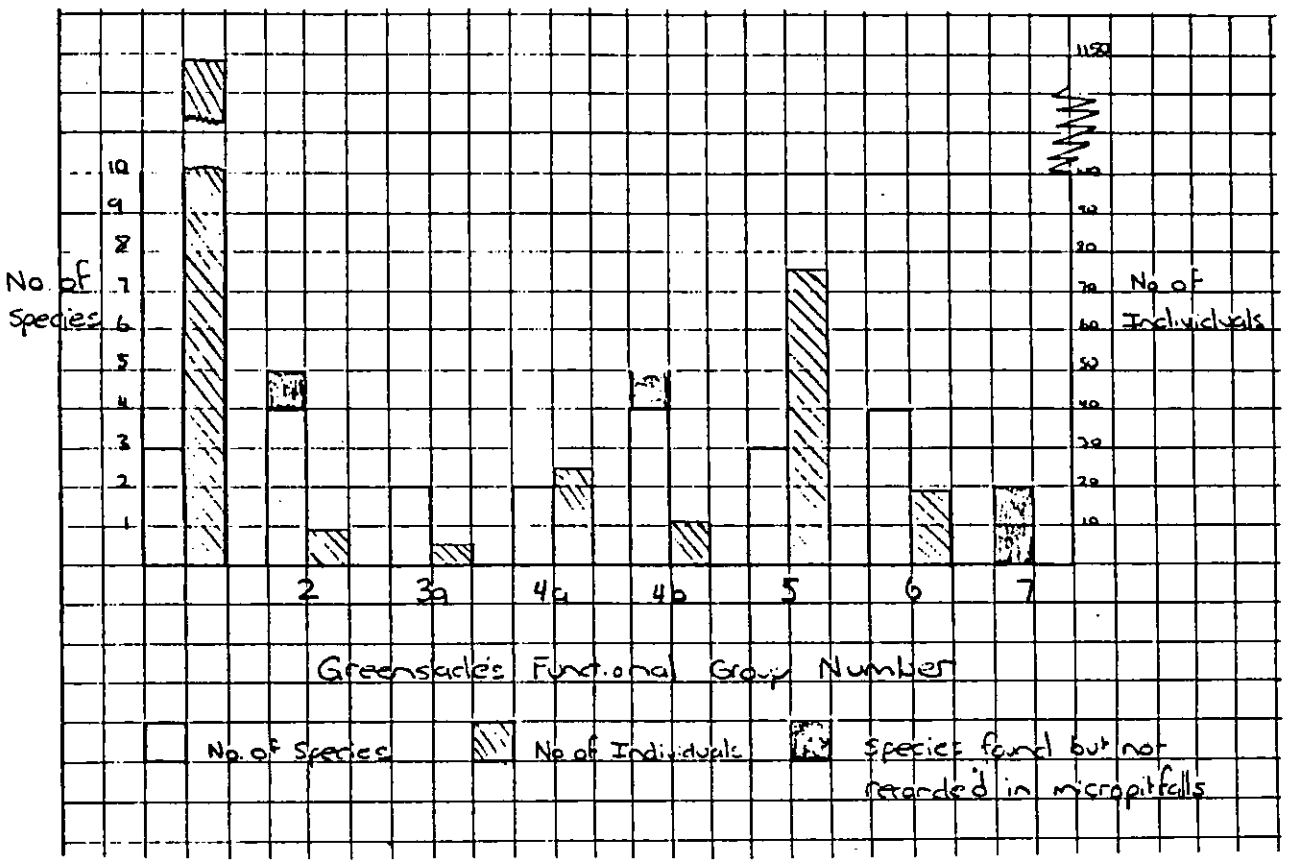


FIGURE 7.12 Greenslade's Functional Groups - Micropitfalls

Fig. 7.12 shows the subordinate species (2) Camponotus with the largest number of species yet one of the lowest number of individuals. The inability to compete with the dominant Iridomyrmex species reduces the numbers of Camponotus and Meranoplus. The low number of Meranoplus could also be attributed to the fact it is a hot climate specialist and it was early winter when the study was carried out. Greenslade (1979) states that the majority of all these species are diurnal and therefore competition would be high for the available resources.

Appendix 7.9 shows the assemblages of ants trapped in micropitfalls in the two communities were somewhat different. Eight species were only found in Mallee/Callitris, six only in Mallee and the other eight species were common to both communities. However, frequencies and numbers are too small to draw any conclusions with the possible exception of Iridomyrmex species 2 and Rhytidoponera species 1/2. Appendix 7.9 also shows only one Camponotus species was trapped (species 2) in Mallee, yet three different Camponotus species were trapped in Mallee/Callitris. This could suggest that the Mallee/Callitris is a more diverse habitat providing greater food resources. According to Greenslade (1979) the ideal situation for ants consists of a mosaic of bare soil and areas of herbs, small shrubs and grasses under a canopy of trees and taller shrubs.

Iridomyrmex species numbers are higher in Mallee/Callitris possibly preferring this type of habitat. Rhytidoponera species numbers are higher in the Mallee, being opportunists they could make use of the available resources and increase their numbers (Appendix 7.10).

7.4.3 Reptiles of EB2

In the Mallee/Triodia/Callitris community of EB2, there was a total of six species of reptile and one species of amphibian identified. Several new species were identified, including a snake and a legless lizard. Unfortunately, no goannas were spotted in the quadrat. Details of species recorded are given in Table 7.11.

TABLE 7.11 Comparison of Reptile species recorded in the Mallee/Triodia quadrats CA3, CA6, CA9 and EB2

SPECIES	CA3 (1986)	CA6 (1987)	CA9 (1988)	EB2 (1989)
AGAMIDAE				
Ctenophorus fordi	81		Abundant	3 caught Many seen
Ctenophorus pictus	2			
Gemmatophora nobbi				3
Pogona vitticeps	1			
PYGOPODIDAE				
Lialis burtonis			1	
Pygopus lepidopodus				1
SCINCIDAE				
Cryptoblepharus carnabyi			1	
Ctenotus atlas	2		1	1
Ctenotus schomburgkii	2		10	
Menetia greyii	2		1	2
ELAPIDAE				
Pseudonaja textilis				1
VARIANIDAE				
Varanus gouldii	1			
TOTAL SPECIES	7	6	6	6

Ctenophorus fordi was the most common lizard caught and observed in EB2. They were caught three times in pitfall traps (pitfall No. 4, No. 4 and No. 8). On the many occasions they were observed, most were not recorded on data sheets due to forgetfulness or responsibility to other duties at the time. These small dragons were seen moving around the outside edges of Triodia grass, foraging and sometimes sunning themselves on the open ground between clumps of Triodia. Ctenophorus fordi were seen at all times during daylight hours, especially, it seemed, when the sun was at its warmest. When disturbed, Ctenophorus fordi would scamper to the nearest Triodia bush or ground shelter. It could be said that Ctenophorus fordi is a territorial lizard, which likes to maintain a range around individual Triodia bushes.

Triodia irritans was also home to Ctenotus atlas and Menetia greyii, both of which were sighted only a few times. Both skinks were hand captured moving into Triodia bushes, while Menetia greyii was also captured in pitfall trap No. 10.

A single Common scaly-foot (see Plate 7.3) was hand caught in the area, moving swiftly on the ground into a dead log. Pygopus lepidopodus has not been recorded in Mallee/Triodia communities in previous years (see Table 7.11).

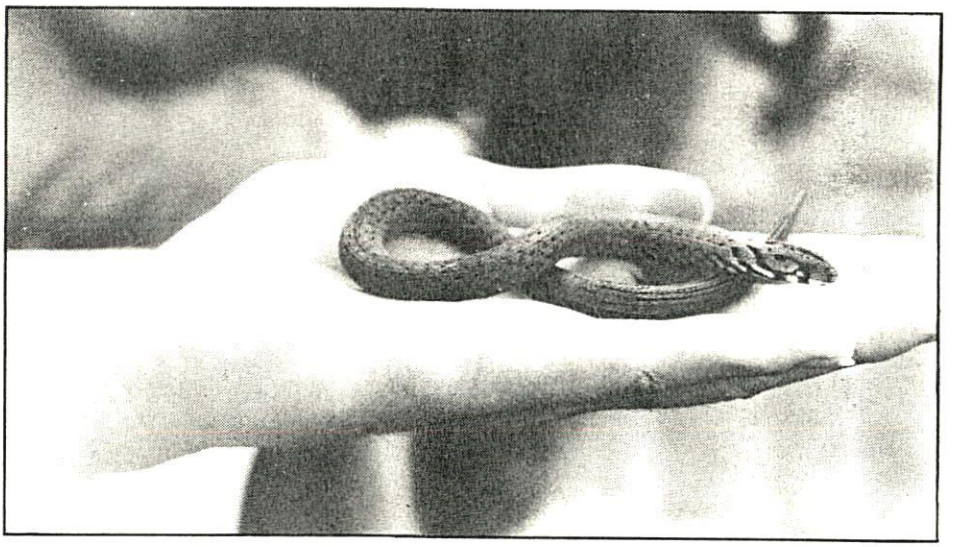


PLATE 7.3 The Common Scaly-foot Lizard, Pygopus lepidopus

A juvenile Eastern-brown snake, Pseudo naja textilis was observed sitting coiled on a Mallee/Callitris dune crest probably sunning itself. It disappeared down a nearby hole when approached.

Gemmatophora nobbi, also, have never been observed in Mallee/Triodia communities in previous years. Three individuals were all hand captured moving from bare ground into or under vegetation cover. Gemmatophora nobbi were only observed in later daylight hours around the vicinity of the campsite.

The only species of amphibian identified in EB2 was found in an area of Callitris vegetation, in pitfall trap 1/S, Neobatrachus sudelli, was approximately 60mm long, rather rotund and drab in colour.

It was hard to catch, let alone identify, many reptile individuals because of the speed at which they retreat at the sight of people. Only two reptile species, Ctenophorus fordi and Menetia greyii were actually caught in pitfall traps in Triodia areas.

Apart from Gemmatophora nobbi and Pygopus lepidopus, all the lizard species had previously been recorded in Mallee/Triodia communities.

7.4.4 Mammals

Mammal trapping, using standard techniques described in Section 2.0, was carried out at EB2. Locations of pitfall and Elliot traps are given in Fig. 7.13. Observations and signs of mammals were also recorded and all results of mammal evidence is summarised in Table 7.12. Figs. 7.13 and 7.14 show details of the microhabitats to be found at the pitfall locations and Table 7.13 shows success of trapping techniques used on mammals.

TABLE 7.12 Mammal evidence at EB2

NAME	No. seen	Method	Comments
Macropus rufus	3	Observed, tracks, scats, hollows	Amongst Mallee
Ningaui yvonneae	2	Longline pitfalls 5 & 7	Mallee/pine transition area
Pseudomys bolami	1	Elliots, amongst Callitris	Some individuals caught on two separate occasions
Sminthopsis murina	1	Longline pitfall 8	Mallee
Chalinolobus picatus	1	1 dead bat, many heard	Found hanging on the border fence
Mus domesticus	7	5 captured Elliots, 2 in single pitfall 4c	Mainly amongst Callitris, particularly evident after rains
Capra hircus	-	Tracks and scats	Amongst Mallee, none seen
Unidentified	1	Elliot	In Callitris, probably M. domesticus

TABLE 7.13 Method of Mammal Capture and Habitat Type

Trap-type	No. caught Callitris	No. caught Mallee	Total	Species
Longline pitfalls	-	3	3	All native marsupials
Single pitfalls	2	-	2	Mus domesticus
Elliot traps	6	1	7	1 P. bolami, 5 M. domesticus, 1 unidentified

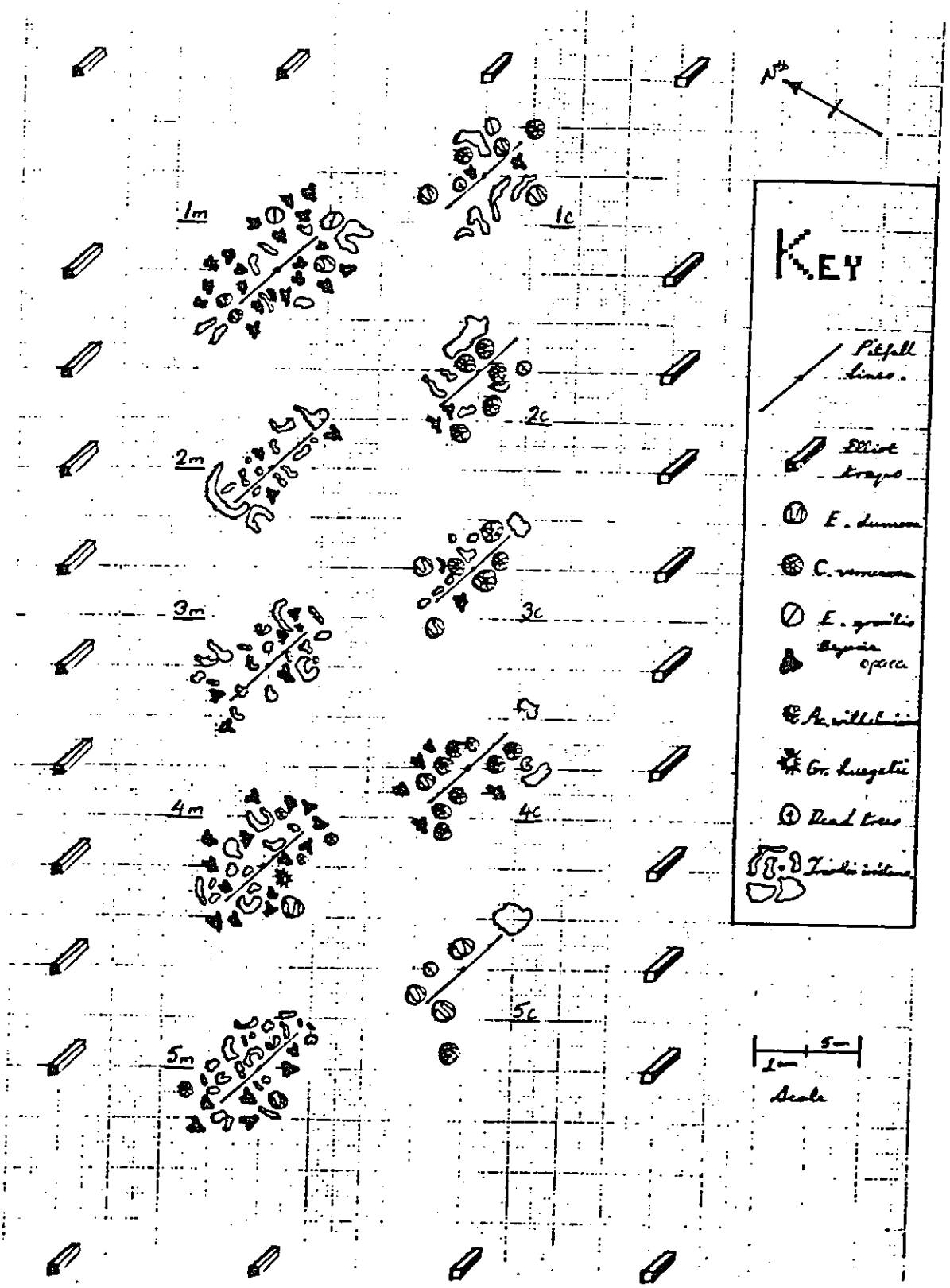


FIGURE 7.13 EB2 - North Pitfall Vegetation Types
EB2 - North Single Pitfall Line, Macrohabitats

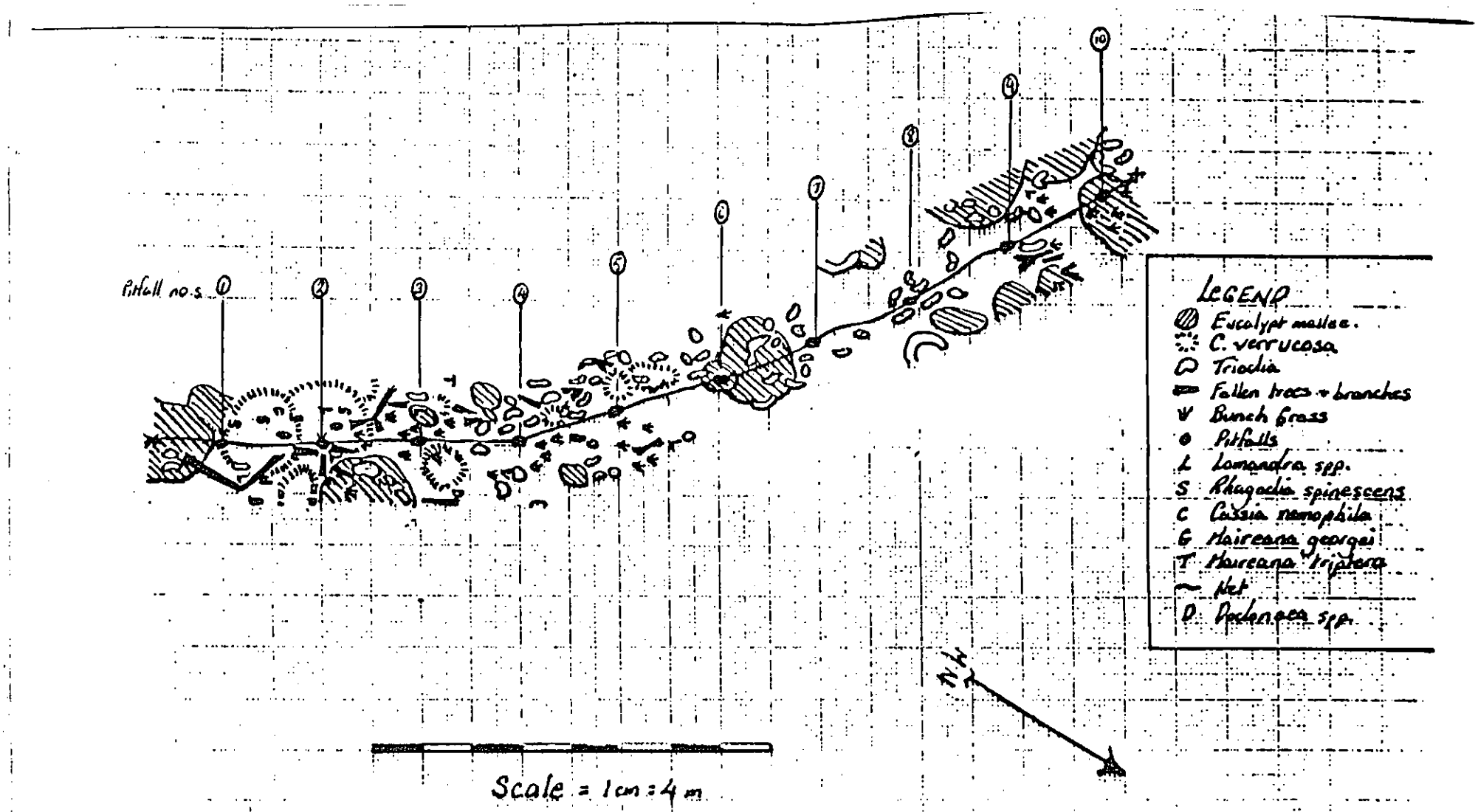


FIGURE 7.14 EB2S - Vegetation of longline pitfalls

7.4.4.1 Discussion

All of the marsupials captured were in the longline pitfall area but this area appeared to be relatively free of common house mice (Mus domesticus), by far the most common mammal captured. The area in which house mice were not captured was the only area in which small native marsupials were captured, however capture numbers are too small to suggest any causes for these observations.

Callitris stands appear to be offering M. domesticus a habitat which it can exploit better than native mammals. All native mammals captured at EB2 were very near transition areas between Callitris and Mallee habitats while M. domesticus were found mainly within the Callitris, with only one captured at a transition area on the mallee side.

One day of continuous rain saw an increase in capture of M. domesticus. The morning following the heavy rains resulted in the capture of six M. domesticus, five of these in Elliot traps. One native mouse (Pseudomys bolami) capture in bedraggled condition within the Callitris also indicates that there may be problems for this species when competing with M. domesticus for a habitat.

The trapping technique used appears to influence the type of mammal captured. A bait mix of honey, rolled oats and peanut paste used in Elliot traps is successful for catching M. domesticus. P. bolami was also captured in this way and it appears this technique is the most successful way of capturing small carnivore rodents. As no Elliots were set in the area of the longline pitfalls it is difficult to tell whether in fact M. domesticus and native marsupials are sharing the same area. A Common dunnart (Sminthopus murina) was captured in Elliots at the EB1 quadrat, indicating that small marsupials are susceptible to Elliot capture. The differing diets of small insectivore marsupials may require varying baits than that of M. domesticus for a higher capture rate.

Faulty and unsuitable equipment made bat sampling impossible. There is a need for further studies of bats at EB2. The Little pied-bat (Chalinolobus picatus) found dead on the border fence and the sounds of bats flying overhead in the evenings indicated the presence of bats at EB2.

The observation of only three kangaroos at the quadrat indicate the likelihood of only a minor population in the area. Scats, tracks and nesting hollows beneath mallees and large Acacia colletioides shrubs further indicated some kangaroo visitation, however the lack of a permanent watering point within the quadrat would probably keep numbers low.

No goats were seen in the quadrat, although fresh tracks and scats indicated their presence. The lack of a watering point would also influence goat populations and it appears that the effect may be higher than that on kangaroos. Watering points provide a resource suitable for large mammal grazers. If watering points do have the effect of increasing goat populations, then the removing of dams in the park would seem to be a desirable objective.

In summary, it appears that Elliot traps are the most successful way of capturing Mus domesticus and longline pitfalls are suitable for the capture of small native marsupials. M. domesticus may compete successfully with native omnivores in Callitris stands and may be restricting the range of native marsupials. The area is not a very suitable habitat for large grazing mammals due to the lack of a permanent watering point.

7.5 Conclusions

In quadrat EB2 the Mallee/Callitris and Mallee communities provide suitable habitats for various fauna species.

Mus domesticus was the most common mammal captured. Most of the mammals captured were caught in the areas of transition between the two plant communities. Following heavy rain there was an increase in the number of mammals caught in the Elliot traps.

The other mammal species caught included Pseudomys bolami with a Ningaui species and Sminthopsis murina trapped in large pitfalls, probably caught while hunting.

Although no bats were captured, they were heard every evening around the camp on the edge of the quadrat.

Because there was no permanent water in the quadrat larger mammals were rarely seen. Three kangaroos were observed as well as tracks and scats of goats.

The reptiles were found mainly around Triodia irritans, with Ctenophorus fordi being the most common lizard. Two rarely seen species in the park were observed, Pygopus lepidopodus and Gemmatophora nobbi.

The birds most observed were the honeyeaters, particularly the spiny-cheeked, yellow-plumed and grey fronted species and striated pardalotes. Above the quadrat groups of white-browed woodswallows were commonly seen.

The invertebrates were by far the most common fauna in the quadrat. An Iridomyrmex species were the most abundant and are the dominant group of ants. Possibly due to the little disturbance in the quadrat, the Iridomyrmex species has been able to dominate the area. In areas where there were fewer Iridomyrmex, the Rhytidoponera species (opportunists) were greater in number although the Iridomyrmex were still by far the most abundant.

Non-ant species were well represented in the quadrat particularly Aranaea, Blattodea, and Diptera species.

7.5.1 Future Studies

There are many interesting topics in EB2 quadrat which would warrant future study. These include:

- find out the age and placement of the Callitris stands - with special attention to the younger trees on the North of the quadrat.
- are Callitris clumps fire resistant?
- what feeds on Callitris - if anything?
- accumulation of Callitris litter - are there toxins in it?
- why little else, but small Chenopods grow under Callitris.
- ongoing monitoring of fauna which uses the Callitris - for food, shelter, refuge.

- why is Acacia wilhelmiana growing in such abundance yet there is little or no evidence of disturbance by fire.

- explore the run-on area in the Southwestern corner of the quadrat and determine the species richness of bird-life present.

- why were a large number of scorpion holes present yet very few were observed or caught in traps.

- determine which species of bunchgrass are present - Enneapogon Amphipogon, Stipa, or otherwise.

- are mice out-competing Pseudomys and possibly affecting carnivorous marsupials.

7.5.2 Habitat Value

The quadrat was of relatively high conservation value. This was due to a number of factors.

Firstly, the Callitris verrucosa stands are infrequent throughout Danggali Conservation Park and are possibly several hundred years old (R. Clay, pers. comment). The Callitris is restricted to the dune crests in EB2 preferring the deep sandy soil. Due to the small percentage of Callitris in the Park it is important that the stands be preserved.

In a portion of the quadrat it was noted that there was regeneration of the Callitris and these need to be closely monitored. Protection of this area would provide a greater source of information for future study.

It should also be noted that Acacia wilhelmiana was found to be one of the dominant shrubs in the quadrat and has not been recorded in previous studies to date.

Fauna increased the habitat value of the area. Many species of birds, mammals and reptiles were recorded and the species diversity of invertebrates was exceptionally high.

7.5.3 Management Implications

As this is the first detailed study of this habitat type in Danggali C.P., the data compiled is an important starting point for management decisions of these areas within the Park.

The study has shown this habitat type is rich in bird, mammal and invertebrate species and as large stands of Callitris verrucosa and Acacia wilhelmiana are not common in the Park, management should ensure these areas are properly monitored, protected and maintained.

As fire is thought to kill Callitris and regenerate Acacia wilhelmiana careful consideration is needed in deciding upon what fire management strategy is appropriate for these areas.

Pest species in the quadrat included mice (captured), foxes (tracks) and goats (scats and tracks). Monitoring of the pest species should be carried out (especially on the house mouse whose capture rate was high) to determine the effect on the native fauna and flora through competition, predation and grazing.

The disturbed zone (Fire break) which borders this habitat has factors which should be monitored and evaluated for action such as rabbits utilizing banked up earth (resulting from mechanical disturbance) for burrows and the encroachment of pest plant species from this zone into adjoining areas.

8.0 EASTERN BOUNDARY 3 (EB3) : Burned Mallee Dunes with Native Poplar

8.1 Quadrat Description

Eastern Boundary 3 (EB3) was established adjacent to the New South Wales border, approximately 70km from Canopus Homestead (999382). It is marked by a permanent marker in the northeast corner which is 4.35km north of the netting fence junction. There is a N.P.W.S. photopoint marker on the New South Wales border fence 144m south of this point. It was located in an area burned by the 1985 fires and placed so as to include stands of Native Poplar (Codonocarpus cotinifolius).

The Eastern Boundary 3 quadrat (1km x 1 km), was composed of sandplains, undulating dunes and claypans. The landform types within the quadrat were mapped (see Fig. 8.1). A tree cover of burned mallee regrowth (KS, Muir's Code) covered 90% of the area. 2% was composed of unburned KT mallee. Native Poplar was confined to the crests of dunes and made up 8% of the quadrat.

The quadrat provides a number of landforms each having an influence on vegetation types. However, the fires of 1985, in conjunction with several good seasons of rainfall, have induced many plant species to grow which would be rare, or absent, in an area unburned for many years. Diversity of fauna, on the other hand, was low. Fires have destroyed habitats but as vegetation recovers and surface litter is restored the number of species of animals would be expected to rise.

8.2 Landforms and Soils

8.2.1 Relationship between Landforms and Soils

A soil sampling site was established on the northeast corner of the quadrat at the base of the dune. The texture was found to be consistent throughout the profile (Appendix 8.1).

Northcote (1971) states that a sandy loam texture classifies as a Vc 5.31 soil (see Appendix 8.1). The soil structure is massive throughout. There was an increase in alkalinity down the profile from pH8 to pH9 using the C.S.I.R.O. pH colour chart. This may have been due to the salinity levels increasing down the profile from 0.04 millisiemens at 50cm in depth to 0.74 millisiemens at 70cm in depth. Sandplains occupy approximately 35% of the quadrat. The surface sand layer is weakly coherent. It has a slight potential to be eroded. This was seen when channels were cut by surface runoff after consistent rain on 30/4/89. The upper soil profile would have little fertility due to the sand particle size and lack of clay particles. Sandplain areas do not hold water for long periods of time due to the substantial soil porosity.

Claypans occupy approximately 41% of the quadrat. Clay forms a thin crust on the surface soil forming a very shallow claypan. Surface runoff from surrounding areas collects in these depressions but the water is not retained for long because of the lack of depth in the clay. Water transports mineral and plant matter into these pans. This provides more nutrients to this area and in association with water availability, allows greater plant diversity and density to exist. Decomposition would be greater in these areas due to higher soil moisture and water availability.

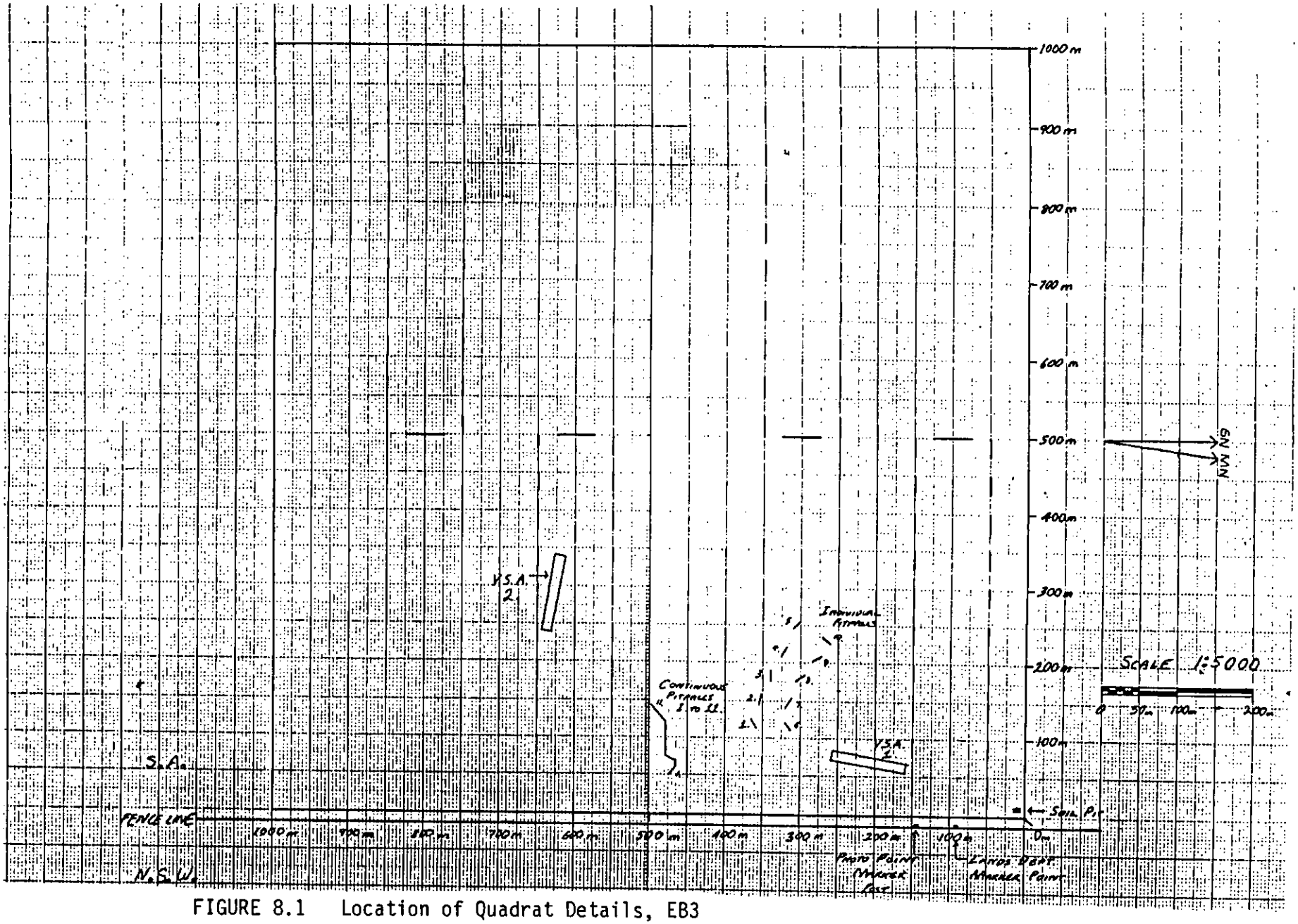


FIGURE 8.1 Location of Quadrat Details, EB3

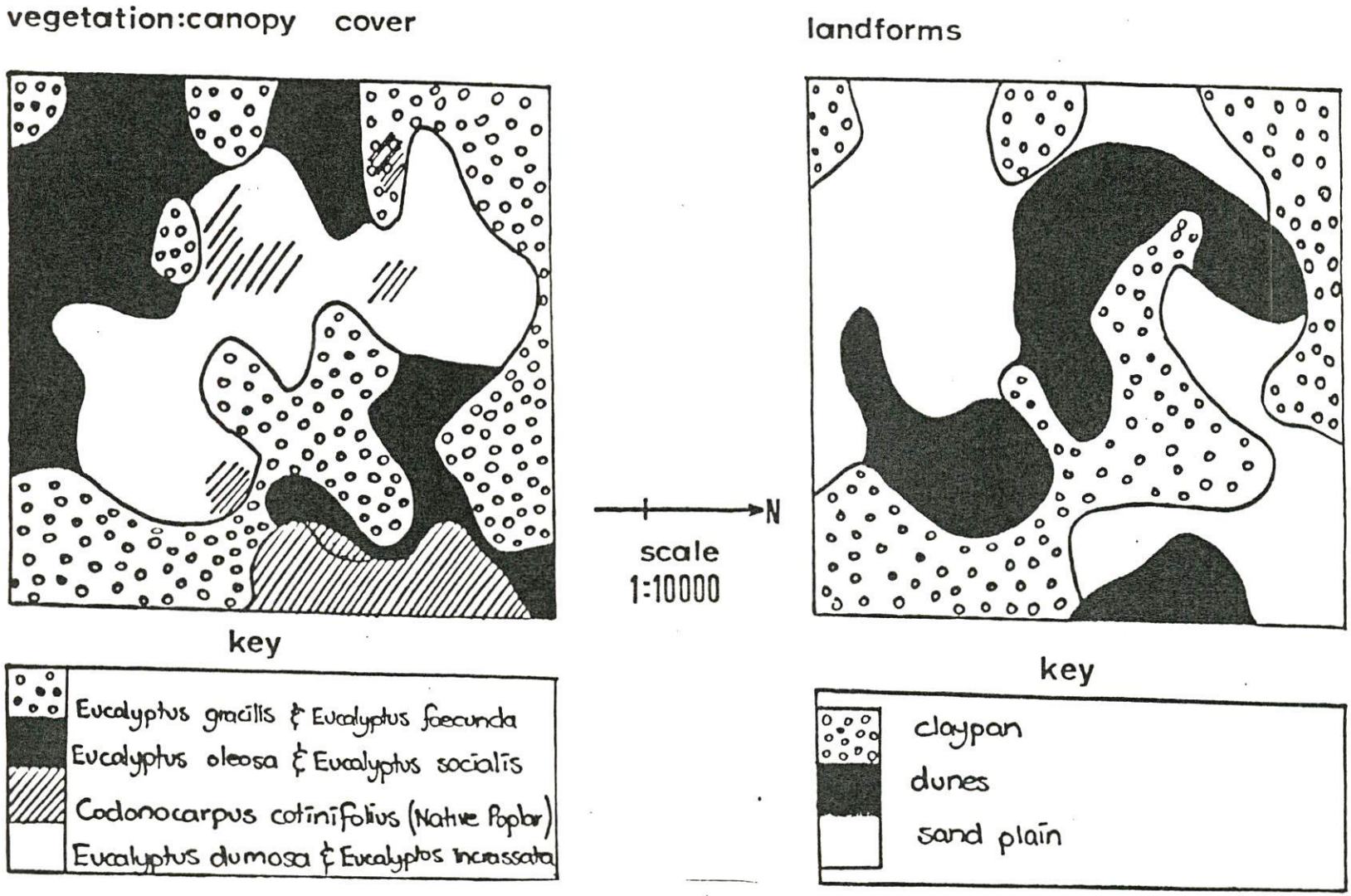


FIGURE 8.2 Vegetation: canopy cover. Landforms. EB3 Quadrat

The dunes, occupying about 24% of the quadrat, are of substantial height (see Fig. 8.2). Due to their sandy texture, soils have low fertility and little capacity to hold water. This is shown by the absence of a microphytic layer.

8.3 Flora, Vegetation and Habitat Types

8.3.1 Qualitative Description

The quadrat was qualitatively sampled along ten 1-kilometre transects. From these, information concerning species dominance and habitat types was recorded. This information was used to compile a vegetation map of the entire quadrat which is illustrated in Fig. 8.3.

The EB3 quadrat consisted of four major types of habitat or 'patches'. The major types of habitat were: Desert Poplar, Mallee-Triodia, Mallee-Shrub and Mixed Shrub. Muir's Code (Muir, 1977) was used to classify them and to determine relative canopy cover by noting the three most numerous species in each stratum. The plant species which had a canopy cover of 10-30% or greater were classified as being dominant.

The Desert Poplar area was classified as a low woodland, with a low open shrub understorey (Muir, 1977). This habitat type occupied 5% of the quadrat (Plate 8.1).

PLATE 8.1 Desert Poplar Shrub, 3 years growth
Codonocarpus cotinifolius

The tree canopy was dominated by desert poplar, *Codonocarpus cotinifolius*. The diameter of the canopy of individual desert poplars ranged from 0.5 to 1 metre. Small sparse stands of *Codonocarpus cotinifolius* were recorded as being present in the Mallee-Triodia patch, mostly on dune crests.

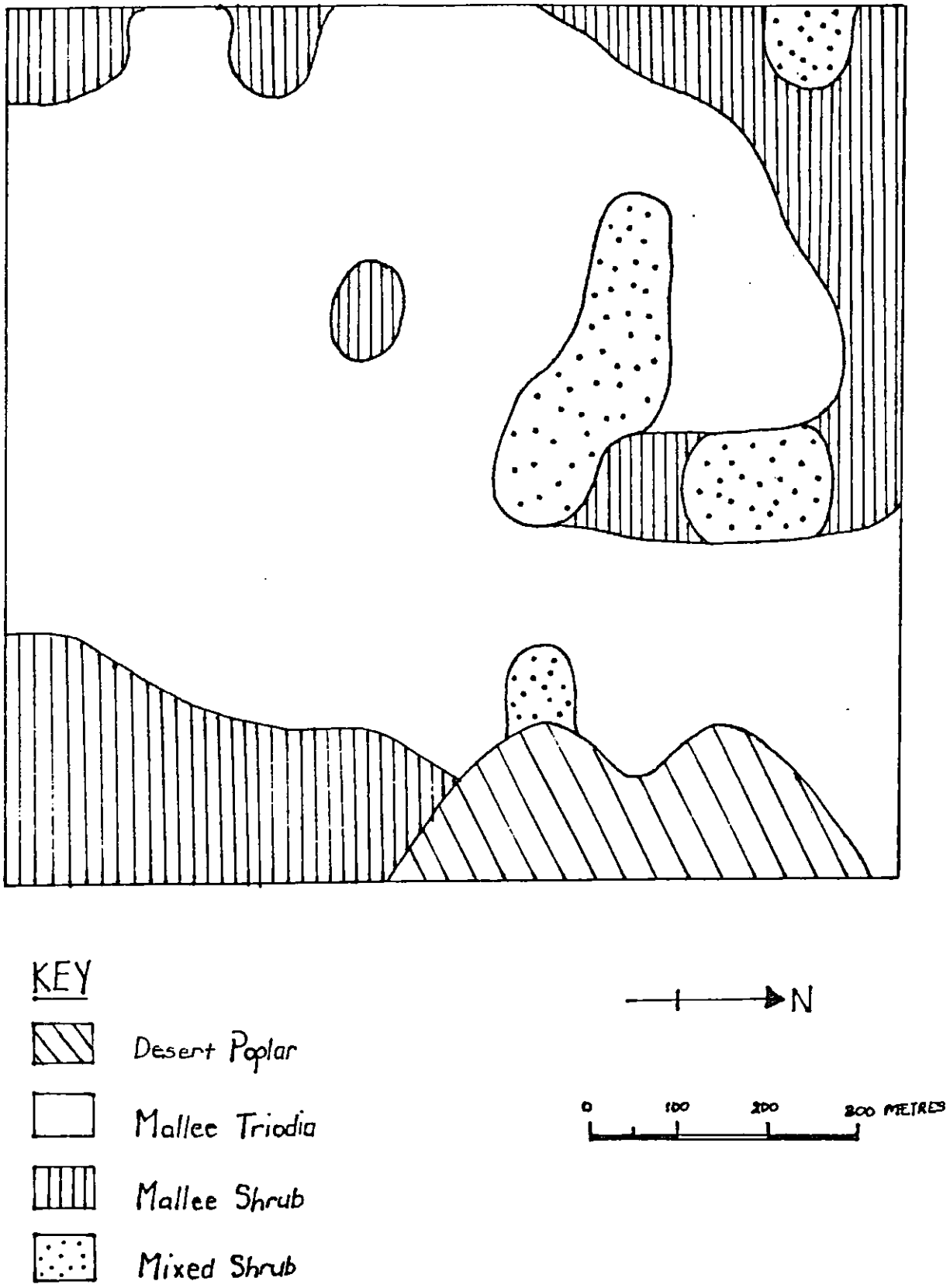


FIGURE 8.3 Vegetation Habitat types, EB3 quadrat

The dominant shrub mallee species included white mallee, Eucalyptus dumosa and ridge fruit mallee, Eucalyptus incrassata. These species had an average canopy diameter of 2 metres. The subshrub species which dominated this patch included: pituri, Duboisia hopwoodii, rough halgania, Halgania cyanea, felted nightshade, Solanum coactiliferum, and Eremophila decipiens. The canopy diameter of these species ranged between 30-70cm.

Porcupine grass, Triodia irritans dominated the groundcover with an average diameter of the hummocks of 10-55cm. A microphytic layer of mainly lichen was present, although moss and algae was found to cover most of the quadrat, but absent from the loose sandy soiled dunes and sandplains.

The Mallee-Triodia habitat type was classified as a low open shrubland, with a low open ground layer (Muir, 1977). (Plate 8.2)

PLATE 8.2 Mallee-Triodia area

This vegetation type occupied approximately 65% of the quadrat. The original canopy had been burned in December 1985, and except for scattered individuals, the May 1989 height of the regenerated canopy was well below 3 metres. For this reason, mallees are described as shrub life forms.

Yorrell, Eucalyptus gracilis, white mallee, Eucalyptus dumosa, and summer red mallee, Eucalyptus socialis were the dominant shrub mallees. These species had an average canopy diameter of 2 metres. The less common shrub mallee species were narrow-leaved red mallee, Eucalyptus foecunda, and ridge fruit mallee, Eucalyptus incrassata. The dominant subshrub species were similar to those of the Desert Poplar habitat type and also had similar average diameters.

Of the groundcover, Triodia irritans dominated the grasses with an average diameter of the hummocks of 30-70cm. Tall greybeard, Amphipogon caricinus was also common. The average diameter ranged from 15 to 25cm. Due to loose sandy soil a microphytic layer which mainly consisted of lichen was present.

The Mallee-Shrub habitat type was classified as a low open shrubland with a sparse shrub understorey (Muir, 1977). This patch covered approximately 20% of the quadrat.

The dominant shrub mallees were similar to those present in the Mallee-Triodia patch, although red mallee, Eucalyptus oleosa, was found only in the Mallee-Shrub patch. The average canopy diameter of these species was 2 metres. Other shrub species included: the four subspecies of desert cassia, Cassia nemophila, broom emubush, Eremophila scoparia, and sandhill wattle, Acacia burkittii. The average canopy diameter was 0.5 - 1 metre.

The shrub understorey consisted of a wide variety of subshrub species. The dominant species included: felted nightshade, Solanum coactiliferum; grey copper burr, Sclerolaena diacantha; and three-winged bluebush, Maireana triptera. These species had an average canopy diameter of 30-70cm. Several species, such as erect mallee bluebush, Maireana pentatropis, thorny saltbush, Rhagodia spinescens, bitter mallee saltbush, Atripex stipitata, and desert goosefoot, Chenopodium desertorum, were also common in certain areas within the patch. Here again, Amphipogon caricinus and Triodia irritans were noted as dominant groundcover species. Moss and algae made up most of the microphytic layer. Clumps of mixed shrubs were regularly found scattered throughout the quadrat.

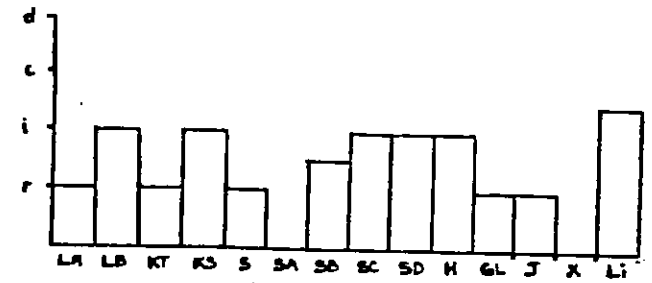
Overall, this habitat type covered approximately 15% of the quadrat and was classified as a tall shrubland with an open groundcover (Muir, 1977).

The dominant shrub species were similar to those present in the Mallee-Shrub patch. However, species such as wait-a-while, Acacia colletioides and turpentine bush, Eremophila sturtii were also commonly found growing within this patch. These species varied in height from 0.5 to 2 metres. Subshrub species are once again similar to those of the Mallee-Shrub patch. Several species which were different included, black fuschia, Eremophila glabra and ruby saltbush, Enchylaena tomentosa.

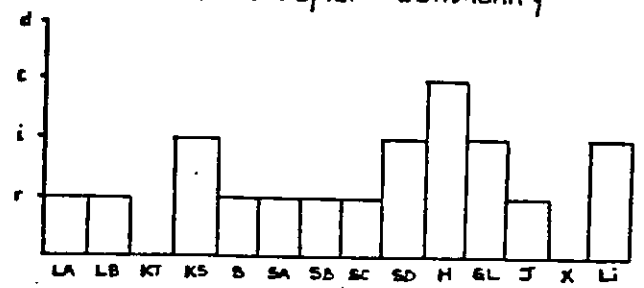
The groundcover was dominated by Amphipogon caricinus and Triodia irritans. Even so, both species were seen to be less abundant than in the other types of habitats. A microphytic layer of moss and lichen was also present.

Tree species such as blackoak, Casuarina cristata, bullock bush, Heterodendrum oleaefolium and sugarwood, Myoporum platycarpum were recorded in very sparse isolated patches in some of the habitat types, therefore were not considered as dominant species. A complete species list is shown in Appendix 8.2. The large number of species present is consistent with the high diversity of species commonly found in recently burned mallee regions where the fire has been followed by good rainfall (Noble, 1989).

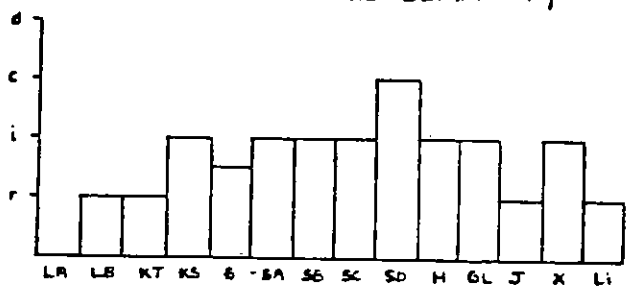
Fig. 8.4 shows the canopy cover of each life form in the major types of habitat or patches, according to Muir (1977).



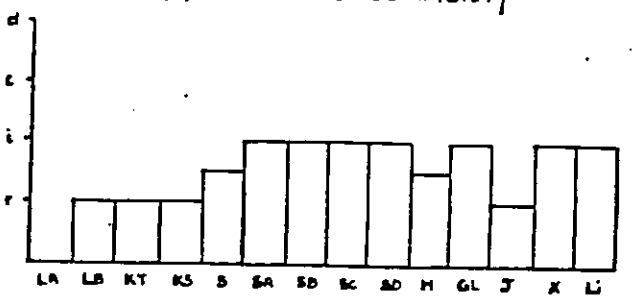
Desert Poplar community



Mallee-Triodia community



Mallee-Shrub community



Mixed Shrub community

KEY

CANOPY COVER

d ... Dense 70-100%.
c ... Mid-dense 30-70%.
i ... Sparse 10-30%.
r ... Very sparse 2-10%.

LIFE FORM

LA Trees 5-15m
LB Trees <5m
KT Mallee tree form
KS Mallee shrub form
S Shrubs >2m
SA Shrubs 1·5-2·0m
SB Shrubs 1·0-1·5m
SC Shrubs 0·5-1·0m
SD Shrubs 0·0-0·5m
H Hummock Grass
GL Bunch grass <0·5m
J Herbaceous spp.
X Mosses
Li Lichens

FIGURE 8.4 Life Form Spectrum for Each Community (Muir, 1977)

From this, we found that in the Desert Poplar community the life form LB, trees < 5 metres which mainly consisted of the species Codonocarpus cotinifolius, was common, but had a sparse canopy cover of 10-30%. This life form was less common in the other communities where desert poplar was not seen as a dominant species. Mallee trees were present but the Mallee shrub form was dominant. The understorey mainly consisted of the smaller shrub life forms which ranged in height between 0.5 - 1.5 metres. Groundcover was dominated by a sparse hummock grass life form with a mid-dense microphytic layer.

In the Mallee-Triodia community the life form KT, Mallee tree form, had been burned. All mallees were less than 5 metres high and classified as KS, Mallee shrub form. The understorey was dominated by subshrub species less than 0.5 metre in height. The groundcover was dominated by a hummock grass life form with a mid-dense canopy cover of 30-70%.

Once again, Mallee shrub form species were common with a sparse canopy cover of 10-30% throughout the Mallee-Shrub community. The understorey consisted of a variety of tall shrub life forms which ranged from 1 to 2 metres. However, the life form SD which consists of shrubs less than 0.5 metre in height were noted to be the most dominant. Groundcover consisted of both a sparse hummock grass and bunchgrass life form with a sparse microphytic layer.

The Mixed Shrub community was found to mainly consist of a variety of shrub life forms, where the species height averaged between 0.5 - 2 metres. Although these life forms were seen as common, the total estimated canopy cover was 10-30%. The groundcover was similar to those present in the Mallee-Shrub community.

The most dominant and important life forms within the entire quadrat are illustrated in Fig. 8.5. From this data, the Mallee shrub life form had the highest number of individual occurrences and therefore dominated the upperstorey throughout the quadrat. The least occurring life forms were trees 5-15 metres (LA), trees less than 5 metres (LB), and shrubs greater than 2 metres (S). This was due to the time since fire, most species having a slow growth rate.

The life form which formed the understorey in each community were the subshrubs less than 0.5 metre in height. As the shrubs increased in height their number of individual occurrences dropped. The reason for this was that a greater diversity and abundance of species were successfully regenerating after the fire. The subshrub species will continue to be conspicuous before the tree and shrub stratum completes development and becomes dominant once again.

Overall, the groundcover was dominated by the hummock grass life form due to the species, Triodia irritans being the most common, especially throughout the Mallee-Triodia patch. The microphytic layer was found to mainly consist of lichens rather than mosses.

Fig. 8.6 shows the three major species in each life form and the percentage each contributed to that life form.

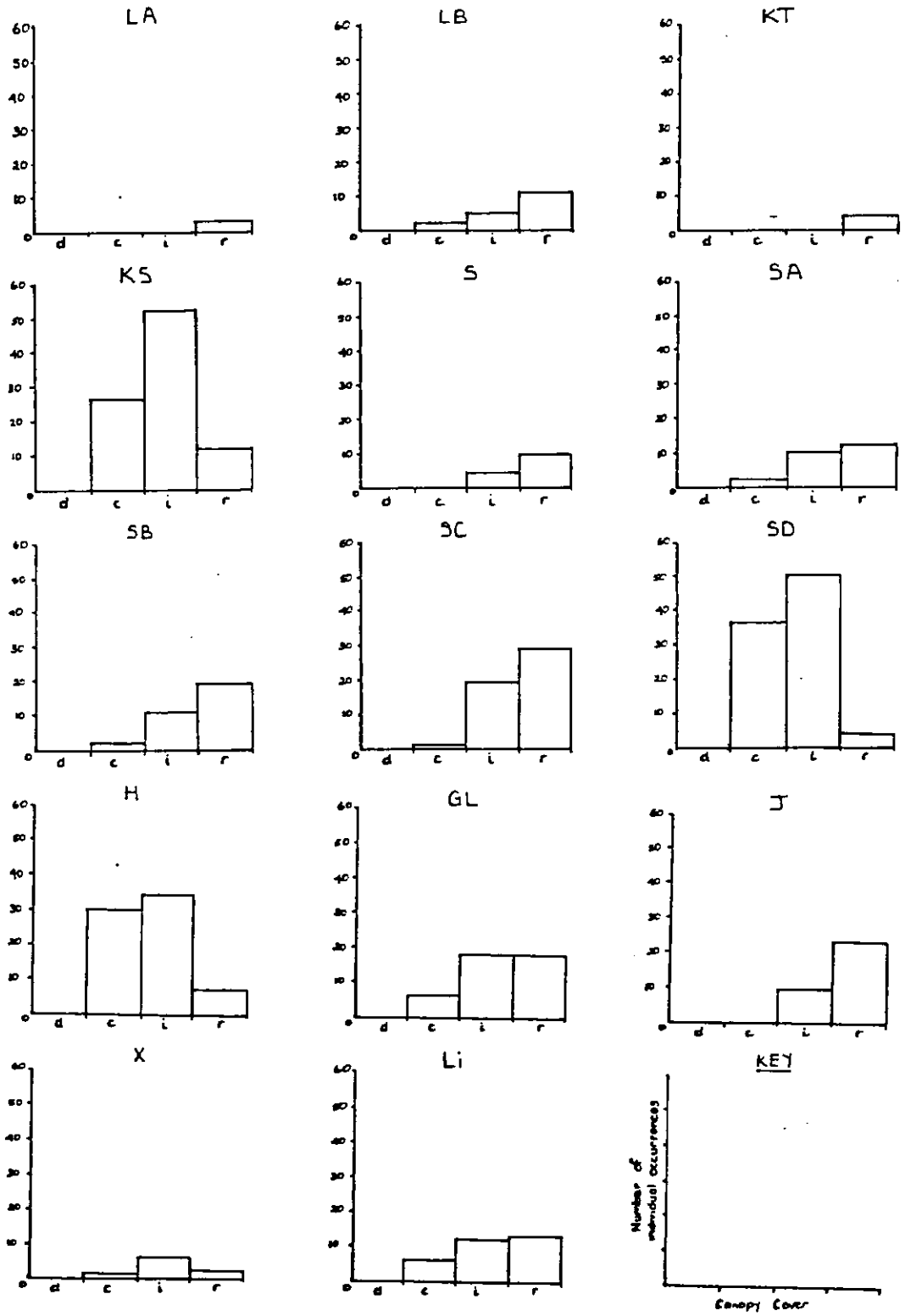


FIGURE 8.5 Number of Occurrences of each Canopy Cover within each Life Form

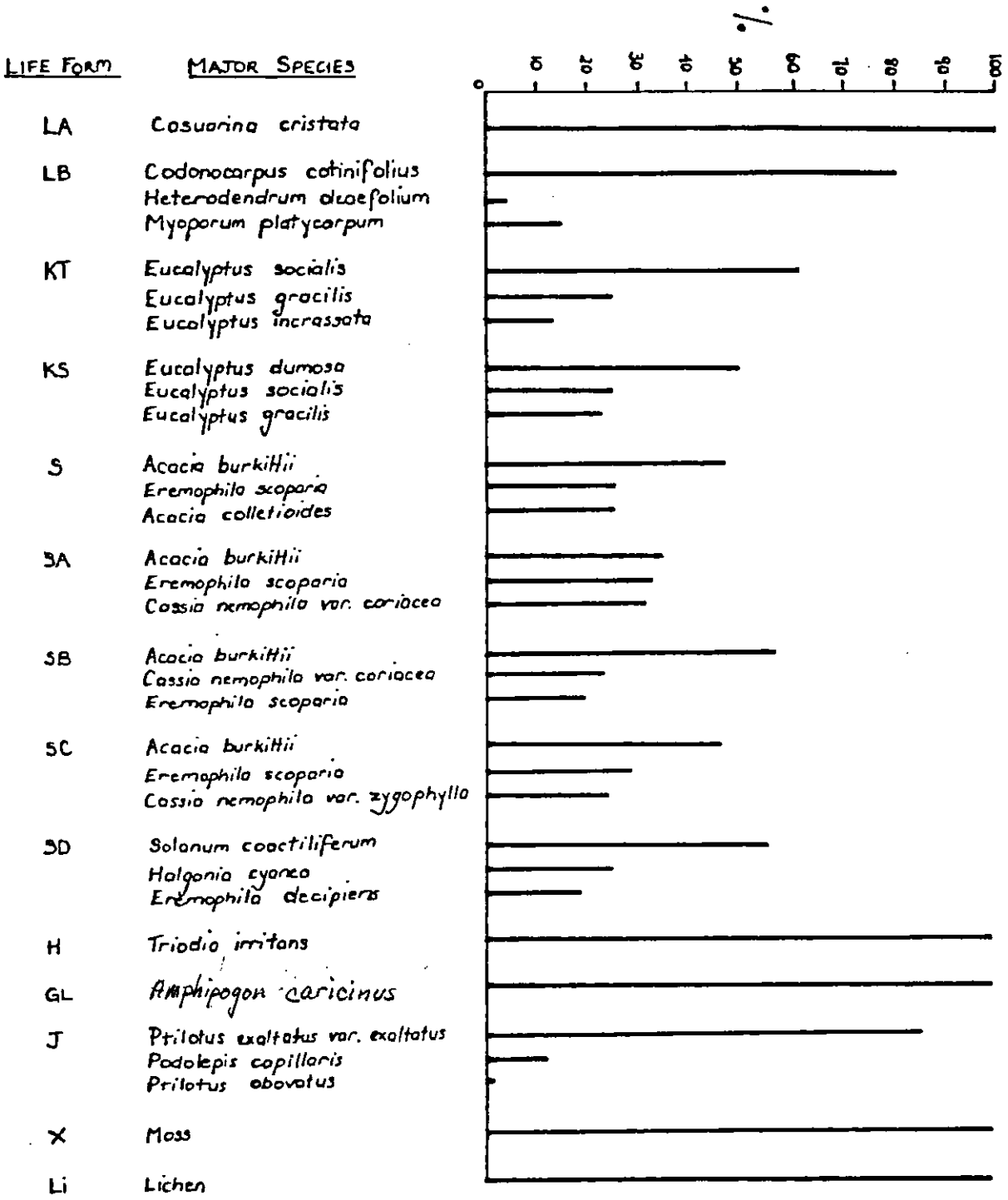


FIGURE 8.6 Major Species for each Life Form

8.3.1.1 Flowering and Fruiting

While walking along the vegetation transects, various plants were found to be flowering. The only flowering mallee shrub was Eucalyptus gracilis. The remaining mallee shrubs were in early stages of regeneration, thus fruits, buds and flowers were not present.

The shrub species found to be flowering were Eremophila scoparia and Cassia nemophila var. coriacea. Subshrub species flowering were Eremophila glabra, Eremophila decipiens, Zygophyllum apiculatum, Solanum coactiliferum and Halgania cyanea. The species Acacia acanthoclada which had been recorded for the first time growing in the area was also flowering. Its small yellow gloublar flowerheads indicated it to be an Acacia species. Flowerheads were forming on Acacia burkitti, whereas, the flowerheads of the herbaceous species, Ptilotus exaltatus var. exaltatus were dead.

The subshrub species found to be fruiting were Maireana triptera and Enchylaena tomentosa. Seed pods were present on the mature hummock grasses, Triodia irritans. The four subspecies of Cassia nemophila also had seed pods present.

8.3.2 Results of Quantitative Methods

In order to gain an idea of the abundance and diversity of species in certain plant communities within the quadrat two 15 x 100m Vegetation Sample Areas (VSA) were set up. The main concern while sampling the quadrat was to provide valid and comprehensive information on the Desert Poplar community. Therefore, a VSA was set up in this area (VSA 1) and, for comparison, another VSA was set up along a gradient from the Mallee-Triodia community to the Mallee-Shrub community (VSA 2). Within each VSA the upperstorey, understorey and groundcover was sampled using the standard method (Section 2.0). This enabled us to measure the abundance of species presently growing in the areas, which in turn, helped to determine the most commonly occurring species in each stratum.

The position of trees and shrubs above 1 metre was measured in each VSA. As a result, VSA maps were compiled which are illustrated in Fig. 8.7 (VSA 1) and Fig. 8.8 (VSA 2). The number of times each of these trees and shrubs occurred is shown in Fig. 8.9; this allows the two communities to be compared.

Within the Desert Poplar community (VSA 1) there was a low diversity of upperstorey species, with Codonocarpus cotinifolius being the most abundant. This species was unevenly distributed throughout the vegetation patch, sometimes forming small clumps and sometimes widely spaced. The least abundant species was Eucalyptus dumosa. The understorey or shrub layer was clearly dominated by Duboisia hopwoodii; it is a fast growing colonizer after fire. Acacia burkitti was also present.

In VSA 2, there was a higher diversity of species. A variety of Eucalypts formed the upperstorey. Eucalyptus gracilis occurred most frequently and Eucalyptus socialis the least frequently. Within the understorey, Eremophila scoparia was the most abundant species, next being Heterodendrum oleaefolium. However, Heterodendrum oleaefolium happened to grow only in a small area within the VSA 2 and very rarely occurred in the rest of the quadrat. The least abundant species were Cassia nemophila var. coriacea, Chenopod spp. and Maireana spp.

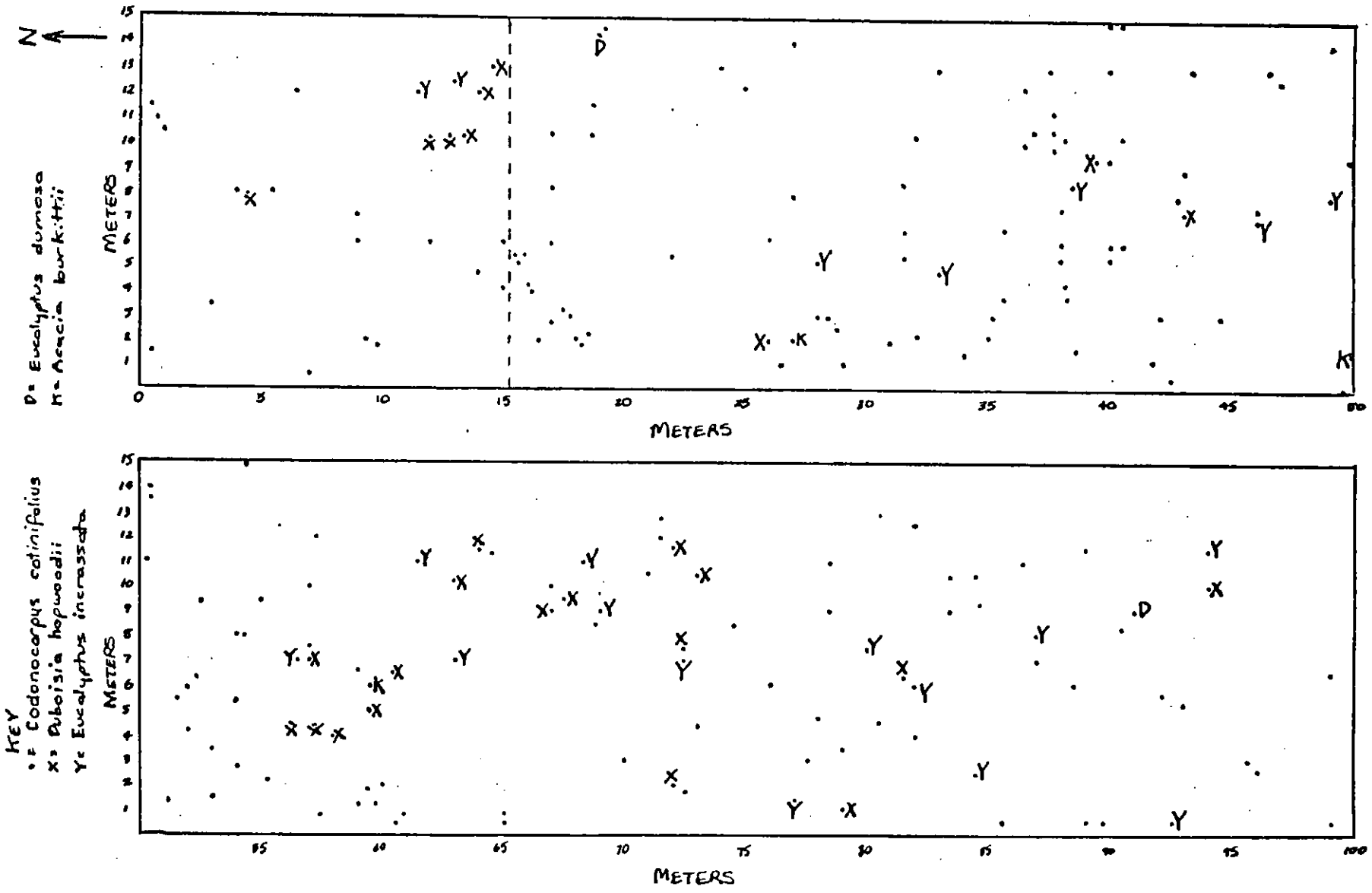


FIGURE 8.7 VSA Map for Trees and Shrubs : VSA 1. (EB3)

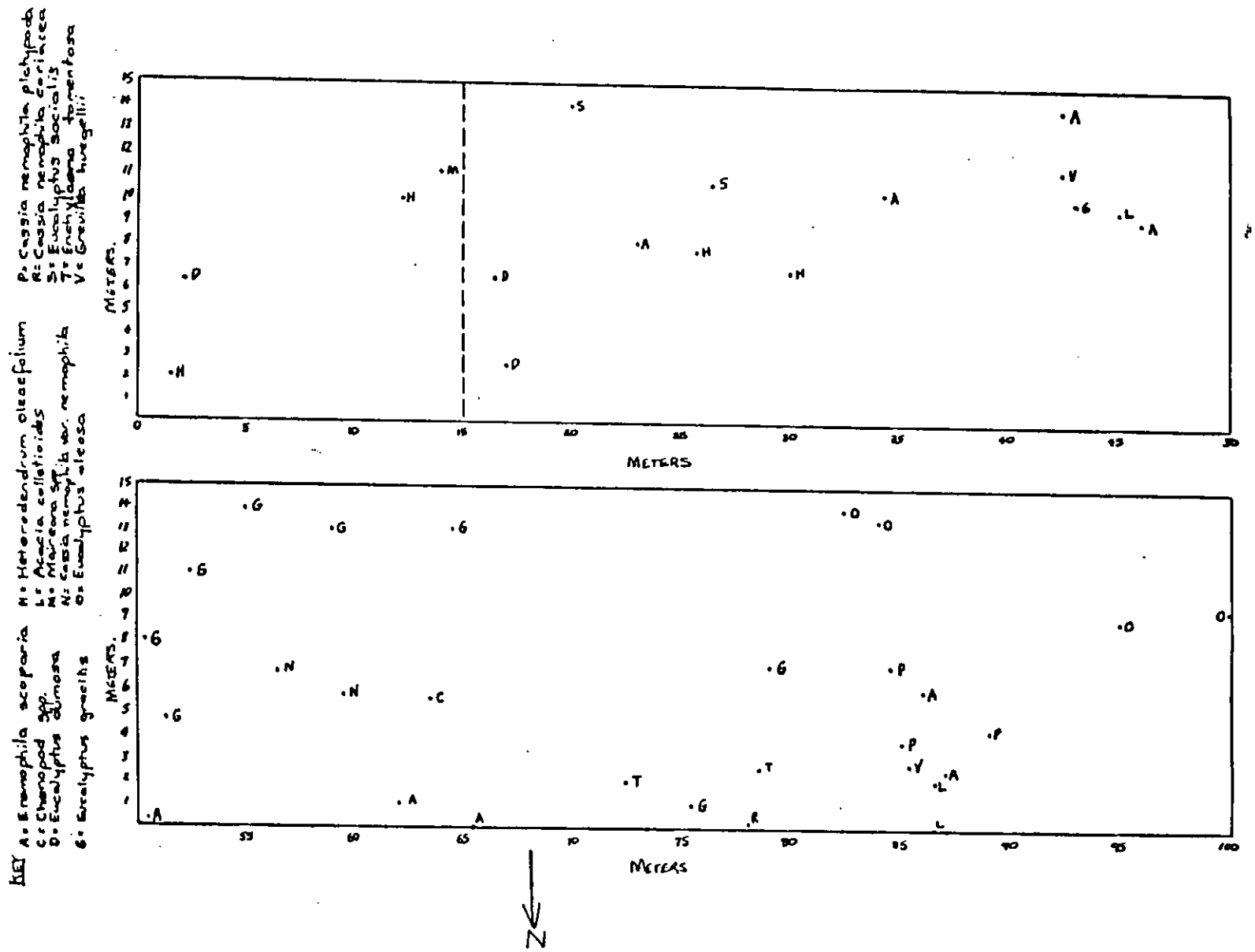


FIGURE 8.8 VSA Map for Trees and Shrubs : VSA 2 (EB3)

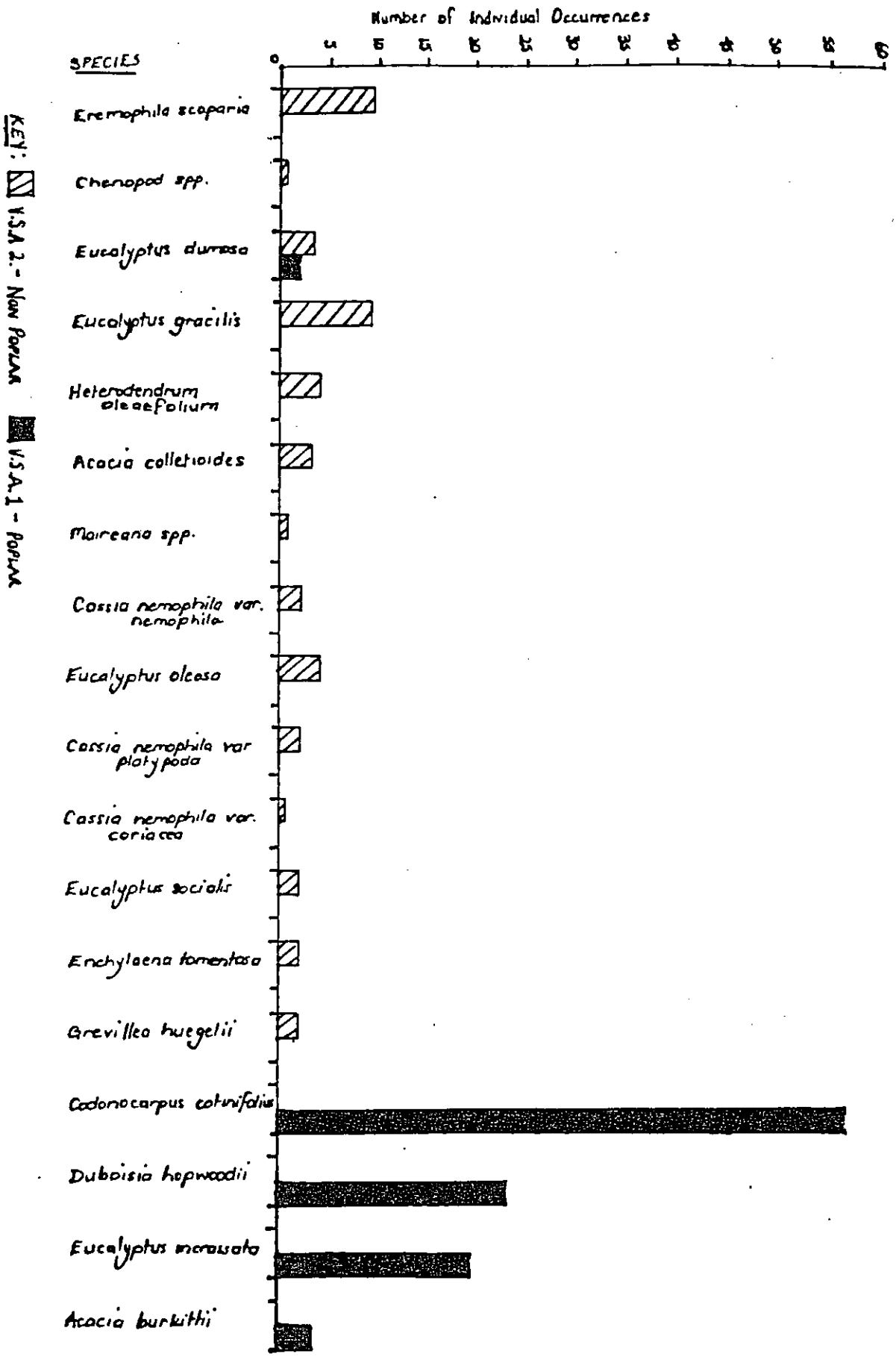


FIGURE 8.9 Trees and Shrubs > 1 metre for VSA 1 and VSA 2

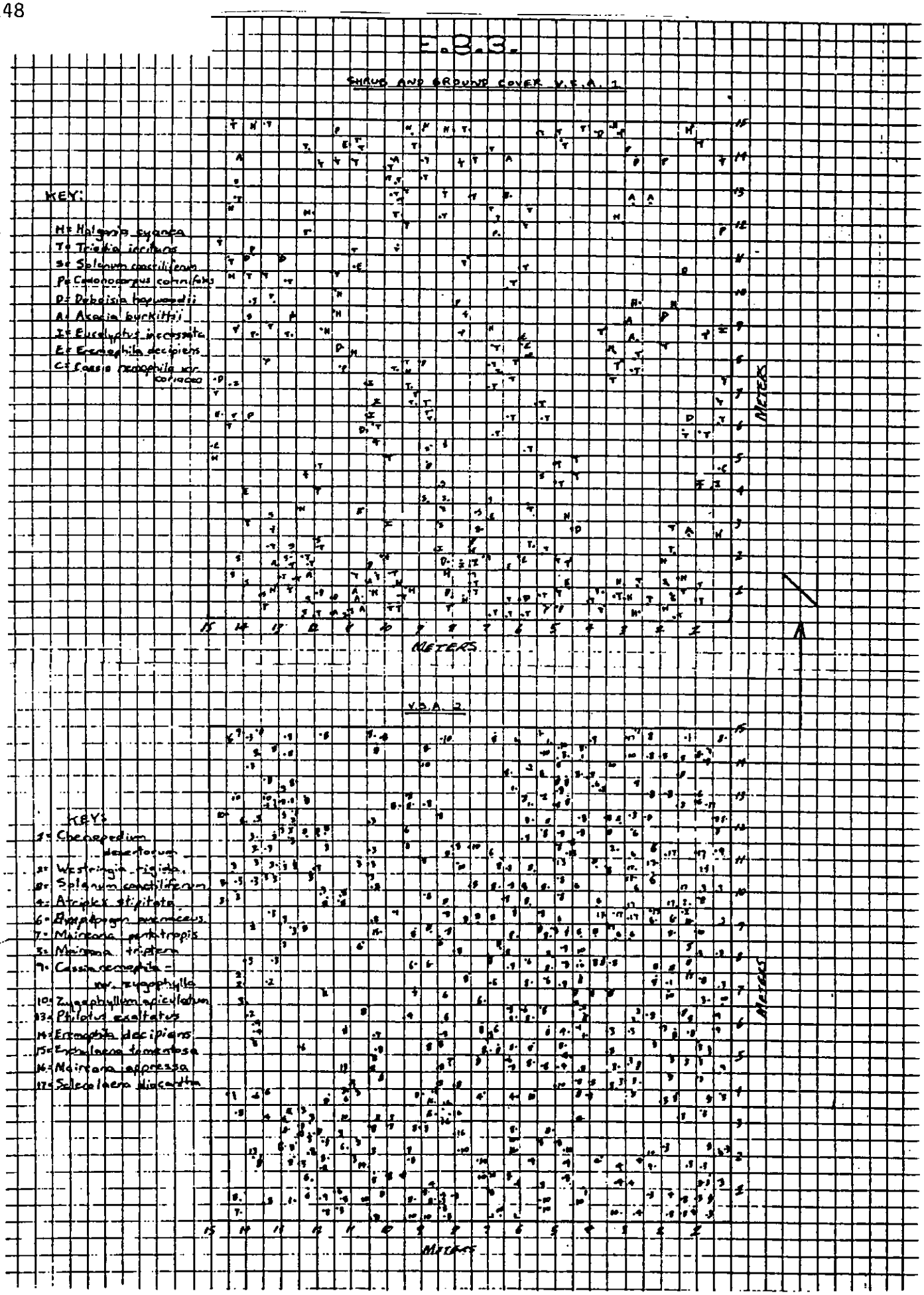


FIGURE 8.10 Shrubs and Groundcover VSA 1 : EB3

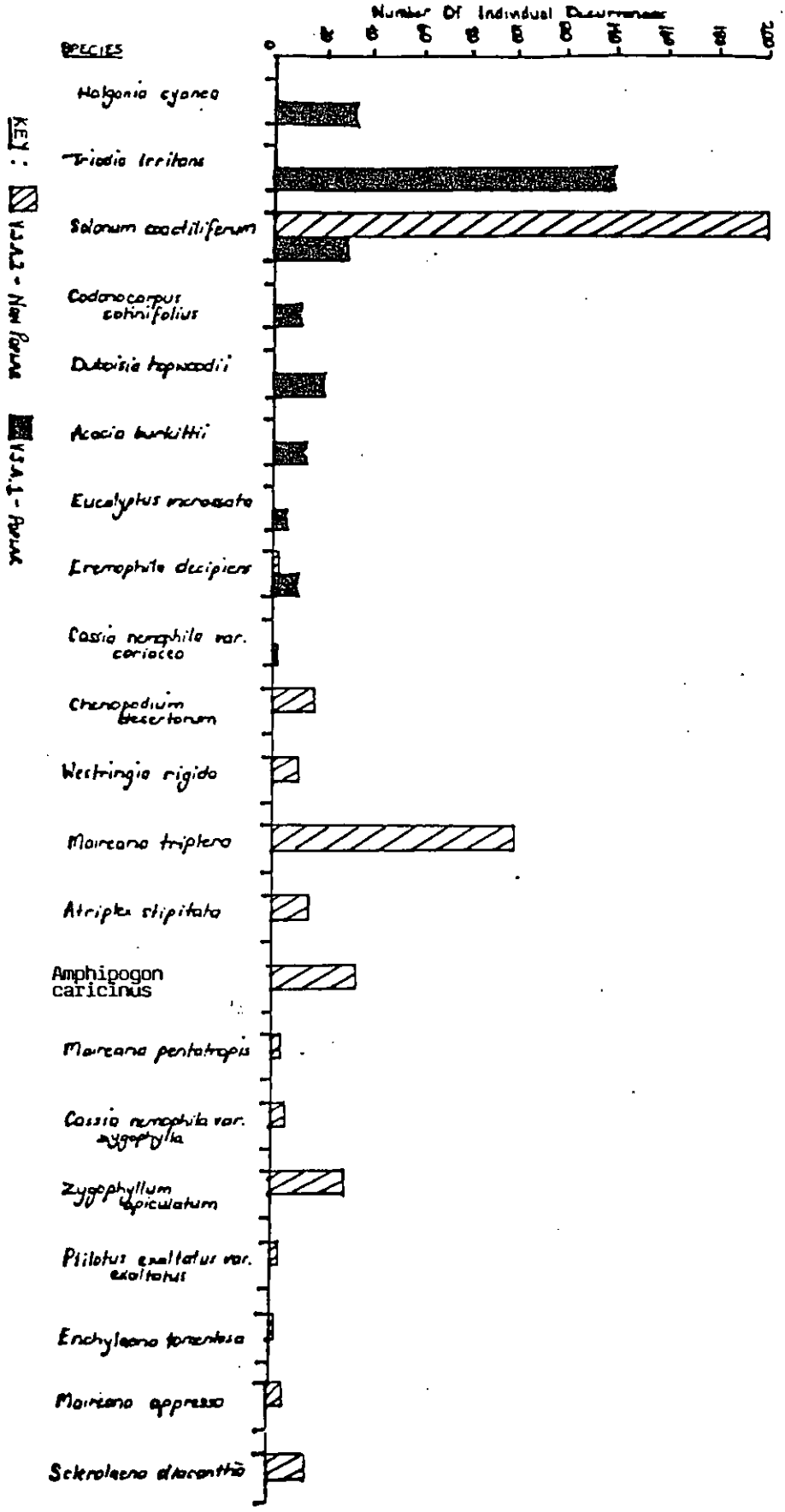


FIGURE 8.11 Shrubs and Groundcover < 1 metre for VSA 1 and VSA 2

Each of the Vegetation Sample Areas was dominated by different plant species, and Eucalyptus dumosa was the only species above 1 metre that occurred in both. The soils in the two VSAs differed. This explains the difference in the species of plants present.

The shrubs and groundcover below 1 metre in the two VSAs were mapped and are shown in Fig. 8.10. Fig. 8.11 allows for a comparison to be made between them.

The subshrub layer in VSA1 was dominated by Halgania cyanea and Solanum coactiliferum with Duboisia hopwoodii being sub-dominant. Juvenile Codonocarpus cotinifolius and Acacia burkittii also formed much of the stratum, showing continuing regeneration. Eremophila decipiens was yet another commonly growing species in the Desert Poplar community. Each species was very sparsely distributed within the sampling area. Groundcover was dominated by the hummock grass, Triodia irritans which was mainly seen in its juvenile stage.

In comparison, VSA 2 had a greater diversity and density of species. Here again, Solanum coactiliferum was by far the most commonly occurring species forming most of the subshrub layer. It was mainly seen growing in mid-dense areas throughout the Mallee-Triodia and Mallee-Shrub habitat types. Why this species should be so successful in recently burned mallee is uncertain, but presumably it is capable of rapid germination and high relative growth rates, so that it can effectively pre-empt resources early in the regeneration cycle before re-entering another dominant phase in its life history (Noble, 1989). The bluebush species, Maireana triptera was also common, next being Zygophyllum apiculatum which occurred only in this habitat type. Enchyleana tomentosa and Eremophila decipiens occurred infrequently.

The groundcover was dominated by Amphipogon caricinus and a herbaceous species, Ptilotus exaltatus var. exaltatus. Although Triodia irritans was not recorded in VSA 2, the species was common elsewhere in both the Mallee-Triodia and Mallee-Shrub patches.

Once again, different plant species occurred in each patch. Solanum coactiliferum and Eremophila decipiens were the only two species found growing in both VSAs. Furthermore, the species occurring in VSA 2 were not as sparsely distributed as those present in VSA 1, but were rather growing in mid-dense stands in certain areas.

These dominant species within each Vegetation Sample Area occupy a large fraction of the niche space, thereby utilizing a correspondingly large fraction of resources for community production. The next most successful species occupies a lesser fraction of the niche space unoccupied by the first and so on (Noble, 1989).

Overall, whilst such areas as those chosen for the VSAs are valuable in that the measurements are repeatable, there is always the possibility that the chosen areas are not truly representative of the habitat type.

The point-quarter technique is useful where individual plants are widely spaced out, or in which the dominant plants are shrubs. Therefore, this technique was carried out along the first 200 metres of the 300 metre transect (Fig. 8.1). The major vegetation type was Codonocarpus cotinifolius situated on a dune crest. The purpose of carrying out such a technique was to gain a greater insight to species density, dominance and frequency in comparison with each other at a given time. From the data collected the species were then ranked according to their importance value - a measure of their photosynthetic input to the community (Baldock, 1988). The raw data sheets for vegetation analysis for the point-quarter technique can be found in Appendix 8.3.

Through this technique, Triodia irritans was found to be the most frequent, dominant and dense species and thus, was awarded the highest importance value, indicating that the species regenerated at the expense of the herbs and subshrubs. Solanum coactiliferum was found to have the second highest importance value. As well as being capbable of rapid germination and high growth rates, for much of the species' history it exists mainly as dormant seeds until fire creates temporary gaps by removing the canopies of overstorey shrubs. These short-term gaps enable the species to establish and reproduce, thereby replenishing seed pools before the tree and shrub stratum refoliates and becomes dominant once again (Noble, 1989).

The mallee shrub species Eucalyptus incrassata was the next highest, even though it had a very low frequency and density value. The reason for this was that it had a relatively high dominance value; dominance values are related to the diameter of the canopy. Desert Poplar, Codonocarpus cotinifolius, had the fourth highest importance value. The results obtained from VSA mapping found Desert Poplar most abundant, whereas, point quarter ranked it lower. The reason for this difference is because VSA 2 was established in an ideal area which was representative of the Desert Poplar community. However, the point-quarter technique was carried out randomly over a smaller sampling area within the community where Codonocarpus cotinifolius was less dense than in the VSA 2. The lowest importance value belonged to the species Sclerolaena diacantha and Acacia acanthoclada.

8.3.3 Condition of Vegetation

Fire has influenced the vegetation in the EB3 quadrat significantly. Specific examples of fire effects are discussed in Section 8.3.5. However major effects are the abundance of new growth, both from epicormic growth and from seed, the presence of burned boughs on the ground and minimal litter accumulation. Ash pits were present in the soil resulting from smouldering roots. The fire potential of the area is presently considered low due to the absence of a continuous layer of combustible material on the ground.

Any effects of previous pastoral grazing of Danggali C.P. is undetectable due to the intervening fire in the region. The effects of Kangaroo and rabbit grazing since the fire can be seen on the bunchgrass, however, the impact on the vegetation appears sustainable.

Recent rains in the area have encouraged the growth of many seedlings, particularly on the claypans. These plants were unidentifiable at this stage, as only their cotyledons were present. A microphytic crust also became more observable in claypans as a result of the rains. The dunes in contrast had large areas of bare ground.

Rill erosion occurs in isolated patches where the soil had a greater content of clay, however, minimal erosion was present throughout the rest of the quadrat.

8.3.4 Relationship between Soils and Vegetation

Trees associated with sandplains include Eucalyptus dumosa, Eucalyptus socialis, Eucalyptus oleosa and Eucalyptus incrassata in order of dominance (see Fig. 8.2). Generally, there is no shrub layer greater than half a metre in height. Groundcover less than half a metre in height is mostly made up of Solanum coactiliferum, Eremophila scoparia and Halgania cyanea. Porcupine grass, Triodia irritans, is abundant on the sandplains (see Fig. 8.12).

The dominant mallees associated with clay pans are Eucalyptus gracilis and Eucalyptus oleosa. The shrub layer is variable and includes Cassia nemophila platypoda, Cassia nemophila coriacea, Cassia nemophila nemophila, Acacia colletioides, Eremophila scoparia and Maireana species. A microphytic layer forms a surface crust with a density between 30% to 70%. A form of bunchgrass was present. This was not found anywhere else within the quadrat.

Since the 1985 fires, Native Poplar (Codonocarpus cotinifolius) has emerged on all the dunes but to varying degrees. Reasons for this were not apparent; the topic was discussed in Section 8.3.2.

The dune in the northeast region of the quadrat has a high density of Native Poplars which are 3-4 metres high. Other dunes have young Native Poplar growing on them (see Fig. 8.2).

Young Myoporum platycarpum is growing on the dune slopes but they are less than 5 metres in height. Mallee species on the dune crests and slopes are Eucalyptus dumosa, Eucalyptus incrassata with some Eucalyptus foecunda. The next major stratum is less than half a metre in height, it consists of Halganea cyanea and Solanum coactiliferum. Porcupine grass, Triodia irritans, is a little more sparse than on the plains but still common (30% to 70%).

8.3.5 Microhabitats

From field observations and various sampling methods numerous microhabitats were recognized in the quadrat.

Fallen logs and branches were scarce and mostly of small diameter ranging from 1-30cm. Thus hollow logs or trees with hollows large enough for nesting birds such as parrots, galahs and cockatoos were lacking. Whereever in supply, burned fallen logs and branches were found to be favoured habitats of reptiles and variety of invertebrate species.

The accumulation of leaf litter was very sparse, but where it occurred in clumps it provided shelter, food, moisture, camouflage and nesting materials for invertebrates, reptiles and small mammals. The soil, being loosely compacted, especially on the dune crests and sandplains, was suitable for burrowing animals such as scorpions, ants, spiders and rabbits.

cross section of transects

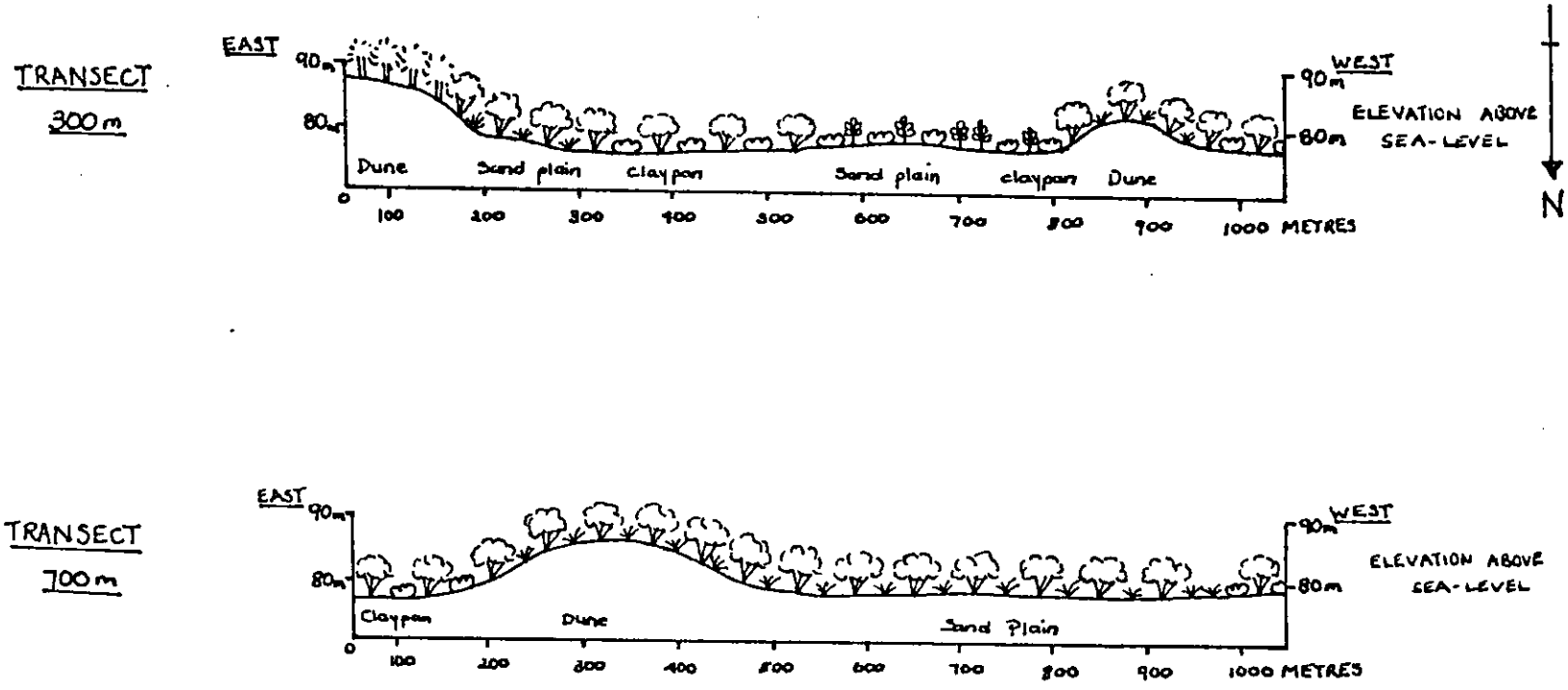


FIGURE 8.12 Cross Section of Transects

The canopy of the shrubs provided ample nesting sites for a variety of birds such as wrens, robins, honeyeaters, weebills and thornbills. The lack of high trees accounted for the near absence of raptors, ravens and magpies. The canopy of the trees and shrubs provided a food supply for invertebrates. Many birds also feed on the invertebrates.

Triodia irritans was a common microhabitat and served as a shelter from both extreme temperature and desiccation, and from predators, especially for the Mallee Dragon, Ctenophorus fordi. Few Triodia hummocks had reached the ring stage, however, where they did reach this stage they provided a resting place for kangaroos. Kangaroo wallows were also found under most mallees.

8.3.6 Effects of Fire

On 19.12.85 approximately 15,000 hectares of Danggali C.P. were burned in a medium intensity fire burning from west to east. No records are available of the exact intensity of the fire, however, the weather conditions were similar on the following day when the intensity of fires in other regions of the Park was calculated as 1400 to 1500 Kcal. The quadrat, EB3, was situated entirely within this burned area. Evidence of the fires was prevalent throughout the quadrat, as detailed below.

Since it is 3½ years since the fire, most plant species likely to regenerate are present (Hopkins, 1985), as well as some remaining fire ephemerals. This may explain why 66 plant species were recorded in the quadrat, which represents a relatively high plant diversity compared to other quadrats with similar vegetation types.

Regeneration after fire may result from seed or resprouting from epicormic buds. In this quadrat there appeared to be more plants regenerated from seed, which indicates a low fire frequency regime (Hopkins, 1985).

Two seedling regenerators are the pioneer plant species, Desert Poplar, Codonocarpus cotinifolius, and pituri, Duboisia hopwoodii. Although there is a significant amount of new growth of these plants, the growth is not so rapid as in less arid regions (Hopkins, 1985). Although the growth appeared healthy the Desert Poplars were infested with galls, and the pituri showed many signs of insect attack. There does not appear to be any reason as to why the pituri is favoured by the insects. Desert Poplar, however, is commonly infested due to the fast grown wood being very soft (Fox, 1985).

Other seed regenerators present include porcupine grass, Triodia irritans, mulla mulla, Ptilotus exaltatus, ruby saltbush, Enchylaena tomentosa, birdseye beanbush, Cassia nemophila, Eremophila, Maireana and Sclerolaena species.

Although porcupine grass was common throughout most of the quadrat, there appeared to be far more plants on the western slopes of the sand dunes. The eastern slopes are dominated by rough halgania, Halgania cyanea and bunchgrass, though residual soil hummocks indicate the existence of porcupine grass before the fire. A possible explanation for this distribution could be, that Triodia species are favoured by high intensity fires (Gibbs, 1989). As the fire was coming from the west, the western slopes of the dunes would have been burned more intensely than the eastern slopes, where the fire would have moved more slowly down the slope.

Regeneration from resprouting was also evident throughout the quadrat, particularly in the mallees. Most mallees present consisted of regenerated growth from lignotubers approximately two metres in height, with taller, blackened branches and trunks, sometimes with buds, but no leaves. Identification of these plants was often difficult as the regrowth was not yet old enough to have produced buds or fruit.

Other resprouting plants present include narrow-leaf hopbush, Dodonaea angustissima, bullockbush, Heterodendrum oleaefolium, birdseye beanbush, and silvery emubush, Eremophila scoparia, which showed resprouting from lignotubers and epicormic buds present on branches and stems.

There were isolated blackoaks, Casuarina cristata and some mallee trees, which appeared to have escaped the fire. This may be due to a discontinuous shrub layer preventing the fire from carrying to the crown of the trees.

In summary, the vegetation was in a stage of regrowth, as described by Hopkins (1985) with a dense low shrub and herb layer, the first flowers of some shrub species, a slowly improving habitat for ground and near ground dwelling vertebrates, and minor litter build-up. During this stage the vegetation is vulnerable, and another fire may cause plant extinctions.

Further monitoring of this site, and others affected by fire, is recommended to obtain a better understanding of fire effects in these regions.

8.4 Fauna

8.4.1 Birds

The activity of birds was greatest between 8 a.m. and 9 a.m. and depended on the weather conditions. A total of 439 individual birds were recorded comprising 34 different species.

The most common species were the White-eared Honeyeater, Lichenostomus leucotis, the White-fronted Honeyeater, Phylidonyris albifrons, and the Yellow-plumed Honeyeater, Lichenostomus ornatus; the Weebill, Smicrornis brevirostris, the Chestnut-rumped Thornbill, Acanthiza uropygialis, and the White-browed Woodswallow, Artamus superciliosus. Small numbers of Crested Bellbirds, Oreoica gutturalis, and Grey Butcherbirds, Cracticus torquatus were also frequently heard in the quadrat, their calls being quite distinctive.

The three Honeyeater species were most common in the Mallee/Triodia/Solanum which occurred on the sandridges. The defoliated, burned mallee branches provided ideal perching sites and most Honeyeaters were recorded using these. The use of sighting limits on these branches will have strongly biased sampling towards species using these limits. The White-fronted Honeyeaters were always recorded perched singly on these branches and called for some time before moving on, whereas the Yellow-plumed Honeyeaters only landed briefly before moving on. Also the Yellow-plumed Honeyeaters occurred in groups of up to ten individuals.

The White-eared Honeyeater, which was the most common bird recorded in the quadrat, was recorded perched on the dead branches and foraging in the regenerating mallee foliage. These birds were often in pairs and seemed tied to a particular area. This could be attributed to the fact that nests with young were observed.

Only one mallee species, Eucalyptus gracilis, was flowering. This implies that the Honeyeater species must have been feeding dominantly on invertebrates which tend to be high in numbers after fires. This can also be supported by the fact that young birds are fed entirely on invertebrates, thus the breeding Honeyeaters would have been using the invertebrates for this purpose.

Both the Weebills and the Chestnut-rumped Thornbills were commonly observed foraging in the regenerating mallee foliage in the Mallee (mixed) shrub and Mallee/Triodia/Solanum areas. Often the two species were recorded together. This is quite common for Thornbill species (H. Bell, in Emery, 1981-1986). Over twice as many Weebills as Chestnut-rumped Thornbills were recorded, but both these species were common wherever the regenerating mallee occurred.

White-browed Woodswallows were present overhead every day. Large numbers were recorded although only two large flocks containing approximately 30 birds each were actually recorded perched in the quadrat.

Red-capped Robins, Petroica goodenovii, and Jacky Winters, Microeca leucophaea, were recorded on all four transects. Both species have a relatively similar feeding technique, known as sallying - this involves launching themselves from a vantage point, which was the burned mallee branches in this case, to catch the flying invertebrates which make up their diet. The burned mallee branches provided excellent vantage points for this sallying.

Two species of parrot, two Fairy-wren species and three species of cuckoo were recorded in the quadrat. Mulga Parrots, Psephotus varius and one Scarlet-chested Parrot, Neophema splendida, were recorded. Splendid Fairy-wrens, Malurus splendens, and Superb Fairy-wrens, Malurus cyaneus were recorded with twice as many Superb Fairy-wrens being recorded. Also Horsefields Bronze-Cuckoos, Chrysococcyx basalis, Black-eared Cuckoos, Cuculus pallidus were recorded with the Horsefields Bronze-Cuckoo being the most common - possibly because of its use of Honeyeaters as host species for their eggs.

The Chestnut Quail-thrush, Cinclosoma castanotum, was recorded once, although the shyness and quick walking movements across the ground may account for other individuals not being recorded, especially as most observers would have been looking at the tree level.

Other individual recordings include the Grey Shrike-thrush, Calluricincla harmonica, Hooded Robin, Melanodryas cucullata, and Wedge-tailed Eagle, Aquila audax.

Although unsighted, Emus, Dromaius novaehollandiae, were also present within the quadrat - scats provided evidence for this.

Table 8.1 shows the association between the percentage of the quadrat that each habitat type covered and the percentage of birds recorded in each of these habitats. It is very interesting to note that no habitat type was particularly favoured by the birds. There is a very strong correlation between the area that each habitat type covered and the percentage of the total number of birds recorded in each area. Although some species favoured particular habitats, on the whole no habitat type was used more by the birds.

TABLE 8.1 Area of Habitats compared to the Percentage of Birds recorded in each Habitat

Habitat Type	% of Area of Quadrat	No. of Birds Recorded (%)
Poplar	5	4
Mixed Shrub	13	22
Mallee (mixed) Shrub	19	19
Mallee/Triodia/ Solanum	63	55

It is interesting to note that no observations were recorded of birds using the individual Desert Poplar trees, Codonocarpus cotinifolius, in any way. All bird recordings occurred in the mallee eucalypts or the shrubby understorey.

The number of individual birds recorded in this quadrat is quite high, especially since the quadrat has recently been burned (see Table 8.2). Research has shown that bird numbers drop considerably after fire due to reduced cover, which would increase the risk of predation, and also because the overall prey numbers fall. It can be expected then that in future years a lot more birds should be recorded in the quadrat, and also it is likely that more than the 34 species recorded this year should be recorded.

8.4.2 Invertebrates

Invertebrates, in particular ants, were considered to be an important group for study. Many species of ants occupy specialized niches and this suggests that they may be useful as bioindicators of various environmental parameters (Majer, 1983). Ants are also high in abundance, sampling and identification is relatively simple, and their sensitivity of community to environmental changes are other reasons for the importance of studying ants.

Methods of capture included micropitfalls; large pitfall traps and hand capture from a variety of habitats and microhabitats. Ants were not collected from the large pitfalls because we put blades of spinifex in them to let the ants out. This was done so as to protect other trapped animals from being attacked.

The invertebrates caught were divided into two groups; ants (which were identified to genus), and non-ants (identified to Order). Voucher specimens were made to keep results consistent and for future reference. These are held at Salisbury Campus of S.A.C.A.E. and identifications were verified by J. White and Dr. R. Clay. Information on the number of invertebrate species and individuals caught, their frequencies, what micropitfalls they were caught in and the numbers caught, capture methods and microhabitats can be found in the Appendices (8.4, 8.5, 8.6, 8.7, 8.8).

TABLE 8.2 Birds Recorded in EB3

NAME	Numbers*	Density (ha)**	Stratum***	Habitat****
White-eared Honeyeater	69	1	a, b, c	P, Mt, Ms, S
Weebill	62	1	a, b	Mt, Ms, S
White-browed Woodswallow	62	0.53	b, c	Mt
Yellow-plumed Honeyeater	33	0.43	a, b, c	Mt, Ms, S
Chestnut-rumped Thornbill	25	0.33	a, b	Mt, Ms, S
White-fronted Honeyeater	40	0.32	b, c	Mt, Ms, S
Jacky Winter	15	0.23	a, b	Mt, Ms, S
Red-capped Robin	13	0.23	a, b	Mt, Ms, S
Spiny-cheeked Honeyeater	11	0.18	a, b	Mt, Ms, S
Mulga Parrots	14	0.16	b, c	P, Mt, Ms, S
Horsefields Bronze-Cuckoo	7	0.12	b	Mt, Ms
Superb Fairy-wren	11	0.1	a, b	Mt, Ms
Splendid Fairy-wren	6	0.1	a, b	Mt, S
Zebra Finch	5	0.08	b	Mt
Grey Butcherbird	10	0.06	b	Mt, Ms
Aust. Raven	6	0.66	b, c	Mt
Yellow-rumped Pardalotes				
Striated Pardalotes	9	0.05	a, b, c	Mt, Ms
Crested Bellbird	10	0.03	b	Mt, S
Chestnut-rumped Heathwren	2	0.03	a	Mt
Black-eared Cuckoo	2	0.03	b	Mt
White-browed Babbler	1	0.02	b	Ms
Chestnut Quailthrush	1	0.02	a	Mt
Magpie	4	0.02	b, c	Mt
Grey Shrike-thrush	1	0.02	b	Ms
Galah	4	-	c	-
Welcome Swallow	4	-	b, c	Ms
Scarlet-chested Parrot	1	-	b	Mt
Hooded Robin	1	-	b	
Purple-gaped Honeyeater	1	-	b	
Pallid Cuckoo	1	-	b	
Willy Wagtail	1	-	a, b	Ms
Emu	-	-	-	-
Wedge-tailed Eagle	1	-	c	

* these numbers include observations apart from the transects.

** the density if only for the transects

*** a - 0-0.5m
b - 0.5-5m
c - > 5m

**** P - Poplar
Mt - Mallee/Triodia/Solanum
Ms - Mallee (mixed) Shrub
S - Mixed Shrub

Two different habitats were chosen at EB3 for the location of the VSAs and micropitfalls, with the large pitfall traps situated between these two areas. (This area displaying a combination of the two major vegetation types.) VSA no. 1 was located amongst Native Poplar with regenerating mallees dominating VSA no. 2 (see Table 8.3).

The whole area was last burned in 1985, resulting in relatively low quantities of ground litter. Leaf litter occurred mainly in small patches where dead branches (with remaining foliage) had fallen to the ground. It is therefore likely that ant species diversity is relatively low when compared to more "mature" areas. This was supported by results obtained from the micropitfall captures at EB2 and EB3 (see Fig. 8.13), where species of ants were found at EB2 (unburned mallee) in comparison to ten species caught at EB3.

Small shrubs and herbs made up the bulk of the plants in flower, as most Eucalypts and many Native Poplar trees had not yet reached maturity.

Overall, 52 species of invertebrates were recorded at EB3 from the micropitfalls, 42 being non-ant species (see Table 8.4). The largest number of individuals caught were ants, of which mainly comprised two Iridomyrmex species, followed closely by true flies (Order: Diptera). All other non-ant species were recorded in relatively low numbers.

Ant diversity was not high at EB3. A total of 942 ants from four genera were identified from the Native Poplar, and a total of 385 ants from six genera were identified from the burned mallee. The most abundant ant group in both VSAs (both in numbers and frequency) was the genus Iridomyrmex which accounted for approximately 89% of all ants caught. The second most abundant group (also in both VSAs) was the genus Rhytidoponera, the opportunistic group (Greenslade) (from functional group table) of ants. These contributed to about 9% of the total number of ants caught. All the other species captured were in relatively low numbers and frequency. The numbers of ants captured though, could be largely influenced by the location of the micropitfall traps in relation to the proximity of ant nests. The frequency of Iridomyrmex was considerably higher in the mallee vegetation even though they were caught in a wide variety of microhabitats. This suggests that they are highly active and mobile. The opportunistic group, only represented here by the genus Rhytidoponera had the same frequency in both VSAs. These ants were found predominantly in open, sandy areas with native Poplar, Triodia and/or Amphipogon species. The small number of sub-cryptic species captured were in micropitfalls located close by to leaf/twig litter, possibly suggesting that the lack of both diversity and numbers could be due to the overall lack of ground litter. Ant species composition is also likely to be seasonal as well as due to recognition types (as in results obtained by Anderson, 1982).

A much larger diversity of Diptera species were recorded this year at EB3 than at other locations in 1988. This is because 70% methylated spirits was used this year which is attractive to many Diptera (Greenslade and Greenslade, 1971), whereas formalin was used previously which does not have the same effect. (Methylated spirits was used this year because it is neither attractive nor repellent to ants.) Other sub-dominant non-ant Orders included Acari (ticks and mites), Araneae (all captures belonging to the Spider family, Arachnida), Coleoptera (beetles) and Hemiptera (bugs). Many more Woodswallows, Artamus superciliosus were observed flying above at EB3 than at EB1 and EB2. This suggests the likelihood of a higher abundance of flying insects.

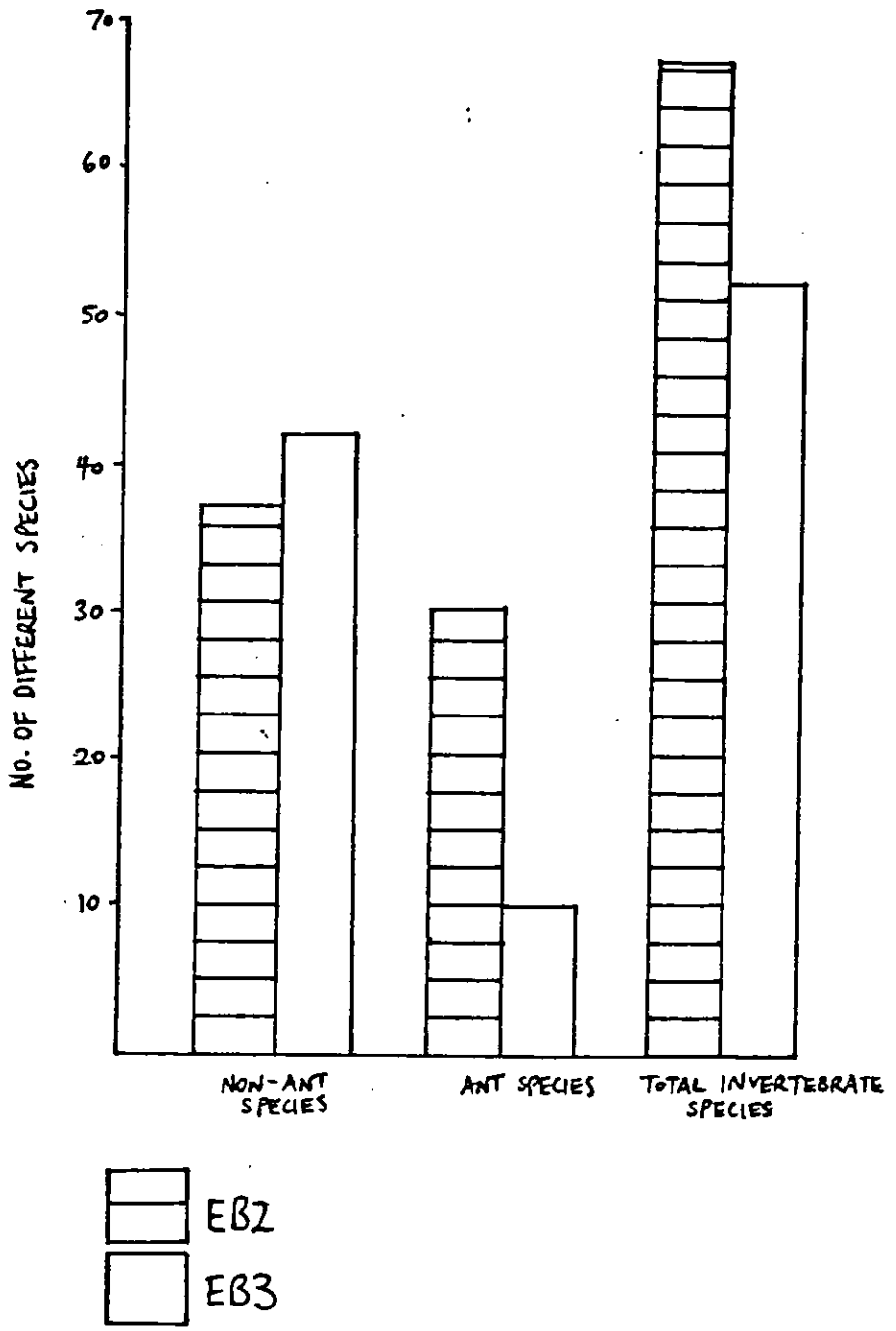


FIGURE 8.13 Species Diversity at EB2 (Unburned) and EB3 (Burned)

TABLE 8.3 Ant Genera caught in Micropitfalls - EB3

Functional Group/ Major Taxa *		VSA No. 1 (Native Poplar)			VSA No.2 (Mallee)		
		No. of species caught	No. of individs.	Frequency (%)	No. of species caught	No. of individs.	Frequency (%)
1.	Dominant species *Iridomyrmex*	2	848	57.5	2	333	80
2.	Subordinate species *Camponotus*				2	15	5
3(a)	Hot climate specialists *Melophorus*, *Meranoplus*				2	3	7.5
4(b)	Sub-cryptic species *Solenopsis*, many small formicines and dolichoderines	1	2	2.5	1	12	2.5
5.	Opportunists *Rhytidoponera*, *Paratrechira*	2	90	30	2	24	30
6.	Generalized myrmicines *Monomorium*, *Pheidole*, *Crematogaster*	1	2	2.5			

* P.J.M. Greenslade's Functional Groups of Australian Ants

TABLE 8.4 Non-Ant Species caught in Micropitfalls - EB3

NON-ANT ORDERS		NATIVE POPLAR (VSA 1)		BURNED MALLEE (VSA 2)	
	spp.no.	Nos.caught	Frequency (%)	Nos.caught	Frequency (%)
ACARI	B	4	7.5	9	22.5
	D	10	27.5	9	10
Total		14		15	
ARANEAE	B	6	12.5	4	10
	C			1	2.5
	G	4	10		
	I			17	32.5
	L			1	2.5
	M			2	5
	N	2	5	1	2.5
	P			1	2.5
Total		12		27	
COLEMBOLA	1	1	2.5	3	2.5
	2	2	2.5		
Total		3		3	
COLEOPTERA	A	2	5	5	10
	B	1	2.5		
	D			2	5
	F	1	2.5		
	G	3	7.5		
	I			1	2.5
	Z	2	5	2	5
Total		9		10	
DIPTERA	A	14	10		
	C	13	12.5		
	D	16	15		
	E	45	25	46	30
	F	153	67.5	536	97.5
	G	27	20	23	20
	I	12	15	26	20
	J	13	15	3	5
	K	2	5	1	2.5
	L			1	2.5
	M	3	2.5		
	N	1	2.5		
	O	2	2.5	1	2.5
	Q			7	2.5
	T	1	2.5		
Total		302		644	
HEMPITERA	A	6	7.5		
	B	1	2.5		
	C	6	10		
	G			1	2.5
Total		13		1	2.5
ISOPTERA	A			1	2.5
LEPIDOPTERA	A	1	2.5		
ORTHOPTERA	A	1	2.5		
	B			1	2.5
Total		1		1	2.5

8.4.3 Reptiles and Amphibians

Twelve species of lizard was recorded at EB3. Details are given in Table 8.5. The lizards were caught in pitfalls or by hand. Others were recorded from sightings. Destructive sampling was not done due to limitations of time. The lack of logs and ground litter as a result of the 1985 fire may have influenced the number of species and individuals found.

Research in Western Australia indicates that reptile species not favoured by habitat changes caused by fire disappeared following a fire, while some species present in low numbers before the fire actually increased for at least a few years (Ford, 1985). Species recorded at EB3 that were included in the above research were Ctenotus schomburgkii and Menetia greyii. Future studies relating to this research would be interesting and valuable.

TABLE 8.5 Reptile presence in EB3

Species	Common Name	No. recorded	Microhabitat
AGAMIDAE			
Ctenophorus fordi	Mallee dragon	Common	*(4) in and arou Triodia irritans
Ctenophorus pictus	Painted dragon	1	Running through Solanum
Gemmatophora nobbi	Nobby dragon	1	Leaf litter
Pogona vitticeps	Central bearded dragon	2	*(1) near Eucalyptus dumos
GECKONIDAE			
Lucasium demaeum	Bearded gecko	3	*(2) Triodia irritans
Heteronotia binoei	Bynoes gecko	2	Blackoak timber
Rhynchoedura ornata	Beaked gecko	1	Near soil pan pitfall
SCINCIDAE			
Ctenotus schomburgkii		5	*(2) In/around Triodia irritans
Ctenotus regius		1	Sheltering from rain in tent
Ctenotus atlas	Striped skink	1	*
Cryptoblephorus carnabyi		1	Under part of fallen tree
Menetia greyii		1	Captured in mallee

Total number of species 12

Total number of individuals 19

*No. caught in Pitfalls

Ten lizards (five species) were caught in pitfalls (see Table 8.5). The spinifex dragon, Ctenotus fordi was most common. This species favours plains and sandridges vegetated with hummock grass, usually in association with mallee. This is consistent with our findings over the entire quadrat. The relative abundance of ants, the main source of food for C. fordi contributes to the abundance of this dragon. C. fordi was observed mainly during the warmer afternoons, often near or running into T. irritans which it uses as cover.

Another species consistently using T. irritans is the skink Ctenotus schomburgkii. This species favours a low sparse groundcover and feeds on a variety of arthropods, particularly termites. Several termite nests were observed in this quadrat, often in association with T. irritans. T. irritans is one of the most common plants in EB3 and its regeneration since the fire has favoured C. fordi and C. schomburgkii.

Lucasium demaeum was the most commonly recorded gecko in this quadrat and this species also appeared to favour T. irritans as its preferred habitat. This may in part be due to the lack of other available habitats following the 1985 fire.

Pitfall captures were most successful for the dragon C. fordi and the gecko L. demaeum.

No frogs or snakes were found.

8.4.4 Mammals

Direct and indirect evidence for mammals within quadrat EB3 was substantial (Table 8.6). Enough evidence was gathered to conclude that while the mammals visit the quadrat, some may also reside in it (apart from Goat).

Bats were heard at night, but not captured and identified, although a mist net was erected on two occasions.

There were 3 sightings of the Western Grey Kangaroo (Macropus fuliginosus) and much indirect evidence in the quadrat (Table 8.6) suggests that the quadrat is used regularly by this species. It is likely the Red Kangaroo (Macropus rufus) also uses the quadrat. However, no attempt was made to distinguish between the two Kangaroo species on the basis of indirect evidence.

As seen in Table 8.6 there is little evidence in quadrat EB3 for larger introduced mammals. There is no evidence of vegetation being heavily grazed, indicating a low density of goats and rabbits in the area. The tracks of Fox were present in the quadrat. No dens were found within the quadrat but this is not unusual as the home range of the animal is several square kilometres.

To sample the small-mammal populations, a total of 50 Elliots and 21 pitfall traps were set (Fig. 8.1). A continuous pitfall line with 11 pits was orientated approximately east-west across a sandplain covered with a Mallee-Triodia-Desert Poplar association. Ten individual pitfalls were arranged in two rows of five orientated approximately east-west on a dune crest covered with Desert Poplar which graded toward an area of mixed shrubs. All pitfalls were lifted overnight on Sunday 30th due to flooding and re-set Monday 1st.

TABLE 8.6 Mammal Presence detected in EB3

Species	Common Name	Evidence	Comment
Pseudomys bolami	Native mouse	Trapped	Only 2 caught in pitfalls
*Mus domesticus	House mouse	Trapped	Only 2 caught in pitfalls
Macropus fuliginosus and M. rufus	Western Grey Kangaroo and Red Kangaroo	Sightings Scats Tracks Wallows	3 sightings of M. fuliginosus. Indirect evidence frequent
*Oryctolagus uniculus	Rabbit	Sighting Burrows	One sighting. Burrows largely uninhabited
*Vulpes vulpes	Fox	Sightings Tracks	No response to whistle. One sighting
*Capra hircus	Goat	Scats Tracks Skeletal remains	Indirect evidence frequent. Seen outside quadrat

*Introduced Mammals

20 Elliots were placed in association with the individual pitfalls. Each pitfall was accompanied by two Elliots placed at a distance of 5-10 metres away from the pitfall. The remaining 30 Elliots were arranged in an East-West oriented "zig-zag" on a sloping dune crest dominated by Desert Poplar.

Over a period of 6 days (5 trap nights not counting Sunday 30th) only two mammal species were trapped in quadrat EB3. A total of 8 Native mice (Pseudomys bolami) and 9 House mice (Mus domesticus) were recorded (Appendix 8.9). The effectiveness of trapping techniques, indicated by numbers caught, is shown in Table 8.7.

Remembering that there are more than twice as many Elliots than pitfalls, the difference between the effectiveness of the two methods is negligible. On this occasion the individual pitfalls were more effective than the continuous pitfalls. From this singular account, it cannot be said with certainty that one pitfall method is better than the other. Similarly, the Elliots associated with the pitfalls yielded more mice per trap than the non-associated Elliots, but the effectiveness cannot be proven until further study is done on the subject, especially as habitat differences may have affected trapping success.

TABLE 8.7 Effectiveness of Trapping Techniques in EB3

Technique	Species	No. of Individuals
Continuous pitfall	Mus domesticus	1
Individual Pitfall	Pseudomys bolami	2
	Mus domesticus	2
Elliots associated with individual pitfalls	P. bolami	3
	M. domesticus	3
Non-associated Elliot (zig-zag line)	P. bolami	3
	M. domesticus	3

There were no retraps of either species of mouse. Only one trap caught a mouse twice (Elliot 25, both House mice).

Pseudomys species, being fire specialists, are well known for their rapid establishment and successful early breeding after fire. In the first two years there is rapid population increase and from there on, the mice are able to maintain a viable breeding population (Catling and Newsome, 1978). If the most recent fire occurred in the quadrat in February 1985, Pseudomys bolami have been through the population explosion and should be in the process of stabilising their numbers.

Mus domesticus flourishes in the second and third year after fire. There may have also been a small population climax very early in the months immediately after fire (Catling and Newsome, 1978).

Both species of mice captured in quadrat EB3 should have populations which are on the decline after reaching a climax 2 years ago. In the years to come, if they have not already done so, the populations may stabilise. The habitat for small ground dwelling animals should continue to improve until about ten years after the fire where it will be at its optimum (Hopkins, 1985). Until the habitat reaches its optimum there will be a low diversity of vegetation and insects and other types of potential food.

8.5 Summary/Conclusions

Eastern Boundary 3 (EB3) is still recovering after the 1985 Danggali fires. It consists of sandplains, undulating dunes and shallow claypans. Vegetation is still recovering after fire. The claypans have a dominant tree cover composed of Eucalyptus foecunda and Eucalyptus gracilis. Many understorey species were present due to the higher proportion of nutrients and water availability in these run-ons.

The dunes had two dominant mallee species, namely Eucalyptus dumosa and Eucalyptus incrassata. It was an excellent opportunity to observe the Native Poplar, Codonocarpus cotinifolius; a plant species that emerges after fire disturbance. It was confined to the dune crests. The dominant understorey species was Triodia irritans. It provided protection for several animal species.

Sandplains consisted of Eucalyptus socialis and Eucalyptus oleosa. The understorey consisted of Halgania cyanea, Eremophila scoparia and Solanum coactiliferum growing amongst Triodia irritans. This condition may change as the mallee species recover from their regrowth stage. There are signs of grazing by Kangaroos, goats and to a minor extent, rabbits. However, the impact on the vegetation appears minimal. The flora is in a stage of regrowth and contains a dense low shrub and herb layer. In 1989, some of the shrub species flowered for the first time since the fires of 1985.

The habitat is slowly improving for ground and near ground vertebrates. However, the vegetation is vulnerable at this stage as the seed reserve is exhausted and another fire may cause plant extinctions.

The Western Grey Kangaroo and Red Kangaroo have had little impact on EB3 since the 1985 fires. There is evidence of their presence but very little impact on the vegetation. The damage caused by feral animals is also minimal in this area.

The population of native mice, Pseudomys bolami, is in the process of stabilization. It is assumed that their numbers flourished approximately two years after the 1985 fires but are now receding to a stable state (Catling and Newsome, 1978). House Mouse, Mus domesticus, was numerous in EB3. It is predicted that their numbers will stabilize and follow the same pattern as Pseudomys bolami.

Bats are present indicating that there is a substantial invertebrate food supply to support them.

Information collected showed that the highest diversity of ants (which may be good indicators of environmental change) occurred in undisturbed areas with a much higher proportion of vegetative litter. Results also showed that by far the most dominant and mobile ant group caught was the genus Iridomyrmex.

Of the 12 species of lizards recorded at EB3, the mallee dragon, Ctenophorus fordi, was the most common. It was usually associated with porcupine grass (Triodia irritans). Ctenotus schomburgkii was also found amongst porcupine grass and feeds on arthropods including termites. Recordings of other skinks, dragons and geckoes were low. A total of 19 individuals were caught in pitfalls, the most common being Ctenophorus fordi and Lucasium demaeum. It is suggested that pitfall techniques should be used to monitor the 1985 fire effects on fauna.

The number of different bird species recorded in EB3 was only 33. This low figure can be expected due to the recent fires of the area as well as inexperience of field identification. In addition to a low species diversity there were low numbers of individuals recorded. Of the 33 species, 27 of them were recorded in numbers less than 20. This is also a direct result of the Danggali fires.

The White-eared, Yellow-plumed and White-fronted Honeyeaters as well as the Chestnut-rumped Thornbill and Weebill were the most common birds sighted, making up over half of the recorded observations.

9.0 CONCLUSIONS

The ongoing study of flora and fauna in Danggali Conservation Park is important for monitoring and research of various semi-arid habitats. The knowledge and information acquired is valuable for the protection and continuing management of the habitat types within the park.

The vegetation type within each study quadrat is associated with the soils and landforms of the area, but may have been influenced by fire, grazing and mechanical disturbance. EB1, a mature, dominantly Blackoak community favoured relatively flat plains, while EB2 has isolated, mature Callitris communities on dune crests. EB3, unlike the other quadrats, was affected by fire resulting in a regenerating mallee/Triodia community with Desert Poplar confined to the dune crests.

The habitats studied contained a wide diversity of fauna species, especially invertebrate species on which more emphasis was placed for study. Pest species were rarely seen but evidence of their presence was observed in the form of scats, tracks, burrows and bones. Despite this, ongoing monitoring of their effects on native flora and fauna should continue.

The study of individual habitats creates an overall view of the dynamic ecosystems which exist within the park. The study of the components of these ecosystems allows an overall representation of a semi-arid habitat to be recognised.

REFERENCES

ANDERSON, A.N. (1982) Seed Removal by Ants in the Mallee of North-western Victoria, in Ant-Plant Interactions in Australia (ed. R. Buckley). Junk Press, The Hague.

ANDERSON (In press) Greenslade's Functional Groups of Australian Ants.

BALDOCK, B. (1988) Lecturer in Applied Biology, S.A. College of Advanced Education, Salisbury. Personal comment.

CATLING, P.C. & NEWSOME, A.E. (1978) Responses of the Australian Vertebrate Fauna to Fire : An Evolutionary Approach, in Fire and the Australian Biota, Australian Academy of Science, Canberra.

CLAY, R. (1989) Personal communication,

FORD, MICHAEL J. (1985) Fire Ecology and Management of Western Australian Ecosystems. Western Australian Institute of Technology, W.A.

FOX, J.E.D. (1985) Fire in mulga - studies at the margins, in Fire Ecology and Management of Western Australian Ecosystems. Western Australian Institute of Technology, W.A.

FRITH, H.J. (Ed.) (1976) Readers Digest Complete Book of Australian Birds. Readers Digest Services Pty. Ltd., Sydney.

GIBBS, J. (1989) Lecturer in Fire Management, S.A. College of Advanced Education, Salisbury. Lecture Notes.

GREENSLADE, P.J.M. (1985) Preliminary Observations on Ants (Hymenoptera: Formicidae) of forests and woodlands in the Alligator Rivers region, N.T. Ecol. Soc. Aust., 13 : 153-160.

GREENSLADE, P. & GREENSLADE, P.J.M. (1971) The Use of Baits and Preservatives in Pitfall Traps. J. Aust. Ent. Soc., 10, pp. 253-260.

HOPKINS, A. (1985) Fire in the Woodlands and Associated Formations of the Semi-Arid Region of South-western Australia, in Fire Ecology and Management of Western Australian Ecosystems, Western Australian Institute of Technology, W.A.

LECTURE HANDOUT. (1989) P.J.M. Greenslade's Functional Groups of Australian Ants, from Anderson (in press).

MAJER, J.D. (1983) Ants : Bio-Indicators of Minesite Rehabilitation, Land Use and Land Conservation. Environmental Management, Vol. 7, No. 4, pp. 375-383. Springer-Verlag, N.Y. Inc.

MUIR, B.G. (1977) Biological Survey of the Western Australian Wheatbelt Part 2. Records of the Western Australian Museum Supplement Number 3.

NOBLE, J.C. (1989) Fire studies in mallee (Eucalyptus spp.) communities of Western New South Wales : The effects of fires applied in different seasons on herbage productivity and their implications for management. Australian Journal of Ecology, 14 : 169-187. Blackwell Scientific Publications, Melbourne.

OSBORN, M. (1989) Personal Communication. (N.P.W.S., Danggali C.P.)

SACAE (1988) Habitat Assessment Report.

SOUTHWOOD, T.R.E. (1966) Ecological Methods. Methuen, London, England.

APPENDIX 3.1 : SPECIES LIST FOR MV1 (UNBURNED QUADRAT)

GRAMINEAE

Stipa nitida
Triodia irritans

PROTEACEAE

Grevillea huegelii

CHENOPODIACEAE

Maireana pentatropis
Maireana sclerolaenoides
Maireana triptera
Rhagodia spinescens

CRUCIFERAE

Carrichtera annua

LEGUMINOSAE

Acacia colletioides
Acacia nyssophylla
Acacia burkittii
Cassia nemophila var. nemophila
Cassia nemophila var. zygophylla

ZYGOPHYLLACEAE

Zygophyllum eremaeum

EUPHORBIACEAE

Beyeria opaca

MYRTACEAE

Eucalyptus dumosa
Eucalyptus gracilis
Eucalyptus incrassata
Eucalyptus socialis

SOLANACEAE

Lycium australe

MYOPORACEAE

Eremophila glabra
Eremophila scoparia

COMPOSITAE

Angianthus burkittii
Brachycome ciliaris
Olearia pimeleoides

APPENDIX 3.2 : SPECIES LIST FOR MV1 (BURNED QUADRAT)

GRAMINEAE

Stipa species
Stipa variabilis
Stipa scabra
Triodia irritans

CHENOPODIACEAE

Atriplex stipitata
Atriplex vesicaria
Chenopodium desertorum
Dissocarpus paradoxus
Maireana ciliatia
Maireana pentatropis
Rhagodia spinescens
Sclerolaena parviflora
Sclerolaena uniflora

AMARANTHACEAE

Ptilotus exaltatus
Ptilotus polystachyus var. polystachyus

LEGUMINOSAE

Acacia burkittii
Acacia ligulata
Cassia nemophila var. coriacea
Cassia nemophila var. platypoda

EUPHORBIACEAE

Beyeria leschenaultii
Beyeria opaca

MYRTACEAE

Eucalyptus dumosa
Eucalyptus incrassata
Eucalyptus oleosa
Eucalyptus socialis

BORAGINACEAE

Halgania cyanea

SOLANACEAE

Solanum coactiliferum
Duboisia hopwoodii

MYPORACEAE

Eremophila glabra
Eremophila sturtii
Eremophila alternifolia
Eremophila scoparia

COMPOSITAE

Angianthus burkittii
Calotis cuneifolia
Helichrysum apiculatum
Podolepis capillaris
Vittadinia triloba

APPENDIX 3.3 : ANTS CAUGHT AT MV1 USING MICROPITFALLS 1989

GENUS & SPECIES NO.	UNBURNT SECTION					BURNT SECTION				
	NO. CAUGHT IN EACH MICROHABITAT			TOTAL NO. CAUGHT	SPECIES FREQUENCY	NO. CAUGHT IN EACH MICROHABITAT			TOTAL NO. CAUGHT	SPECIES FREQUENCY
	MALLEE LITTER	OPEN AREA	TRIODIA COVER			MALLEE LITTER	OPEN AREA	TRIODIA COVER		
Iridomyrmex Sp.1	–	–	2	2	5%	–	–	–	–	–
" Sp.2	33	–	22	55	10%	–	31	4	35	5%
" Sp.3	–	–	–	–	–	–	13	14	27	12.5%
" Sp.5	74	32	131	237	60%	30	31	28	89	25%
" Sp.7	–	–	–	–	–	5	–	–	5	2.5%
Camponotus Sp.9	4	2	24	30	22.5%	1	23	2	26	17.5%
" Sp.11	–	–	–	–	–	–	–	1	1	2.5%
Melophorus Sp.2	16	8	6	30	25%	–	11	20	31	15%
" Sp.3	2	–	–	2	2.5%	2	–	–	2	2.5%
" Sp.4	–	–	2	2	2.5%	–	–	–	–	–
Meranoplus Sp.2	–	–	–	–	–	–	6	–	6	2.5%
Tapinoma Sp.1	1	–	–	1	2.5%	–	–	–	–	–
Rhytidoponera Sp.1	–	6	–	6	2.5%	3	8	3	14	15%
" Sp.2	5	6	5	16	20%	4	13	3	20	20%
Pheidole Sp.1	3	5	2	10	10%	–	–	1	1	2.5%
Crematogaster Sp.1	22	5	8	35	25%	–	29	–	29	5%
" Sp.4	24	4	6	34	12.5%	–	8	–	8	2.5%
Monomorium Sp.1	1	–	–	1	2.5%	–	–	–	–	–
Sexual stage unknown Sp.	3	–	–	3	7.5%	–	–	–	–	–
TOTAL NO. OF SPECIES FOUND IN MICRO-HABITAT	12	8	10	15		6	10	9	14	

2mm Squares

APPENDIX 3.4 : ANT SPECIES NOS. AND INDIVIDUAL NOS. CAPTURED AT MV1

	FUNCTIONAL GROUPS	UNBURNT SECTION			BURNT SECTION		
		No. Species	No. Individuals	Frequency	No. Species	No. Individuals	Frequency
1	DOMINANT SPECIES *Iridomyrmex*	3	294	65%	4	156	42·5%
2	SUBORDINATE SPECIES *Camponotus*	1	30	25%	3	29	22·5%
3a	HOT CLIMATE SPECIALISTS *Melophorus, Meranoplus*	3	34	30%	3	39	20%
4b	SUB-CRYPTIC SPECIES *Tapinoma*	1	1	2·5%	–	–	–
5	OPPORTUNISTS *Rhytidoponera*	2	22	20%	2	34	30%
6	GENERALISED MYRMICINES *Pheidole, Crematogaster Monomorium*	4	80	40%	3	38	10%

* Frequency – % of pitfalls functional group found in.

2mm Squares

APPENDIX 4.1 : SHRUB AND TOPOGRAPHY RELATIONSHIPS TO1

	Recordings (minimum 10 recordings)					
NAME	upslope	downslope	Crest	Swale	Total	Rank
Cassia nemophila (var)	24	22	10	54	110	1
Acacia colletioides	19	14	11	37	81	2
Beyeria opaca	19	14	10	21	64	3
Grey-leafed mallee	19	10	10	17	56	4
Eremophila spp.	10	9	5	31	55	5
Solanum coactiliferum	14	8	9	20	51	6
Green-leafed mallee	8	11	6	14	39	7
Halgania cyanea	11	8	6	9	34	8
Wboisia hopwoodii	11	6	8	3	28	9
Acacia ligulata	8	—	8	7	23	10
Acacia burkittii	9	5	1	8	23	10
Olearia spp.	4	1	11	6	22	12
Dodonaea spp.	6	7	1	4	18	13
Chenopod spp.	2	3	—	12	17	14
Myoporum platycarpum	6	2	3	—	11	15
TOTALS -	170	120	99	243	632	

Life-form and Topography Relationships

Life-form	Recordings Upslope	downslope	Crest	Swale	Total
KS	27	21	16	31	105
S	10	7	4	11	32
SA	7	12	8	11	38
SB	18	10	12	15	55
SC	22	17	13	25	77
SD	23	20	15	26	84
H	6	5	8	5	24
GL	12	8	9	13	43
J	12	7	5	18	42
LB	7	2	8	2	19

Upslope recordings : 145
Downslope recordings : 109
Crest recordings : 98
Swale recordings : 157

APPENDIX 4.2 : MUIR'S CODE (1977)

(Muir, B.G. (1977) Rec.West.Aust.Mus.suppl.3)

LIFE FORM/HEIGHT CLASS	CANOPY COVER			
	DENSE 70 - 100% d	MID DENSE 30 - 70% c	SPARSE 10 - 30% i	VERY SPARSE 2 - 10% r
T Trees > 30 m (co)	Dense Tall Forest	Tall Forest	Tall Woodland	Open Tall Woodland
M Trees 15 - 30 m	Dense Forest	Forest	Woodland	Open Woodland
LA Trees 5 - 15 m	Dense Low Forest A	Low Forest A	Low Woodland A	Open Low Woodland A
LB Trees < 5 m	Dense Low Forest B	Low Forest B	Low Woodland B	Open Low Woodland B
KT Mallee tree form	Dense Tree Mallee	Tree Mallee	Open Tree Mallee	Very Open Tree Mallee
KS Mallee shrub form	Dense shrub Mallee	Shrub Mallee	Open Shrub Mallee	Very Open Shrub Mallee
S Shrubs > 2 m	Dense Thicket	Thicket	Scrub	Open Scrub
SA Shrubs 1.5 - 2.0 m	Dense Heath A	Heath A	Low Scrub A	Open Low Scrub A
SB Shrubs 1 0-1.5 m	Dense Heath B	Heath B	Low Scrub B	Open Low Scrub B
SC Shrubs 0.5 - 1.0 m	Dense Low Heath C	Low Heath C	Dwarf Scrub C	Open Dwarf Scrub C
SD Shrubs 0.0 - 0.5 m	Dense Low Heath D	Low Heath D	Dwarf Scrub D	Open Dwarf Scrub D
P Mat plants	Dense Mat Plants	Mat Plants	Open Mat Plants	Very Open Mat Plants
H Hummock Grass	Dense Hummock Grass	Mid Dense Hummock Grass	Hummock Grass	Open Hummock Grass
GT Bunch grass > 0.5 m	Dense Tall Grass	Tall Grass	Open Tall Grass	Very Open Tall Grass
GL Bunch grass < 0.5 m	Dense Low Grass	Low Grass	Open Low Grass	Very Open Low Grass
J Herbaceous spp.	Dense Herbs	Herbs	Open Herbs	Very Open Herbs
VT Sedges > 0.5 m	Dense Tall Sedges	Tall Sedges	Open Tall Sedges	Very Open Tall Sedges
VL Sedges < 0.5 m	Dense Low Sedges	Low Sedges	Open Low Sedges	Very Open Low Sedges
X Ferns,	Dense Ferns	Ferns	Open Ferns	Very Open Ferns
Mosses, Liverwort	Dense Mosses	Mosses	Open Mosses	Very Open Mosses
L1 Lichens	Dense Lichens	Lichens	Open Lichens	Very Open Lichens

APPENDIX 4.3 : COMPARISONS BETWEEN MICROHABITAT AND INVERTEBRATE CAPTURE RATE

T01 Micropitfalls
Insects - Non-ant

ORDER	sp.No. n=27	MICROHABITATS: Total f	Total No. n=95	Vegetation Cover: Open ground f	Open ground No. n=59	Overhung by mallee f	mallee No.	Overhung by other f	other No.	Litter presence: none f	none No.	sparse f	sparse No. n=53	mod. f	mod. No.	?
DIPTERA	1	13	24	9	12	2	8	2	4	3	4	4	6	5	10	2
	2	3	3	3	3					1	1			2	2	
	3	4	8	3	5			1	3	2	4	2	4			
	4	1	2	1	2					1	2					
	5	3	3	2	2			1	1			2	2			1
	6	3	5	2	4			1	1			2	4	1	1	
	7	1	7	1	7							1	7			
	9	1	1	1	1							1	1			
	10	1	1					1	1			1	1			
	11	1	1	1	1					1	1					
	12	1	1	1	1					1	1					
COLEOPTERA	1	1	1	1	1					1	1					
	5	4	13	1	5	1	1	2	6	1	1	2	6	1	5	
	6	2	2	1	1	1	1					1	1	1	1	
	7	1	1			1	1							1	1	1
	8	1	1	1	1							1	1			
	10	1	1			1	1					1	1			
COLEOPTERA LARVAE		1	2	1	2									1	2	
HEMIPTERA	1	4	5	3	4			1	1			2	3	1	2	
	2	4	5	2	2	1	2	1	1			3	4	1	1	1
HYNUNOPTERA	1	1	1	1	1					1	3					
DERMAPTERA	1	1	1					1	1			1	1			
ISOPTERA	1															
ORTHOPTERA	1	1	1	1	1									1	1	
BLATTODIA	1	1	1	1	1					1	1					
COLLEMBOLA		(Present but not analysed)														
COLLEOPTERA	1	1	1													
COLEOPTERA	6A	2	2			1	1	1	1			2	2			
Totals			95		57		15		70		15		46		26	

APPENDIX 4.3 (continued)

T01 Micropitfalls
- Ants

GENUS	sp.No.	Occur. freq. (%)	Total No.	Vegetation: Open ground f*	Open ground No.	Overhung by mallee f	mallee No.	Overhung by other f	other No.	Litter: none f	none No.	sparse f	sparse No.	mod f	mod No.
IRIDOMYRMEX	1	2.9	1	1	1					1	1				
	2	17.0	151	4	65	2	86					5	143	1	8
	3	8.6	22	2	11	1	11					1	11	2	11
	4	2.9	9	1	9					1	9				
	5	57.0	406	14	370	3	33	3	3	6	191	8	157	6	57
	6	8.6	21	1	19			2	2			3	20		
	7	5.7	5			2	5					1	1	1	4
	sp.	2.9	1	1	1									1	1
CAMPONOTUS	3	5.7	4	1	1	1	3					2	4		
	7	8.6	14			3	14			1	10	1	1	1	3
MERANOPLUS	6	2.9	1	1	1									1	1
	sp.	2.9	1			1	1					1	1		
MELOPHORUS	4	2.9	1			1	1					1	1		
STIGMACRPSS	1	5.7	2	2	2					2	2				
	3	2.9	7	2	7					2	7				
TAPINOMA	2	2.9	1	1	1							1	1		
RHYTIDOPONERA	2	2.9	1			1	1					1	1		
	3	11.4	4	3	3			1	1	1	1			3	3
CREMATOGASTER	1	31.4	58	8	23	2	13	1	5	2	7	6	19	3	15
	3	20.0	60	4	34	2	11	1	15	1	14	4	35	2	11
PHEIDOLE	1	11.4	121			1	26	3	95			2	87	2	34
	2	11.4	37	3	10	1	27					3	86	1	1
	5	5.7	25	1	3			1	22			2	25		
CHELANER	1	34.2	86	10	53	1	13	1	22	4	24	4	38	4	26
TETRAMORIUM	4	2.9	10			1	10					1	10		
BRACHYPONERA	1	2.9	1	1	1					1	1				
Totals			1055		621		255		165		267		603		175

*f indicates number of micropitfalls it occurred in.

APPENDIX 4.3 (continued)

T01 Micropitfalls
Non-insect Invertebrates

ORDER	sp.No. n=10	Total f n=16	Total No.	MICROHABITATS: Vegetation Cover: Open ground f n=12	Open ground No.	Overhung by mallee f	mallee No.	Overhung by Other f	Other No.	Litter presence: none f	none No.	sparse f n=10	sparse No.	mod. f	mod. No.	?
ARANAEA	1	2	2	2	2					1	1			1	1	
	4	1	1	1	1							1	1			
	6	2	4	2	4					1	2	1	2			
	7	2	2	2	2							2	2			
	10	1	1	1	1							1	1			
	11	1	1			1	1					1	1			
	12	0	0													
ACARINA	1	1	2					1	2			1	2			
	2	2	2	1	1	1	1					1	1	1	1	
	3	1	1	1	1					1	1					1
Totals			16		12		2		2		4		10		2	

Totals

Non-ant invertebrates	111	63%	70						47%	53	
Ants	1055	58%	621						57%	603	
Habitats	35	60%		20%		20%		30%	90%		30%

Total No. of Invertebrate species = 67

Total No. of Non-ant species = 37

APPENDIX 5.1 : SPECIES LIST FOR BURNED PATCH LB1

FAMILY	GENUS + SPECIES	VOUCHER NO.	LIFEFORM	FLOWERING
GRAMINEAE	*Amphipogon caricinus*	20	GL	–
	Triodia irritans	1	H	Seed pods
LILIACEAE	*Lomandra effusa*	13	J	–
PROTEACEAE	*Grevillea huegelii*	41	SC	–
	Grevillea ptérosperma	37	SD	–
	Hakea leucoptera	–	SD	–
CHENOPODIACEAE	*Enchylaena tomentosa*	88	SD	Fruit
	Maireana pentatropis	15	SD	–
	Rhagodia spinescens	36	SD	–
	Sclerolaena diacantha	14	SD	–
	Sclerolaena obliquicuspis	12	SD	–
AMARANTHACEAE	*Ptilotus exaltatus* var. *exaltatus*	18	J	Dead Flower head
LEGUMINOSAE (MIMOSACEAE)	*Acacia burkitthi*	7	S, SA, SC, SD	Flower heads formir
	Acacia ligulata	17	SC	–
	Acacia notabilis	31	SC	–
	Acacia nyssophylla	–	SC	–
(CAESALPINACEAE)	*Cassia nemophila* var. *coriacea*	42	SA, SD	–
	Cassia nemophila var. *zygophylla*	3	SA, SB, SC, SD	–
(FABACEAE)	*Eutaxia microphylla* var. *microphylla*	27	SD	–
ZYGOPHYLLACEAE	*Zygophyllum apiculatum*	34	SD	–
EUPHORBIACEAE	*Beyeria opaca*	9	SC, SD	Fruit
MYRTACEAE	*Baeckea crassifolia*	35	SD	–
	Micromyrtus ciliata	22	SD	–
	Eucalyptus dumosa	10	KS	–
	Eucalyptus foecunda	23	KS	–
	Eucalyptus [illegible]	–	KS	✓

APPENDIX 5.1 (continued)

FAMILY	GENUS & SPECIES	VOUCH NO.	LIFEFORM	FLOWERING
LOGANIACEAE	Logania ruda	39	J	✓
BORAGINACEAE	Halgania cyanea	32	SD	✓
LABIATAE	Westringia rigida	25	SB, SC, SD	–
SOLANACEAE	Duboisia hopwoodii	24	SB, SC, SD	–
	Solanum coactiliferum	33	SD	✓
MYOPORACEAE	Eremophila decipiens	26	SC, SD	✓
	Eremophila glabra	4	SB, SC, SD	✓
	Eremophila scoparia	40	SD	✓
	Eremophila sturtii	30	SC	–
	Myoporum platycarpum	–	LB	–
COMPOSITAE	Olearia pimeleoides	2	SC, SD	–
	Podolepis capillaris	21	J	✓

APPENDIX 5.2 : SPECIES LIST FOR UNBURNED PATCH LB1

FAMILY	GENUS + SPECIES	VOUCH NO.	LIFEFORM	FLOWERING
GRAMINEAE	*Amphipogon caricinus*	20	GL	–
	Triodia irritans	1	H	Seed pods
CHENOPODIACEAE	*Enchylaena tomentosa*	38	SD	Fruit
	Maireana pentatropis	15	SD	–
AMARANTHACEAE	*Ptilotus exaltatus* var. *exaltatus*	18	J	–
LEGUMINOSAE (MIMOSACEAE)	*Acacia burkittii*	7	S, SA, SB, SC	Flower heads forming
	Acacia colletioides	8	S, SA, SB, SC	–
	Acacia notabilis	31	S	–
	Acacia nyssophylla	–	S	–
(CAESALPINIACEAE)	*Cassia nemophila* var. *platypoda*	5	S, SD	–
	Cassia nemophila var. *zygophylla*	3	SA, SB, SC, SD	–
ZYGOPHYLLACEAE	*Zygophyllum apiculatum*	34	SD	–
	Zygophyllum eremaeum	16	SD	–
EUPHORBIACEAE	*Beyeria opaca*	9	SB, SC, SD	Fruit
MYRTACEAE	*Eucalyptus dumosa*	10	KT, KS	–
	Eucalyptus foecunda	23	KT	–
	Eucalyptus gracilis	–	KT, KS	✓
	Eucalyptus socialis	6	KT, KS	–
LABIATAE	*Westringia rigida*	26	SD	–
MYOPORACEAE	*Eremophila glabra*	4	SB, SC, SD	✓
	Eremophila sturtii	30	SA	–
COMPOSITAE	*Olearia muelleri*	11	SC	–
	Olearia pimeleoides	2	SC, SD	–
	Podolepis capillaris	21	J	–

APPENDIX 5.3 : NUMBER OF MICROPITFALL CAPTURES - ANT SPECIES - LB1 UNBURNED PATCH

Functional Group	
1. Iridomyrmex Sp 1.	24 (4), 21 (100+), 30(3), 33(3), 39 (50)
" 2.	1 (11), 4(1), 10(1), 14(5), 32(8), 35 (9), 39 (100+);
" 5	4 (4), 16(3), 23 (9), 27 (16), 31(3), 32 (5)
2. Camponotus Sp 1.	27 (1), 38 (1)
" 3	33 (3),
" 7	35 (2)
" 8	23 (1)
3. Melophorus	21 (2), 27 (1), 30 (21), 36 (5), 38 (8)
Prolasius	16 (4), 30 (4),
Notoncus	25 (1)
5. Rhytidoponera	1 (1), 24 (1), 25 (1), 27(1), 29 (1), 39 (1), 40 (1)
6. Notoncus	1(86), 4(3), 16(3), 23 (3), 24 (1),
Rhiodicle Sp. 1.	26(50+), 27 (1), 29(4), 32(9), 33(6), 38(4), 39(2), 40(1)
" 2.	30 (3)
Crematogaster	4(5), 10(12), 16 (9), 24(11), 27(5), 31(3), 33(3), 36(2), 38(2)

APPENDIX 5.4 : NUMBER OF MICROPITFALL CAPTURES - ANT SPECIES - LB1 BURNED PATCH

Functional Group	
1. Iridomyrmex Sp 1.	44 (100+), 47 (30), 50 (1), 56 (4), 60 (1), 67 (1), 68 (1), 74 (2)
" 2.	41 (100+), 44 (9), 46 (100+), 47 (50+), 48 (13), 51 (50+), 56 (18), 54 (5), 60 (3), 72 (7), 74 (47), 78 (3), 80 (2),
" 5.	47 (13), 56 (3), 57 (9), 78 (23), 80 (12).
" 6.	74 (2)
2. Camponotus Sp 3.	41 (1), 47 (1), 57 (3), 80 (1),
3. Meloptheres	47 (2), 48 (2), 51 (4), 60 (1)
5. Rhytidoponera	41 (4), 46 (1), 48 (1), 72 (2), 75 (2), 78 (3), 79 (1), 80 (2)
6. Meranoplus	51 (6)
Pheidole Sp 1.	54 (2), 57 (8), 60 (3), 73 (2), 80 (2).
Crematogaster	50 (6), 54 (5), 57 (4), 60 (2), 79 (5)

APPENDIX 5.5 : METHODS AND CAPTURE OF NON-ANT ORDERS LB1

Non-Ant Orders	Capture Methods Number of Species (Number of Individuals)		
	Microfalls	Pitfalls	Hand Capture
Acarina	1 (8)	—	—
Araneae	1 (7)	—	1 (1)
Collembola	1 (45)	—	—
Coleoptera	3 (12)	—	—
Diptera	6 (38)	—	—
Hemiptera	1 (4)	—	—
Hymenoptera	1 (4)	—	—
Isoptera	1 (3)	—	—
Lepidoptera	2 (2)	—	—
Orthoptera	—	—	3 (5)

APPENDIX 5.6 : NUMBERS OF MICROPITFALL CAPTURES - NON-ANT ORDERS LB1 UNBURNED PATCH

Acarina Sp B	25 (2), 26 (1), 29 (1), 30 (1), 32 (1),
Araneae Sp B	27 (2), 33 (3),
Collembola Sp 1	21 (1), 24 (1), 25 (1), 27 (1), 29 (1), 30 (1), 33 (1), 38 (1), 39 (1), 40 (1)
Coleoptera Sp A	10 (1), 30 (3), 27 (1),
Sp B	16 (2), 29 (1), 36 (1),
Sp F	31 (1)
Diptera Sp B	16 (3),
" C	16 (1), 29 (3), 30 (2), 33 (1),
" D	1 (1),
" F	1 (1), 16 (1), 35 (1),
" R	23 (1),
" T	25 (1), 36 (1), 38 (1), 39 (1),
Hymenoptera Sp B	31 (1)
Lepidoptera Sp A	24 (1)

APPENDIX 5.7 : NUMBERS OF MICROPITFALL CAPTURES - NON-ANT ORDERS LB1 BURNED PATCH

Acarina Sp B	44 (1), 47 (1).
Araneae Sp B	48 (1), 68 (1).
Collembola Sp 1	41 (1), 44 (1), 46 (1), 48 (1), 50 (1), 57 (1), 60 (3), 67 (2), 68 (7), 72 (1), 78 (6).
Coleoptera Sp A	67 (1)
Sp B	78 (1)
Diptera Sp C.	47 (3), 48 (1), 54 (1), 56 (1) 57 (3), 72 (1)
Sp F.	41 (1), 48 (1), 54 (1), 56 (1), 57 (1), 67 (2), 72 (1)
Hemiptera Sp A	47 (4)
Hymenoptera Sp B	78 (3)
Isoptera Sp A	54 (1), 57 (1), 68 (1)
Lepidoptera Sp E	56 (1)

APPENDIX 5.8 : MICROHABITATS OF MICROPITFALLS WITHIN VSA 2 LB1

Micropitfall Numbers	Description of Microhabitat.
LB1 1	Bare sand, 20 cm from small Triodia irritans.
4	Between T. irritans; some leaf litter.
10	Under Acacia colleticides, lots of litter.
16	Open area, some litter.
21	Near T. irritans, some litter.
22	" " " "
24	Open area, some litter.
25	In middle of T. irritans, some litter.
26	Open area. plenty of litter.
27	Open area, near T. irritans, some litter.
29	" ", some litter.
30	" ", plenty of litter, 30 cm from T. irritans.
31	" ", dead T. irritans, some litter.
32	Under Eucalyptus dumosa, near T. irritans, plenty of litter.
33	Bare, open area, very little litter, 30 cm from T. irritans.
35	Completely bare area, no litter
36	Under E. dumosa, near T. irritans, a lot of litter.
38	Open area, 30 cm. from T. irritans, some litter.
39	Open area, some litter.
40	Under E. dumosa, near T. irritans, some litter.

APPENDIX 5.9 : MICROHABITATS OF MICROPITFALLS WITHIN VSA 1 LB1

Micropitfall Numbers		Description of Microhabitat.
LB1	41	Bare area, 30 cms from T. irritans
	44	Open area, near Halganea cyanea
	46	" " , near small Halganea.
	47	Completely open, 50 cm to Halganea
	48	" " 50 cm to Grevillea.
	50	Under Eucalyptus socialis, near Halganea
	51	" E. dumosa, near Halganea, some litter.
	54	Open area, near Halganea, very little litter.
	56	Under E. dumosa, some litter.
	57	Open area, near Halganea.
	60	Open area, near Eremophila divaricata
	62	" " near Halganea.
	67	In T. irritans ring.
	68	Completely open, 50 cm to T. irritans.
	72	Near T. irritans, some litter.
	73	Open area, near T. irritans, some litter.
	74	" " , near Halganea
	78	Completely open ~ 80 cm from T. irritans.
	79	Open area, near T. irritans.
	80	" " " " "

APPENDIX 6.1 : SOIL PROFILE RECORD SHEET - EB1

SOUTH AUSTRALIAN COLLEGE OF ADVANCED EDUCATION — SALISBURY

SOIL PROFILE RECORD SHEET

ECOTONE MALLEE/BLACKOOH

Salinity	PROFILE SKETCH	COLOUR	WATER CONDITIONS	TEXTURE	STRUCTURE	pH	ORGANIC MATTER	MINERAL ACCUMULATIONS
·04ms (CM. 0–10)	Aoo: / Ao: moisture mark	W - 2·5YR 3/6 D - 2·5YR 4/8	Moist	Sandy loam	Weakly pedal	7	No obvious OM except for small roots	no CaCO3
(10–20)	A	W - 2·5YR 3/6 D - 2·5 YR 4/8	Moist	Sandy loam	Weakly pedal	8½	roots of plants	no CaCO3
·13ms (30)		W - 2·5YR 3/6 D - 2·5YR 4/8	Moist	Sandy clay loam	Massive	8½	roots of plants	no CaCO3
(40)	B							
·61ms (50)		W - 2·5YR 4/6 D - 2·5YR 4/8	Moist	Sandy clay loam	Massive	9		yes CaCO3
(60)		W - 2·5YR 4/6 D - 2·5YR 4/8	Moist	Sandy clay loam	Massive	9-9½		yes CaCO3
(70)		W - 2·5YR 4/6 D - 2·5YR 5/8	Moist	Sandy clay loam	Massive	9-9½		yes CaCO3
·77ms (80–90)		W 2·5YR 4/8 D 2·5YR 5/8	Moist	Sandy clay loam	Massive	9-9½		yes CaCO3
(100)		W - 2·5YR 4/8 D - 2·5YR 5/8	Moist	Sandy clay loam	Massive	9-9½		yes CaCO3
(110–160)								

Called Dr as it has more than 1·5 texture groups through texture testing, as well as appearance.

Classified as Dr as 2·5YR is redder than 5YR

Considered as whole coloured as value chroma rating of blotches (lime) is the same as the matrix (uncoloured diag) We could determine if it was hardsetting or not as the soil wasn't dry so we could do the drop weight test as suggested in the definition.

Considered however to be hardsetting in the end as it had a surface crust and allocation of this soil type fits better than if it would be considered not hardsetting.

Dr 2·1 – As no A2 horizon

Dr 2·13 – As has alkaline SRT.

PROFILE NUMBER: Number 1

LOCATION/MAP REFERENCE: EB1

PARENT MATERIAL: ----------

DEGREE OF SLOPE: 3° ecotone mall blacke

VEGETATION/LAND USE: Cossarina

RAINFALL: <250mm

Influence of CLIMATE

Influence of PARENT MATERIAL

Influence of SLOPE: little

Influence of ORGANIC MATTER: little

Influence of TIME: —

APPENDIX 6.2 : VEGETATION SPECIES LIST FOR EB1

CASUARINACEAE

Casuarina cristata

CHENOPODIACEAE

Atriplex stipitata
Einadia nutans
Enchylaena tomentosa
Maireana georgei
Maireana pentatropis
Maireana sedifolia
Salsola kali
Sclerolaena diacantha.

AMARANTHACEAE

Ptilotus spp.

LEGUMINOSAE

Acacia colletioides.
Cassia nemophila var coriaceae.
Cassia nemophila var platypoda.
Cassia nemophila var zygophylla.
Templetonia egena.

ZYGOPHYLLACEAE

Zygophyllum billardierei

EUPHORBIACEAE

Beyeria opaca.

SAPINDACEAE

Dodonaea atteneuata
Heterodendrum oleaefolium

THYMELAEACEAE

Pimelea microcephala

MYRTACEAE

Eucalyptus dumosa
Eucalyptus gracilis
Eucalyptus incrassata
Eucalyptus socialis

SOLANACEAE

Eremophila glabra
Eremophila oppositifolia
Myoporum platycarpum

COMPOSITAE

Olearia muelleri
Podolepis capillaris
Vittadinia trilobia.

Triodia irritans

APPENDIX 6.3 : MICROPITFALL INVERTEBRATES - NON-ANT SPECIES EB1

NON-ANT		MICROHABITAT (Number of Pitfalls)															
		Open (20) Ground		Triodia (3)		Acacia (3) Colletoides		Dodanaea(9) attenuata		Allocasurina cristata (2)		Mallee (1)		Other (2)		Total (40)	
ORDER	Sp.	f%	No.	f%	No.	f%	No.	f%	No.	f%	No.	f%	No	f%	No.	f%	No.
ARANEAE	1	20	4	2	4			1	1							7	9
	12	1	5													1	5
	13	1	1			2	10		1	2	11					6	23
	16													1	1	1	1
	18	10	23	2	4			5	20			1	2	1	6	19	55
	19							1	1							1	1
	20	1	1					1	1							2	2
	21			1	1	1	1	1	1							3	3
	22							1	1							3	3
	23									1	1					1	1
	24	5	13					2	4			1	4	1	1	9	22
	25							1	2							1	2
	26	2	2													2	2
DIPTERA	1																
	2	5	11	1	3											6	14
	3	2	4											1	2	3	7
	4	3	12													3	12
	7	1	2					1	3							1	5
	9	1	2			1	1	1	1	1	2					4	6
	10	1	1					1	1							2	2
	11											1	1			1	1
	12	13	117	2	13	3	16	8	30	1	4	1	10	1	2	29	192
	13	1	1	1	3											2	4
	14	6	27	1	2	2	3	1	5							10	37
COLEOPTERA	1	1	2					1	1							2	3
	4																
	9	1	1			1	1									2	2
	10	3	3			1	2							1	1	5	6
	11			1	1											1	1
	12	3	3	1	1			4	4					1	1	9	9
	13	1	2					1	1							2	3
	14	1	1									1	1			2	2
ACARI	1	2	2	1	1			1	1							4	4
	2	1		1	1											2	2
AMPHIPODA	1	2	3					2	2							2	5
COLLEMBOLA	1	4	19			2	5									6	24+
HEMIPTERA	4			1	1			1	1							2	2
ISOPTERA	1							2	6	2	3					4	9
ORTHOPTERA	4	1	1													1	1
THYSANOPTERA	1	1	1													1	1

APPENDIX 6.4 : MICROPITFALL INVERTEBRATES - ANT SPECIES EB1

ANTS		MICROHABITAT (Number of Pitfalls)															
		Open Ground (20		Triodia (3)		Acacia (3) colletioides		Dodanaea(9) attenuata		Allocasurina cristata (2)		Mallee (1)		Other (2)		Total	
GENUS	Sp.	f%	No.	f%	No.	f%	No.	f%	No.	f%	No.	f%	No	f%	No.	f%	No.
CAMPONOTUS	2	2	2					1	1							3	3
	3			1	2											1	2
	7																
	9	1	4													1	4
	11	1	1													1	1
IRIDOMYRMEX	1																
	2	2	20					1	1							3	21
	3	9	19	1	1			1	1	1	1					12	22
	5	14	136	2	61	2	22	8	61	2	8	1	20	2	18	31	326
	7	3	3	1	1			2	2							6	6
	8	1	1													1	1
CREMATO-GASTER	1																
	2																
	4			1	1											1	1
PHEIDOLE	1	9	28	1	1	1	4	1	1			1	3	1	3	14	40
	3	1	1													1	1
	4	1	34													1	34
	6							1	7					1	2	2	9
	7	1	6													1	6
TETRAMORIUM	1																
	2	2	3													2	3
	3	1	1													1	1
RHYTIDOPONERA	1							2	11							2	11
	2	9	14	1	2			4	6			1	2	1	1	16	25
MELAPHORUS	2							1	3							1	3
	3																
	4	1	1					1	1							2	2
CHELANER	1																
PODOMYRMA	1																
CALOMYRMEX	1	1	1													1	1
TAPINOMA	1	1	2													1	2
MONOMORIUM	1	1	1													1	1
MERANOPLUS	2	1	1					1	1							2	2
NOTONCUS	2	1	10			1	5	2	6	2	27			1	20	7	68
STIGMACROS	1							1	1							1	1
BRACHYPONERA	1	1	1					1	2							2	3
UNKNOWN				1	1											1	1

APPENDIX 6.5 : ANT ASSOCIATIONS TO PLANT COMMUNITIES

ANTS		PLANT COMMUNITY					
		Mallee Triodia 14 micropitfalls		Blackoak 26 micropitfalls		TOTAL	
GENUS	Sp.	f%	No.	f%	No.	f%	No.
CAMPONOTUS	2	14.3	2	3.8	1	7.5	3
	3	7.1	2			2.5	2
	9			3.8	4	2.5	4
	11			3.8	1	2.5	1
IRIDOMYRMEX	2	14.3	20	3.8	1	7.5	21
	3	42.9	14	23.1	8	30.0	20
	5	71.4	133	80.8	193	77.5	330
	7	21.4	3	11.5	3	15.0	6
	8	7.1	1			2.5	1
CREMATOGASTER	4	7.1	1			2.5	1
PHEIDOLE	1	57.1	28	23.1	12	35.0	48
	3			3.8	1	2.5	1
	4			3.8	34	2.4	34
	6			7.7	9	5.0	9
	7			3.8	6	2.5	6
TETRAMORIUM	2	7.1	2	3.8	1	5.0	3
	3			3.8	1	2.5	1
RHYDITOPONERA	1			7.7	11	5.0	11
	2	35.7	8	42.3	17	40.0	25
MELOPHORUS	2			1	3	2.5	3
	4	7.1	1	1	1	5.0	2
CALOMYRMEX	1	7.1	1			2.5	1
TAPINOMA	1	7.1	2			2.5	2
MONOMORIUM	1	7.1	1			2.5	1
MERANOPLUS	2			7.7	2	5.0	2
NOTONCUS	2			26.9	68	17.5	68
STIGMACROS	1			3.8	1	2.5	1
BRACHYPONERA	1			7.7	3	5.0	3
UNKNOWN			1			2.5	1
		No. of sp. 16	Total 220	No. of sp. 20	Total 381		601

APPENDIX 6.6 : BIRDS RECORDED ALONG TRANSECTS IN EB1

SPECIES	TRANSECT				TOTAL
	1	2	3	4	
White browed babbler	15	4	10	5	34
Spiney cheeked honeyeater	12	18	25	9	64
Crested pigeon	3				3
Red capped robin	7	11	4	6	28
Mistletoe bird	1	3	3		7
Whitebrowed treecreeper	1	2	4		7
Crested bellbird	5	4	3	2	14
Grey shrike thrush	1	2	1		4
Fantailed cuckoo	1				1
Mulga parrots	2	5	11	16	34
Chesnut rumped thornbill	17	18	23+	26	74+
Pied honeyeater		1			
Weebills	4	7	17	26	54
Jacky Winter		2	2	1	5
Brown treecreeper		1		1	2
Grey fantail	2	5	6	2	15
Inland thornbill	4	2	1		7
Mallee ringneck	4	1	2	5	12
Singing honeyeater		5	2		7
Striped honeyeater			5		5
Grey butcherbird				5	5
Splendid fairy wren	2	2		8	12
Yellow-rumped thornbill	2			7	9
Mallee fowl				Heard twice	
Brown headed honeyeater		1			1
Yellow plumed honeyeater		1			1
Black eared cuckoo		1	2		3
White winged fairy wren		1	8	1	10
Black faced cuckoo shrike				2	2
White browed woodswallow				1	1
Common bronzewing	2		3		5
Pied butcherbird	4		3	2	9
Australian raven	5				5
Galah	2				2
White eared honeyeater	2	2	1	1	6
Southern whiteface		10	2	5	17
White fronted honeyeater		1		2	3
Grey currawong				1	1
Chestnut crowned babbler	5				5
	101	110	140	134	485

APPENDIX 6.7 : BIRDS OF EB1 FOR EACH DAY AND THE PLANT COMMUNITY THEY OCCURRED IN

	DAY					COMMUNITY			
SPECIES	1	2	3	4	Total	Mallee	Mallee/ Blackoak	Blackoak	Heard or Overhead
Whitebrowed babblers	9	5	11	9	34	1	8	25	
Spiney cheeked honeyeater	27	7	23	15	72	6	3	61	
Crested pigeon	3				3			3	
Redcapped robin	11	5	5	8	29	3	1	25	
Mistletoe bird	4	1	2		7			7	
Whitebrowed treecreeper	1	2	4		7			7	
Crested bellbird	4	5	1	5	15	3		12	
Grey shrike thrush	2	2			4			4	
Fantailed cuckoo	1							1	
Mulga parrots	9	12	11	6	38	6		32	
Chestnut rumped thornbill	16	25	11+	31	83+	13	9	63+	
Pied honeyeater		1			1	1			
Blackfaced cuckoo shrike		10	6		16			2	14
Weebill	13	25	2	12	52	21	15	17	
Jacky Winter		2	2	1	5	2		3	
Australian Raven		7	4		11	3		2	6
Brown Treecreeper	3	1		1	5			5	
Grey Fantail		5	1	9	15	7	3	4	
Inland thornbill		2	1	4	15	7	3	4	
Mallee ringneck		3	4	5	12	3	1	8	
Singing honeyeater		2			2			2	
Striped honeyeater				4	5			5	
Grey butcherbird			3	2	5	2		3	
Splendid fairy wren	2	4		6	12	4	2	6	
Yellow rumped thornbill		2	5	2	9			9	
Mallee fowl			Heard	Heard					2
Brownheaded honeyeater	1				1	1			
Yellow-plumed honeyeater	1				1			1	
White fronted honeyeater		2		1	3	1	2		
Blackeared cuckoo	3				3			3	
White-winged fairy wren	5	10			15		1	14	
Australian magpie		1		1	2				2
Whitebrowed woodswallow			1		1			1	
Common bronzewing	3			2	5		2	3	
Pied butcherbird	2	4		3	9	1		8	
Galah		2			2		2		
White eared honeyeater		2	2	2	6	3	1	2	
Southern whiteface			10	2	12	12			
Grey currawong		1			1	1			
Chestnut crowned babbler			5		5			5	
Total	120	148	117	131	516	96	50	348	22

APPENDIX 7.1 : SOIL PROFILE SHEET EB2

SOUTH AUSTRALIAN COLLEGE OF ADVANCED EDUCATION Uc 1·22 SALISBURY

SOIL PROFILE RECORD SHEET

CM.	PROFILE SKETCH	COLOUR	WATER CONDITIONS	TEXTURE	STRUCTURE	pH	ORGANIC MATTER	MINERAL ACCUMULATIONS
10	Aoo: / Ao:	2·5 YR 4/8	damp	loamy sand	structureless	6½-7	dark staining roots	·04 mS (soil salinity)
30		2·5 YR 4/8	damp	clayey sand		7½	roots	·02 mS
50	A	2·5 YR 5/8	damp	loamy sand		7½		·02 mS
90		2·5 YR 5/8	damp	clayey sand		8		·04 mS
140		5YR 5/8	dry	loamy sand		8		scattered patches of powdery lime (just visible) ·03 mS
160								

PROFILE NUMBER: EB2 P1

LOCATION/MAP REFERENCE: ----------

PARENT MATERIAL: ----------

DEGREE OF SLOPE: ----------

VEGETATION/LAND USE: Cellitris (lightly grazed in the past)

RAINFALL: ----------

Influence of CLIMATE: semi-arid

Influence of PARENT MATERIAL

Influence of SLOPE:

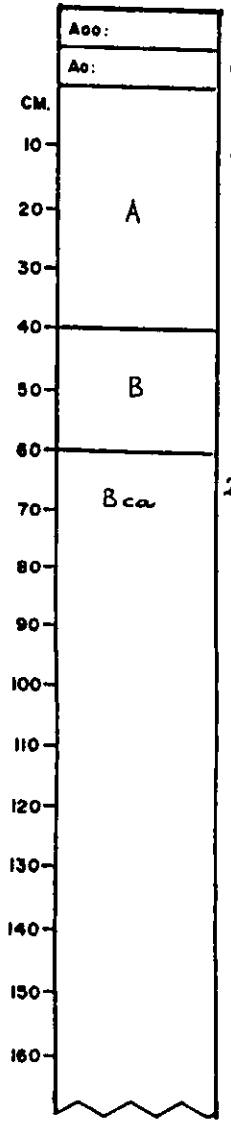
Influence of ORGANIC MATTER:

Influence of TIME:

APPENDIX 7.2 : SOIL PROFILE SHEET EB2

SOUTH AUSTRALIAN COLLEGE OF ADVANCED EDUCATION Uc 5.32. *SALISBURY*

SOIL PROFILE RECORD SHEET



COLOUR	WATER CONDITIONS	TEXTURE	STRUCTURE	pH	ORGANIC MATTER	MINERAL ACCUMULATIONS
2·5 YR 3/6	damp	loamy sand	massive	6½	-	·03 mS (soil salinity)
2·5 YR 4/6						
2·5 YR 3/6 (wet)				6½	-	·06 mS
2·5 YR 4/6	damp	clayey sand		6½	-	·54 mS
5YR 4/6 (wet)						
2·5 YR 4/8	dry	sandy loam		8½	-	calcium layer starts 1·24 mS
2·5 YR 4/6 (wet)						
5YR 6/6	dry	fine sandy loam	↓	9	-	calcium visible. 1·06 mS

PROFILE NUMBER: EB2 P2

LOCATION/MAP REFERENCE: ----------

PARENT MATERIAL: ----------

DEGREE OF SLOPE: 0°

VEGETATION/LAND USE: ----------

RAINFALL: ----------

Influence of CLIMATE

Influence of PARENT MATERIAL

Influence of SLOPE:

Influence of ORGANIC MATTER:

Influence of TIME:

APPENDIX 7.3 : DATA SHEET FOR EB2 - DUNE SWALE - USING STANDARD POINT QUARTER METHOD

Species name	Number of individuals	Average dominance	Relative density	Density	Dominance	Relative dominance	Number of points of occurrence	Frequency	Relative frequency	Importance value	Rank
E. fecunda	6	6·216	7·50	0·00345	0·0215	4·355	3	0·15	5·50	17·40	4
E. lumosa	27	20·198	33·75	0·01552	0·3159	63·788	17	0·85	30·90	128·00	1
E. gracilis	19	9·753	23·75	0·01092	0·1073	21·666	11	0·55	20·00	65·00	2
E. sociale	7	9·144	8·75	0·00402	0·0371	8.186	5	0·25	9·10	26·00	3
Cassia var. plat.	6	0·461	7·50	0·00345	0·0016	0·323	5	0·25	9·10	17·00	5
Acacia villelmiana	5	0·862	6·25	0·00287	0·0025	0·505	4	0·20	7·30	14·00	6
Cassia var. spp.	1	0·780	1·25	0·00057	0·0004	0·089	1	0·05	1·80	π	10
Grevillea hueglii	2	0·292	2·50	0·00115	0·0003	0·066	2	0·10	3·60	6.20	7
Acacia colletioides	1	12·570	1·25	0·00057	0·0071	1·445	1	0·05	1·80	4·50	9
Eremophila alentii	1	1·770	1·25	0·00057	0·0011	0·002	1	0·05	1·80	3·10	11
Atriplex stipitata	1	0·050	1·25	0·00057	0·0001	0·006	1	0·05	1·80	3·10	11
Rhiriana georgii	1	0·070	1·25	0·00057	0·0001	0·008	1	0·05	1·80	3·10	11
Rhiriana triptera	2	0·101	2·50	0·00115	0·0001	0·023	2	0·10	3·60	6·10	8
Rhiriana sedifolia	1	0·385	1·25	0·00057	0·0002	0·044	1	0·05	1·80	3·10	11
	80				0·4952			2·75			

APPENDIX 7.4 : DATA SHEET FOR EB2 - CALLITRIS CREST - USING STANDARD POINT QUARTER METHOD

Species name.	Number of individuals	Average dominance	Relative density	Density	Dominance	Relative Dominance	Number of points of occurrence	Frequency	Relative frequency	Importance values	Rank.
E. socialis	2	3.14	2.50	0.00170	0.00530	0.560	2	0.10	3.6	6.7	8
Acacia subspicata	1	0.20	1.25	0.00085	0.00017	0.018	1	0.05	1.8	3.1	10
E. fecunda	10	7.60	12.50	0.00850	0.06500	6.840	7	0.35	12.7	32.0	3
E. dumosa	27	23.53	33.75	0.02300	0.54000	56.840	15	0.75	27.3	118.0	1
Callitris ~~verrucosa~~	12	30.28	15.00	0.01020	0.31000	32.630	8	0.40	14.6	62.0	2
Acacia willdenowii	9	1.92	11.25	0.00765	0.01470	1.550	7	0.35	12.7	26.0	4
Dodonaea angustissima	1	0.20	1.25	0.00085	0.00017	0.018	1	0.05	1.8	3.1	10
Acacia ramulosa	1	1.77	1.25	0.00085	0.00150	0.160	1	0.05	1.8	3.2	9
Hakea leucoptera	6	1.18	7.50	0.00510	0.00600	0.630	4	0.20	7.3	15.4	6
E. gracilis	1	0.78	1.25	0.00085	0.00066	0.070	1	0.05	1.8	3.1	10
Melaleuca lanceolata	3	0.28	3.75	0.00260	0.00073	0.077	3	0.15	5.5	9.3	7
Myoporum insulare	7	0.80	8.75	0.00600	0.00480	0.510	5	0.25	9.1	18.4	5
	80				0.95000			2.75			

APPENDIX 7.5 : VEGETATION SPECIES LIST FOR EB2

CUPRESSACEAE
- Callitris verrucosa

GRAMINEAE
- Amphipogon caricinus
- Enneapogon spp.
- Stipa spp.
- Triodia irritans

CYPERACEAE
- Schoenus sybaphyllus

LILIACEAE
- Lomandra leucocephala

CASUARINACEAE
- Causarina cristata*

PROTEACEAE
- Grevillea huegelli
- Hakea leucoptera

SANTALACEAE
- Santalum spp.*

CHENOPODIACEAE
- Atriplex stipitata
- Chenopodium desertorum
- Chenopodium gaudichaudianum*
- Dissocarpus paradoxus
- Enchylaena tomentosa*
- Maireana georgei
- Maireana pentatropis
- Maireana parviflora*
- Maireana sedifolia
- Maireana triptera
- Rhagodia spinescens
- Rhagodia ulicina*
- Sclerolaena obliquicuspis
- Sclerolaena parviflora

AMARANTHACEAE
- Ptilotus exaltatus var. exaltatus

GERANIACEAE
- Erodium spp.

LEGUMINOSAE

(MIMOSACEAE)
- Acacia brachybotrya
- Acacia burkitti
- Acacia colletioides
- Acacia rigens
- Acacia wilhelmiana

(CAESALPINIACEAE)
- Cassia nemophila coriacea
- Cassia nemophila platypoda
- Cassia nemophila zygophylla

(FABACEAE)
- Eutaxia microphylla*

ZYGOPHYLLACEAE
- Zygophyllum apiculatum
- Zygophyllum billiardierei

RUTACEAE
- Boronia coerulescens*
- Phebalium bullatum*

EUPHORBIACEAE
- Beyeria opaca

THYMELAEACEAE
- Pimelea microcephala*

MYRTACEAE
- Eucalyptus dumosa
- Eucalyptus foecunda
- Eucalyptus gracilis
- Eucalyptus incrassata
- Eucalyptus porosa
- Eucalyptus socialis

UMBELLIFERAE
- Daucus spp.*

LOGANIACEAE
- Logania nuda*

CHLOANTHACEAE
- Dicrastylis verticillata*

LABIATAE
- Westringia rigida

SOLANACEAE
- Solanum coactiliferum
- Duboisia hopwoodii

MYOPORACEAE
- Eremophila glabra
- Eremophila scoparia
- Eremophila sturtii

GOODENIACEAE
- Scaevola depauperata*

COMPOSITAE
- Olearia subspicata
- Podolepis capillaris
- Senecio spp.*
- Vittadinia cunneata
- Vittadinia trioba

* denotes few found in quadrat

APPENDIX 7.5A : BIRDS WHICH HAVE BEEN RECORDED AT DANGGALI C.P.

COMMON NAME	SCIENTIFIC NAME	RAOU NO.
Emu	Dromaius novaehollandiae	1
Australasian Grebe	Tachybaptus novaehollandiae	61
White-faced Heron	Ardea novaehollandiae	188
Black Swan	Cygnus atratus	203
Australian Shelduck	Tadorna tadornoides	207
Pacific Black Duck	Anas superciliosa	208
Grey Teal	Anas gibberifrons	211
Maned Duck	Chenoetta jubata	202
Black Kite	Milvis migrans	229
Brown Goshawk	Accipter fasciatus	
Wedge Tailed Eagle	Aquila audax	224
Peregrine Falcon	Falco peregrinus	237
Brown Falcon	Falco berigora	239
Australian Kestrel	Falco cenchroides	240
Malleefowl	Leipoa ocellata	7
Masked Lapwing	Vanellus miles	133
Banded Lapwing	Vanellus tricolor	135
Black-winged Stilt	Himantopus himantopus	146
Australian Pratincole	Stiltia isabella	173
Common Bronzewing	Phaps chalcoptera	34
Crested Pigeon	Ocyphaps lophotes	43
Galah	Cacatua roseicapilla	273
Little Corella	Cacatua sanguinea	271
Pink Cockatoo	Cacatua leadbeateri	270
Regent Parrot	Polytelis anthopeplus	278
Cockatiel	Nymphicus hollandicus	274
Budgerigar	Melopsittacus undulatus	310
Mallee Ringneck	Barnardius barnardi	291
Mulga Parrot	Psephotus varius	296
Blue Bonnet	Northiella haematogaster	297
Scarlet-chested Parrot	Neophema splendida	303
Pallid Cuckoo	Cuculus pallidus	337
Southern Boobook	Ninox novaeseelandiae	242
Australian Owlet-nightjar	Aegotheles cristatis	317
Spotted Nightjar	Caprimulgus guttatus	331
Red-backed Kingfisher	Halcyon pyrrhopygia	325
Sacred Kingfisher	Halycon sancta	326
Rainbow Bee-eater	Merops ornatus	329
Welcome Swallow	Hirundo neoxena	357
Tree Martin	Cecropis nigricans	359
Richard's Pipit	Anthus novaeseelandiae	647
Ground Cuckoo-shrike	Coracina maxima	423
White-winged Triller	Lalage sueurii	430
Southern Scrub-Robin	Drymodes brunneopygia	441
Red-capped Robin	Petroica goodenovii	381
Hooded Robin	Melanodryas cucullata	385
Jacky Winter	Microeca leucophaea	377
Gilbert's Whistler	Pachycephala inornata	403
Rufous Whistler	Pachycephala rufiventris	401
Golden Whistler	Pachycephala pectoralis	
Grey Shrike-Thrush	Colluricincla harmonica	408

APPENDIX 7.5A (continued)

COMMON NAME	SCIENTIFIC NAME	RAOU NO.
Crested Bellbird	Oreoica gutturalis	419
Restless Flycatcher	Myiagra inquieta	369
Grey Fantail	Rhipidura fuliginosa	361
Willie Wagtail	Rhipidura leucophrys	364
Chestnut Quail-thrush	Cinclosoma castanotum	437
White-browed Babbler	Pomatostomus superciliosus	445
Chestnut-crowned Babbler	Pomatostomus ruficeps	446
Splendid Fairy-wren	Malurus splendens	532
Variegated Fairy-wren	Malurus lamberti	536
Mallee Heath-wren	Sericornis cautus	
Striated Grasswren	Amytornis striatus	513
Weebill	Smicrornis brevirostris	465
Inland Thornbill	Acanthiza apicalis	476
Chestnut-rumped Thornbill	Acanthiza uropygialis	481
Yellow-rumped Thornbill	Acanthiza chrysorrhoa	486
Yellow Thornbill	Acanthiza nana	471
Southern Whiteface	Aphelocephala leucopsis	466
White-browed Treecreeper	Climacteris affinis	561
Brown Treecreeper	Climacteris picumnus	555
Spiny-cheeked Honeyeater	Acanthagenys rufogularis	640
Striped Honeyeater	Plectorhyncha lanceolata	585
Red Wattelbird	Anthochaera carunculata	
Noisy Friarbird	Philemon corniculatus	645
Singing Honeyeater	Lichenostomus virescens	608
White-eared Honeyeater	Lichenostomus leucotis	617
Yellow-plumed Honeyeater	Lichenostomus ornatus	622
Grey-fronted Honeyeater	Lichenostomus plumulus	623
White-plumed Honeyeater	Lichenostomus penicillatus	625
Brown-headed Honeyeater	Melithreptus brevirostris	583
White-fronted Honeyeater	Phylidonyris albifrons	594
Crimson Chat	Ephthianura tricolor	449
Orange Chat	Ephthianura aurifrons	450
Mistletoebird	Dicaeum hirundinaceum	564
Striated Pardalote	Pardalotus striatus	976
Yellow-rumped Pardalote	Pardalotus xanthopygus	
Zebra Finch	Poephila guttata	653
White-winged Chough	Cocorax melanorhamphos	
Masked Woodswallow	Artamus personatus	544
Black-faced Woodswallow	Artamus cinereus	546
Grey Butcherbird	Cracticus torquatus	702
Pied Butcherbird	Cracticus nigrogularis	700
Australian Raven	Corvus coronoides	930
Little Raven	Corvus mellori	954
Little Crow	Corvus bennetti	691

APPENDIX 7.6 : NON-ANT SPECIES IN EB2 - FREQUENCY AND NUMBER CAPTURED

		MICROPITFALLS (40)		LARGE PITFALLS (20)	
	Sp.	Species Frequency %	Total No. Caught	Species Frequency %	Total No. Caught
ACARINA	1	17.5	14	40	23
ARANAEA	1	5	2	35	19
	2	2.5	2	10	3
	3	2.5	1	15	3
	4	2.5	1	15	4
	5	5	8	5	1
	6	12.5	11	35	9
	7	22.5	16	5	1
	9			5	2
	16	2.5	1		
	17	5	2		
	18	2.5	1		
	19	2.5	2		
	20	2.5	1		
	21	2.5	1		
BLATTODEA	1			80	42
	2	5	3		
	3	2.5	1		
COLEOPTERA	1	2.5	1		
	2			70	34
	3			5	1
	4	12.5	5	25	8
	5	7.5	3	5	1
	6	15	26	5	1
	6A	15	11		
	8	5	2		
	15	2.5	2		
	16	2.5	1		
COLLEMBOLA	2	2.5	1		
DIPTERA	1	55	66		
	4	2.5	1		
	5	25	12		
	6	5	2		
	7	25	1		
	9	2.5	1		
	10	5	2		
	11	2.5	1		
	13	5	2		
	15	5	4		
	16	2.5	3		
	18	2.5	1		
	19	2.5	1		
	20	7.5	3		

APPENDIX 7.6 (continued)

	Sp.	MICROPITFALLS (40) Species Frequency %	MICROPITFALLS (40) Total No. Caught	LARGE PITFALLS (20) Species Frequency %	LARGE PITFALLS (20) Total No. Caught
HEMIPTERA	1	2.5	1		
	2	5	2		
	3	2.5	1		
HYMENOPTERA	1	2.5	3	5	2
	2			10	2
	3	2.5	1		
ISOPODA	1			10	2
LEPICLOPTERA	1			5	3
	3	2.5	1		
MOLLUSCA	1	2.5	1		
ORTHOPOTERA	1			15	6
	2			10	3
	3	2.5	1	15	4
	5	2.5	1		
PSOCOPTERA	2	2.5	1		
SCORPIONIDAE	1			10	2
THYSANURA	1			15	3
			232		179

* Frequency = $\frac{\text{No. pitfalls species found in}}{\text{Total No. pitfalls}}$ X 100

APPENDIX 7.7 : ANT SPECIES IN EB2 - FREQUENCY AND NUMBER CAPTURED

	Sp.	MICROPITFALLS (40) Species Frequency %	MICROPITFALLS (40) Total No. Caught	LARGE PITFALLS (20) Species Frequency %	LARGE PITFALLS (20) Total No. Caught
APHAENOGASTER	1	5	4		
CALOMYRMEX	1	5	8	30	12
CAMPONOTUS	2	2.5	1		
	3			5	4
	5	2.5	1		
	6	2.5	1	10	5
	13	2.5	2		
CHELANER	1	20	21		
CREMATOGASTER	1	2.5	1	10	13
	2	5	6		
IRIDOMYRMEX	2	87.5	1119	5	1
	4	2.5	13	5	7
	5	5	16		
MERANOPLUS	4	7.5	4		
	5	2.5	1		
MYRMECIA	1			5	3
	2			40	50+
PHEIDOLE	3	2.5	1		
	7	2.5	11		
POLYRACHIS	1			5	1
RHYTIDOPONERA	1			15	4
	2			50	92
*	1 & 2	55	74		
	3	5	2		
STIGMACROS	1	5	2		
	2	2.5	1		
	3	2.5	1		
			1293		193+

* Note Rhytidoponera sp 1 and sp 2 are grouped together because confusion arose in identifying the two spp. in micropitfalls.

APPENDIX 7.8 : PLANT BEATINGS - EB2

NON-ANTS

ORDER	sp.	TREES			SHRUBS		
		Es	Ed	Cv	Aw	Os	Bo
ARANAEA	12			1			
	13	1					
	14						1
	15				2		
COLEOPTERA	12	1					
	14						1
DIPTERA	14					2	
HEMIPTERA	4	1					
	5	1					
	6						1
	7						1
	8						1
	9				1		
	11					1	
	12					1	
HYMENOPTERA	3				13		
ISOPTERA	1			1			
LEPIDOPTERA	2					1	
LERPS		5	1				
PSOCOPTERA	1			4			
ANTS							
GENUS							
CALOMYRMEX	1	2					

Es = Euclayptus socialis
Ed = Eucalyptus dumosa
Cv = Callitris verrucosa
Aw = Acacia wilhelmiana
Os = Olearia subspicata
Bo = Beyeria opaca

APPENDIX 7.9 : DISTRIBUTION OF ANTS IN EB2 PLANT COMMUNITIES

ANTS		PLANT COMMUNITY: Mallee 16 Micropitfalls		Mallee/Calitris 24 Micropitfalls		Total	
Genus sp		Frequency %	No.	Frequency %	No.	F%	No.
IRIDOMYRMEX	sp 2	81	361	92	758	87.5	1119
	sp 4	6	13			2.5	13
	sp 5	12.5	16			5	16
CAMPANOTUS	sp 2	6	1			2.5	1
	sp 5			4	1	2.5	1
	sp 6			4	4	2.5	4
	sp 13			4	2	2.5	2
MERANOPLUS	sp 4	6	1	8	3	7.5	4
	sp 5			4	1	2.5	1
APHAENOGASTER	sp 1	6	1	4	3	5	4
CHELANER	sp 1	25	9	17	12	20	21
STIGMACROS	sp 1	6	1	4	1	5	2
	sp 2			4	1	2.5	1
	sp 3	6	1			2.5	1
RHYTIDOPONERA	sp.1) sp 2)	62.5	48	50	26	55	74
	sp 3	6	1	4	1	5	2
CALOMYRMEX	sp 1			8	8	5	8
CREMATOGASTER	sp 1			4	1	2.5	1
	sp 2	12.5	6			5	6
PHEIDOLE	sp 3			4	1	2.5	1
	sp 7	6	11			2.5	11

Note - 14 species occurred in the Mallee and
16 species occurred in the Mallee/Callitris with
8 species occurring in both Plant Communities.

APPENDIX 7.10 : SUMMARY OF ANTS SPECIES IN EB2 PLANT COMMUNITIES - MICROPITFALLS

MALLEE		16 pitfalls - (SW1 - SW8, SE1 - SE8)	
Genus		Micropitfall No. / Number caught ( )	Total
IRIDOMYRMEX	sp 2	SW1(85) SW2(29) SW3(40) SW4(64) SW5(2) SW6(25) SW7(37) SE1(10) SE2(6) SE4(15) SE5(1) SE7(3) SE8(34)	361
	sp 4	SW5(13)	13
	sp 5	SW3(4) SE3(12)	16
CAMPONOTUS	sp 2	SE6(1)	1
MERANOPLUS	sp 4	SW7(1)	1
APHAENOGASTER	sp 1	SW4(1)	1
CHELANER	sp 1	SW1(1) SW7(2) SE6(1) SE8(5)	9
STIGMACROS	sp 1	SW5(1)	1
	sp 3	SE1(1)	1
RHYTIDOPONERA	sp 1 & 2	SW1(2) SW2(8) SW3(15) SW4(1) SW5(3) SW7(1) SE2(1) SE3(6) SE4(2) SE6(9)	48
	sp 3	SE6(1)	1
CREMATOGASTER	sp 2	SW5(4) SE7(2)	6
PHEIDOLE	sp 7	SW1(11)	11
			470

MALLEE/CALLITRIS		24 pitfalls - (SW9 - SW20, SE9 - SE20)	
Genus			
IRIODMYRMEX	sp 2	SW9(12) SW10(16) SW12(59) SW13(304) SW14(50) SW16(56) SW17(60) SW18(19) SW19(22) SW20(12) SE9(2) SE10(7) SE11(2) SE12(8) SE13(30) SE14(12) SE15(5) SE16(21) SE17(8) SE18(2) SE19(26) SE20(7)	758
CAMPONOTUS	sp 5	SW16(1)	1
	sp 6	SE19(4)	4
	sp 13	SW10(2)	2
MERANOPLUS	sp 4	SW16(1) SE19(2)	3
	sp 5	SW14(1)	1
APHAENOGASTER	sp 1	SE17(3)	3
CHELANER	sp 1	SW14(5) SW16(3) SE15(2) SE18(2)	12
STIGMACROS	sp 1	SE13(1)	1
	sp 2	SW14(1)	1
RHYTIDOPONERA	sp 1 & 2	SW9(4) SW12(2) SW13(3) SW14(4) SW15(2) SW16(2) SW17(1) SW18(1) SE9(2) SE13(1) SE16(3) SE18(1)	26
	sp 3	SE14(1)	1
CALOMYRMEX	sp 1	SW17(1) SW18(7)	8
CREMATOGASTER	sp 1	SE10(1)	1
PHEIDOLE	sp 3	SE14(1)	1
			823

APPENDIX 7.11 : SUMMARY OF ANT SPECIES IN EB2 PLANT COMMUNITIES - LARGE PITFALLS

MALLEE / CALLITRIS		10 pitfalls	
Genus		Large pitfall No. / Number caught ( )	Total
IRIDOMYRMEX	sp 2	NC1(1)	1
CAMPONOTUS	sp 6	NC4(3)	3
CALOMYRMEX	sp 1	NC3(1)	1
RHYTIDPONERA	sp 2	S4(2) S5(7) S3(19) S1(1) NC5(2)	49
MYRMECIA	sp 1	S5(3)	3
	sp 2	S5(14) S4(8)	22
			79

MALLEE		10 pitfalls	
Genus			
IRIDOMYRMEX	sp 4	NM1(7)	7
CAMPONOTUS	sp 3	S10(4)	4
	sp 6	S7(2)	2
CALOMYRMEX	sp 1	S9(2) NM3(3) NM2(4) S10(1) S7(1)	11
POLYRACHIS	sp 1	NM2(1)	1
RHYTIDOPONERA	sp 1	NM2(1) NM4(2) NM3(1)	4
	sp 2	S7(29) S10(5) S6(2) S8(6) S9(1)	43
	sp 3	NM4(1)	1
CREMATOGASTER	sp 1	S7(4) NM(9)	13
MYRMECA	sp 2	S8(5) S9(3) NM4(5) NM1(5) NM3(5) NM5(5)	28
			114

APPENDIX 8.1 : SOIL PROFILE SHEET - EB3

SOIL PROFILE RECORD SHEET

SOUTH AUSTRALIAN COLLEGE OF ADVANCED EDUCATION

SALISBURY

PROFILE SKETCH (1 METRE × 2 METERS)

Aoo:

Ao:

CM.	Horizon	COLOUR	WATER CONDITIONS	TEXTURE	STRUCTURE	pH	ORGANIC MATTER	MINERAL ACCUMULATIONS	SOIL SALINITY (millisiemens)
0		5yr 3/3 (d) 5yr 3/4 (w)	moist	SANDY LOAM	MASSIVE	8	Roots, MOTTLING	- NO CaCO₃ VISIBLE OR REACTING.	0.04
10	A	5yr 3/3 (d) 5yr 4/6 (w)	moist	SANDY LOAM	MASSIVE	8	Roots & MOTTLING	- NO CaCO₃ VISIBLE OR REACTING	0.025
30		5yr 4/6 (d) 5yr 4/6 (w)	DRY	SANDY LOAM	MASSIVE	8	ROOTS	- NO CaCO₃ VISIBLE OR REACTING	0.12
50		5yr 4/6 (d) 5yr 4/6 (w)	DRY	SANDY LOAM	MASSIVE	8	ROOTS	- SLIGHT REACTION WITH HCl & CaCO₃ VISIBLE IN SMALL AMOUNTS	0.19
60	Bca.								
70		5yr 5/6 (d) 5yr 5/6 (w)	DRY	SANDY LOAM	MASSIVE	8.5	ROOTS	STRONG HCl REACTION AND VISIBLE	0.54
90		5yr 5/6 (d) 5yr 5/6 (w)	DRY	SANDY LOAM	MASSIVE	9	NON	STRONG HCl REACTION AND VISIBLE.	0.74

Depth scale (cm): 10, 20, 30, 40, 50, 60, 70, 80, 90, 100, 110, 120, 130, 140, 150, 160

CLASSIFIED AS: Uc 5.31

PROFILE NUMBER: EB.3.

LOCATION/MAP REFERENCE: EASTERN BOUNDARY 3.

PARENT MATERIAL: siliceous material

DEGREE OF SLOPE: 1°

VEGETATION/LAND USE: KSC/conservation

RAINFALL: 250mm

Influence of CLIMATE:
SEMI-ARID

Influence of PARENT MATERIAL:
EVIDENCE OF CALCRETE AT 50cm - STRONG REACTION AT 90 cm.

Influence of SLOPE:
WITHIN SWALE
1° - MINIMAL

Influence of ORGANIC MATTER:
MOSS-LICHEN LAYER - Sparse OCCURING THROUGHOUT

Influence of TIME:
BURNT VEGETATION 1985.

APPENDIX 8.2 : COMPLETE LIST OF PLANT SPECIES RECORDED IN EB3

	FAMILY	GENUS & SPECIES	VOUCH. NO.	LIFEFORM	FLOWERING
*	GRAMINEAE	Amphipogon caricinus	55	GL	-
*		Triodia irritans	54	H	✓
	LILIACEAE	Lomandra leucocephala	53	J	Flowering heads
	CASUARINACEAE	Casuarina cristata	1	LA	Fruit
	PROTEACEAE	Grevillea huegelii	18	SA, SC	-
		Grevillea pterosperma	-	SC, SD	-
		Hakea leucoptera	14	S	Fruit
*	CHENOPODIACEAE	Atriplex acutibractea	39	SD	Flowering heads
		Atriplex stipitata	38	SD	Flowering heads
		Chenopodium desertorum	33	SD	Flowering heads
		Chenopodium gaudichaudianum	26	SC	Berries
		Chenopodium melanocarpum	32	SD	Flowering heads
		Enchylaena tomentosa	19	SB, SD	Red/Yellow berrie
*		Maireana appressa	25	SC, SD	-
		Maireana pentatropis	21	SB, SC, SD	-
		Maireana sedifolia	49	SD	-
		Maireana triptera	20	SB, SC, SD	Fruit
		Maireana sp A	50	SD	-
		Maireana sp B	51	SD	-
		Maireana sp C	52	SD	-
		Rhagodia spinescens	34	SD	Flowering heads
		Sclerolaena diacantha	37	SD	-
		Sclerolaena obliquicuspis	35	SD	-
		Sclerolaena parviflora	36	SD	Fruit
	AMARANTHACEAE	Ptilotus exaltatus var. exaltatus	56	J	Dead flower heads
		Ptilotus obovatus	57	J	-
	GYROSTEMONACEAE	Codonocarpus continifolius	2	LB	Fruit
	LEGUMINOSAE				
*	(MIMOSACEAE)	Acacia acanthoclada	31	SD	✓
		Acacia burkittii	8	S, SA, SB, SC, SD	Flowering heads forming
		Acacia colletioides	9	S, SA, SB, SC, SD	Seed pods
	(CAESALPINIACEAE)	Cassia nemophila var coriacea	12	S, SA, SB, SC, SD	
		Cassia nemophila var nemophila	16	SA, SC, SD	-
		Cassia nemophila var platypoda	15	SA, SB	-
		Cassia nemophila var zygophylla	13	S, SA, SB, SC, SD	-

APPENDIX 8.2 (continued)

	FAMILY	GENUS & SPECIES	VOUCH. NO.	LIFEFORM	FLOWERING
	(FABACEAE)	Eutaxia microphylla var microphylla	28	SC, SD	-
		Swainsona microphylla	43	SD	✓
		Templetonia egena	48	SD	-
	ZYGOPHYLLACEAE	Zygophyllum apiculatum	40	SD	✓
	EUPHORBIACEAE	Beyeria opaca	-	SA, SC	-
	SAPINDACEAE	Dodonaea angustissima	45	SD	-
		Heterodendrum oleaefolium	3	LB	-
	MYRTACEAE	Baeckea crassifolia	-	SD	-
		Eucalyptus dumosa	7	K5	-
		Eucalyptus foecunda	-	K5	-
		Eucalyptus gracilis	5	KT, K5	✓
		Eucalyptus incrassata	-	KT, K5	-
		Eucalyptus oleosa	6	K5	-
		Eucalyptus socialis	-	KT, K5	-
*		Micromyrtus ciliata	-	SD	-
	BORAGINACEAE	Halgania cyanea	42	SD	✓
	CHLOANTHACEAE	Dicrastylis verticillata	23	SB, SC, SD	Dead flower heads
	LABIATAE	Salvia verbenaca	46	J	Flowering heads
		Westringia rigida	44	SD	✓
	SOLANACEAE	Duboisia hopwoodii	22	SB, SC, SD	-
		Solanum coactiliferum	41	SD	✓
*	MYOPORACEAE	Eremophila decipiens	24	SC, SD	✓
		Eremophila glabra	17	SA, SC, SD	✓
		Eremophila scoparia	11	S, SA, SB, SC, SD	✓
		Eremophila sturtii	10	S, SB, SC	-
		Myoporum platycarpum	4	LB, SA, SB	-
	COMPOSITAE	Brachycome ciliaris var languinosa	30	SC	✓
		Cassinia laevis	29	SC	✓
		Olearia muelleri	27	SC, SD	-
		Olearia pimeleoides	47	SD	-
		Podolepis capillaris	58	J	✓
		Vittadina triloba	59	J	✓

APPENDIX 8.3 : VEGETATION ANALYSIS FOR POINT QUARTER TECHNIQUE - EB3

TABLE 1 : RAW DATA SHEET FOR VEGETATION ANALYSIS BY THE POINT QUARTER TECHNIQUE

Point No.	QUADRANT											
	1			2			3			4		
	Species	p	d	Species	p	d	Species	p	d	Species	p	d
1	Amphipogon	.21	.35	T. irritans	1.35	2.50	Amphipogon	.68	.20	Amphipogon	.38	.28
2	Solanum coactiliferum	.50	.06	Bunchgrass	.10	.12	Amphipogon	.25	.35	Amphipogon	.25	.45
3	Rhagodia spinescens	.55	.15	T. irritans	.75	.50	T. irritans	.70	.53	T. irritans	1.05	.45
4	H. cyanea	1.03	.025	D. hopwoodii	1.00	.55	D. hopwoodii	1.05	.35	D. hopwoodii	.45	.20
5	T. irritans	.65	.20	D. hopwoodii	.45	.40	R. spinescens	.30	.04	T. irritans	.25	.25
6	T. irritans	.50	.30	S. coactiliferum	.20	.10	D. hopwoodii	.45	.35	T. irritans	.23	.25
7	S. coactiliferum	.20	.20	C. cotinifolius	.30	.55	T. irritans	.05	.25	S. coactiliferum	.55	.32
8	C. cotinifolius	1.10	1.00	E. incrassata	1.70	1.70	Sclerolaena diacantha	.25	.40	Bunchgrass	.55	.50
9	T. irritans	.65	.15	H. cyanea	.65	.65	H. cyanea	.35	.05	T. irritans	.28	.20
10	T. irritans	.30	.30	Acacia acanthoclada	.55	.25	H. cyanea	.25	.25	T. irritans	.30	.35
11	S. coactiliferum	.70	.05	C. cotinifolius	.50	.50	R. spinescens	.43	.10	S. coactiliferum	.35	.20
12	T. irritans	.05	.05	T. irritans	.45	.25	T. irritans	.45	.20	T. irritans	.60	.10
13	T. irritans	.15	.10	T. irritans	.30	.15	T. irritans	.38	.29	T. irritans	.45	.23
14	T. irritans	.50	.10	T. irritans	.35	.10	T. irritans	1.20	.40	T. irritans	.35	.25
15	S. coactiliferum	.42	.10	T. irritans	.25	.27	T. irritans	.25	.10	T. irritans	.25	.30
16	T. irritans	.35	.55	T. irritans	.50	.25	S. coactiliferum	.25	.30	T. irritans	.10	.5
17	R. spiniscens	.52	.02	T. irritans	.50	.30	S. coactiliferum	.25	.10	T. irritans	.30	.30
18	T. irritans	.45	.30	T. irritans	.40	.20	T. irritans	.30	.40	T. irritans	.30	.25
19	S. coactiliferum	.30	.10	S. coactiliferum	.12	.25	S. coactiliferum	.25	.20	S. coactiliferum	.20	.18
20	S. diacantha	.30	.30	S. coactiliferum	.25	.10	S. coactiliferum	.25	.10	S. coactiliferum	.23	.05
Totals		9.43			10.67			8.34			7.42	

Date: 30th April 1989 (E)
Locality: 1st 200m of 300m transect (300m from north end of Quadrat)
Vegetation type: C. cotinifolius on dune crest
Units for p & d: metres

APPENDIX 8.3 (continued)

TABLE 2 : PARTIALLY PROCESSED DATA FOR VEGETATION ANALYSIS BY THE POINT QUARTER TECHNIQUE

SPECIES	No. of points at which species occurred	INDIVIDUAL PLANT CANOPY AREAS (i.e. Dominance Values)	TOTAL OF DOMINANCE VALUES (a)	TOTAL NO. OF INDIVIDUALS (b)	AVERAGE DOMINANCE VALUE (= a/b)
Amphipogon	2	.096 + .031 + .096 + 0.159	0.444	5	0.089
T. irritans	14	4.91 + .196 + .221 + .159 + 0.31 + .049 + .071 + .049 + .049 + .018 + .031 + .071 + .096 + .002 + .049 + .031 + .008 + .008 + .018 + .066 + .042 + .008 + .008 + .126 + .049 + .008 + .057 + .071 + .238 + .002 + .071 + .071 + .071 + .031 + .126 + .049	7.210	37	0.195
S. coactiliferum	9	.003 + .008 + .031 + .080 + .002 + .031 + .008 + .071 + .008 + .008 + .049 + .031 + .025 + .008 + .008 + .002	0.373	16	0.023
Bunchgrass	2	.011 + .196	0.207	2	0.104
Rhagodia spinescens	4	.018 + .002 + .008 + .0003	0.0283	4	0.007
H. cyanea	3	.0005 + .332 + .002 + .049	0.3835	4	0.096
D. hopwoodii	3	.238 + .096 + .031 + .126 + .096	0.587	5	0.117
C. cotinifolius	3	0.238 + 0.785 + .296	1.319	3	0.440
Sclerolaena diacantha	2	.126 + .071	0.197	2	0.099
E. incrassata	1	2.27	2.27	1	2.27
Acacia acanthoclada	1	.049	0.049	1	0.049
			13.0678 (13.068)	80	3.489

APPENDIX 8.3 (continued)

TABLE 3 : SUMMARY OF VEGETATION ANALYSIS BY THE POINT QUARTER TECHNIQUE

Total of all point to plant distances (P's) = 3.586
Total of all individuals of all species = 80
Average point-to-plant distance = 0.045
Mean area per plant = 0.0020
Total density of all species = 500

SPECIES	NO. OF INDIVIDUALS	RELATIVE DENSITY (%)	DENSITY	DOMINANCE	RELATIVE DOMINANCE (%)	FREQUENCY	RELATIVE FREQUENCY (%)	IMPORTANCE VALUE	RANK ORDER OF IMPORTANC VALUES
Amphipogon	5	6.25	31.25	2.78	3.40	0.1	4.55	14.20	8
T. irritans	37	46.25	231.25	45.09	55.19	0.7	31.82	133.26	1
S. coactiliferum	16	20.00	100.00	2.30	2.81	0.45	20.45	43.26	2
Bunchgrass sp.	2	2.50	12.50	1.30	1.59	0.1	4.55	8.64	9
Rhagodia spinescens	4	5.00	25.00	0.18	0.22	0.2	9.08	14.30	7
H. cyanea	4	5.00	25.00	2.40	2.94	0.15	6.82	14.76	6
D. hopwoodii	5	6.25	31.25	3.66	4.48	0.15	6.82	17.55	5
C. cotinifolius	3	3.75	18.75	8.25	10.10	0.15	6.82	20.67	4
Sclerolaena diacantha	2	2.50	12.50	1.24	1.52	0.1	4.55	8.57	10
E. incrassata	1	1.25	6.25	14.19	17.37	0.05	2.27	20.89	3
Acacia acanthoclada	1	1.25	6.25	0.31	0.38	0.05	2.27	3.90	11
TOTALS	80	100.00	500.00	81.70	100.00	2.20	100.00	300.00	

APPENDIX 8.4 : NUMBER OF MICROPITFALL CAPTURES - ANT SPECIES EB3

Functional Group	NUMBER OF MICROPITFALL (NUMBER CAUGHT). - ANT SPECIES. - EB3
1.	1MP2(9), 1MP4(28), 1MP7(6), 1MP10(8), 1MP11(5), 1MP12(40), 1MP13(5), 1MP16(23), 1MP17(48), 1MP20(19), 1MP21(14), 1MP22(35), 1MP23(1), 1MP25(5), 1MP28(2), 1MP33(13), 1MP35(13), 1MP36(21), 1MP37(150), 1MP38(34), 1MP39(12), 2MP1(26), 2MP2(53), 2MP3(2), 2MP4(7), 2MP5(27), 2MP6(8), 2MP7(18), 2MP8(7), 2MP9(6), 2MP10(15), 2MP11(19), 2MP12(3), 2MP14(4), 2MP16(3), 2MP19(3), 2MP20(4), 2MP22(3), 2MP23(8), 2MP24(4), 2MP25(4), 2MP26(7), 2MP27(29), 2MP28(4), 2MP30(20), 2MP31(4), 2MP33(1), 2MP34(9), 2MP37(7), 2MP38(3), 2MP39(11), 2MP40(13), 1MP1(18), 1MP5(7).
2.	2MP6(1), 2MP9(12)
3.(a)	2MP11(1), 2MP15(1), 2MP24(1)
4.(b)	1MP17(2), 2MP15(12)
5.	1MP2(1), 1MP4(2), 1MP7(4), 1MP10(1), 1MP16(5), 1MP17(1), 1MP20(5), 1MP21(3), 1MP22(6), 1MP24(14), 1MP23(23), 1MP25(10), 1MP28(2), 1MP29(4), 1MP32(5), 1MP33(2), 1MP37(1), 2MP5(1), 2MP9(1), 2MP10(1), 2MP11(2), 2MP14(2), 2MP16(1), 2MP17(2), 2MP20(7), 2MP24(2), 2MP35(3), 2MP31(1), 2MP32(1), 1MP5(1).
6.	1MP18(2).

APPENDIX 8.5 : METHOD AND CAPTURE OF NON-ANT SPECIES - EB3

NON-ANT ORDERS	CAPTURE METHODS - EB3 Number of Species (Number of Individuals)		
	MICROPITFALLS	PITFALLS	HAND CAPTURE
Acari	3 (34)	–	–
Araneae	8 (39)	1 (1)	3 (5)
Colembola	2 (6)	–	–
Coleoptera	7 (19)	6 (15)	2 (5)
Diptera	15 (945)	–	–
Dictyoptera	–	1 (1)	–
Hemiptera	4 (14)	–	–
Isoptera	1 (1)	–	–
Lepidoptera	1 (1)	–	–
Orthoptera	2 (2)	–	–

APPENDIX 8.6 : MICROHABITATS OF PITFALLS EB3

Pitfall no.	Description of Microhabitat
C1	Under dead branch of E. socialis, near S. coactiliferum and leaf/bark litter.
C2	Under dead branch of E. dumosa, near S. coactiliferum and leaf litter.
C3	Bare area with Triodia irritans nearby.
C4	Surrounded by leaf/stick litter, with S. diacantha and Enneapogon spp. nearby.
C5	Bare area near E. socialis, S. coactiliferum and S. diacantha
C6	Open area near S. coactiliferum and S. diacantha
C7	Open area near A. stipitata and S. diacantha
C8	Open area near Ptilotus exaltatus and dead Eucalypt branch
C9	Open, bare area near Enneapogon spp. and fallen dead branches.
C10	Bare area under dead E. socialis branch, near S. coactiliferum and Dodonaea angustissima.
C11	Open area near S. coactiliferum and Enneapogon spp. and leaf litter.
I1	Under E. socialis, near S. coactiliferum, D. hopwoodii and B. opaca
I2	Bare, open area near C. cotinifolius and S. coactiliferum.
I3	Bare area next to H. cyanea, young C. cotinifolius and Enneapogon spp.
I4	Amongst T. irritans, young E. dumosa and H. cyanea.
I5	Open, bare area near T. irritans, H. cyanea and young C. cotinifolius
I6	Amongst young S. coactiliferum.
I7	Bare area near young C. cotinifolius and S. coactiliferum
I8	Open area amongst young C. cotinifolius.
I9	Open area near D. hopwoodii and B. opaca
I10	Open area near T. irritans.

APPENDIX 8.7 : MICROHABITATS OF MICROPITFALLS (VSA 2) EB3

micro-pitfall numbers	Description of Microhabitat
2MP1	Open, bare ground, 30cm from Cassia nemophila var nemophila
2MP2	Open ground underneath dead E. socialis branch and E. socialis leaf litter
2MP3	Open area next to Enneapogon spp.
2MP4	Under burnt branch of E. socialis, next to Cassia nemophila var zygophylla.
2MP5	Under dead E. socialis next to dead Enneapogon spp.
2MP6	Next to Eucalyptus socialis
2MP7	In open area amongst young Sclerolaena diacantha and Enneapogon spp.
2MP8	Under Eremophila scoparia, next to young Eremophila glabra and Enneapogon spp.
2MP9	Open area next to Atriplex stipitata and Enneapogon spp., and surrounded by lichen.
2MP10	Amongst Enneapogon spp. and next to Cassia nemophila var nemophila, and near Grevillea huegellii
2MP11	Next to young Vittadinia triloba and surrounded by lichen and Enneapogon spp.
2MP12	Under Cassia nemophila var zygophylla and litter from it.
2MP13	In bare ground near young C. nemophila var zygophylla and lichen.
2MP14	Next to ant nest and small Maireana radiata and lichen
2MP15	Under E. socialis and dead branch, next to M. radiata and S. diacantha and near Eremophila glabra
2MP16	Under E. socialis
2MP17	Under E. socialis and next to hollow, and small broken twigs / litter.
2MP18	Under burnt shrub, next to Solanum coactiliferum.
2MP19	Open ground amongst Triodia irritans and Rhagodia spinescens.
2MP20	Amongst T. irritans and Acacia hakeoides

APPENDIX 8.7 (continued)

micro-pitfall number	Description of Microhabitat
2MP21	Next to S. diacantha, Acacia colletioides, Solanum coactiliferum and grassy litter.
2MP22	Amongst Eremophila glabra, S. coactiliferum, and dead Sclerolaena diacantha
2MP23	Amongst S. coactiliferum, dead Enneapogon spp., and near young Eremophila scoparia
2MP24	Under Atriplex stipitata, and surrounded in leaf and twig litter.
2MP25	Under Cassia nemophila var nemophila with bark and twig litter
2MP26	Amongst leaf and bark litter and lichen.
2MP27	Next to Sclerolaena diacantha with leaf litter.
2MP28	Amongst S. coactiliferum and under dead shrub.
2MP29	Under E. socialis and near Rhagodia spinescens.
2MP30	Next to dead branch with leaf litter and near S. coactiliferum
2MP31	Next to S. coactiliferum and amongst litter from E. socialis
2MP32	Next to dead branch and twig litter and near R. spinescens.
2MP33	Under E. socialis and Chenopodium desetorum, amongst S. coactiliferum and leaf litter.
2MP34	Under dead E. socialis, amongst seedlings and S. coactiliferum.
2MP35	Amongst seedlings and next to dead branch, near S. coactiliferum.
2MP36	Amongst leaf litter next to S. diacantha
2MP37	Amongst S. coactiliferum and seedlings.
2MP38	Under E. socialis and dead branch, amongst S. diacantha and S. coactiliferum.
2MP39	Amongst S. diacantha and S. coactiliferum.
2MP40	Under numerous dead branches and leaf litter, and amongst S. coactiliferum.

APPENDIX 8.8 : MICROHABITATS OF MICROPITFALLS (VSA 1) EB3

micro-pitfall number	Description of Microhabitat
IMP1	Among Poplar and Eucalyptus incrassata
IMP2	Under Poplar with Iridia irritans around base
IMP3	Under D.hopwoodii near T. irritans
IMP4	Surrounded by D.hopwoodii and Poplar. Dead branch fallen across.
IMP5	Between Poplar and D.hopwoodii bushes
IMP6	Dead burnt tree hanging over micropitfall
IMP7	Bare patches with dead fallen branch fallen across it. Near T. irritans.
IMP8	Clear, sandy patch
IMP9	Between D. hopwoodii and dead fallen E. incrassata branch
IMP10	Clear, sandy patch. Dead branch overhanging
IMP11	Bare, sandy patch between small T. irritans bushes
IMP12	Between Halgania cyanea and T. irritans
IMP13	Between H. cyanea and Poplar
IMP14	As above, almost on dune crest.
IMP15	Dead branch overhanging.
IMP16	On dune crest. Mostly bare, sandy patch with H. cyanea scattered around.
IMP17	As above, but mostly with T. irritans scattered around.
IMP18	As above - on side of dune.
IMP19	" " "
IMP20	" " "

APPENDIX 8.3 (continued)

micro-pitfall number	Description of Microhabitat
IMP21	Bare, sandy patch
IMP22	As above, near Poplar.
IMP23	Near Poplar and H. suaveolens. Overhanging branch
IMP24	Open ground, mixed vegetation.
IMP25	As above - near Solanum coactiliferum and Poplar
IMP26	Sandy patch of mixed vegetation.
IMP27	Sandy area surrounded by Poplar
IMP28	Surrounded by Poplar and D. hopwoodii
IMP29	As above
IMP30	Open area, with Poplar a little denser. Slightly rising onto another slope.
IMP31	Dead E. incrassata hanging over site.
IMP32	Densely surrounded by Poplar and H. suaveolens bushes
IMP33	Open area with some Poplar and T. irritans
IMP34	As above - near tall Poplar tree
IMP35	As above
IMP36	Between two juvenile Eucalypts.
IMP37	Open sandy area with mixed vegetation
IMP38	As above
IMP39	Overhanging Eucalypt branches.
IMP40	On dune crest, near tall Poplar and D. hopwoodii.

APPENDIX 8.9 : MAMMALS CAUGHT IN EB3 LISTED IN ORDER OF CAPTURE

SPECIES	COMMON NAME	CAPTURE METHOD			MICROHABITAT
		Elliot	Individual Pitfall	Continuous Pitfall	
Pseudomys bolami	Native mouse	4			At base of E. dumosa
Mus domesticus	House mouse			6	Open. Near Atriplex stipitata and scleroland diacantha.
" "	" "	22			
" "	" "	25			
" "	" "		10		Open. Near T. irritans
" "	" "	21			
" "	" "	25			
P. bolami	Native mouse		5		Open. Near T. irritans
"	" "	36			
"	" "		1		Under E. socialis
M. domesticus	House mouse		8		Open. Among C. cotinifolius.
"	" "	18			At base of E. incrassata
"	" "	22			
P. bolami	Native mouse	11			At base of E. incrassata
"	" "	13			At base of E. incrassata.
"	" "	34			
"	" "	43			